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VOLUME 1M

AERODYNAMIC DESIGN DATA BOOK

VOLUME 1
ORBITER VEHICLE
STS-1

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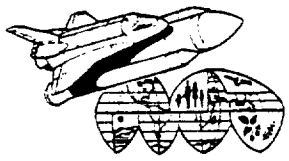

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SPACE SHUTTLE ORBITER

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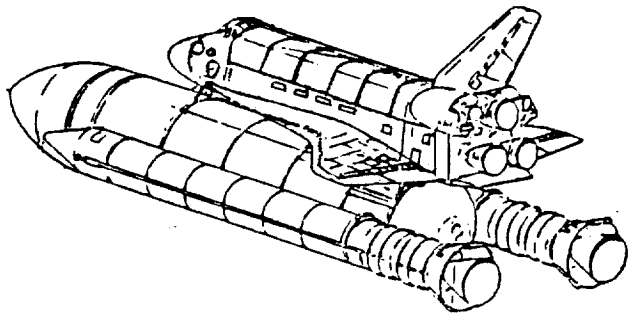
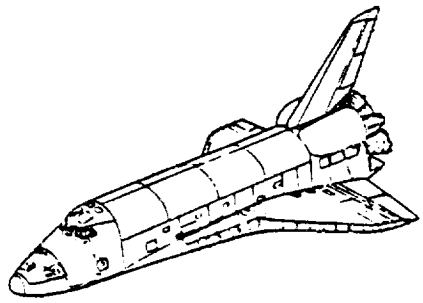


FOREWORD

The Rockwell Space Shuttle is a combination aircraft-spacecraft designed to launch a variety of payloads into Earth orbit and/or retrieve payloads from orbit, return to Earth, and land in the manner of conventional aircraft. The Space Shuttle Vehicle is comprised of three major elements; the Orbiter Vehicle, External Tank, and Solid Rocket Boosters. Since the flight vehicle is a combination aircraft-spacecraft, its external features are designed to provide the protection and versatility for both space and atmospheric flight regimes. This particular volume provides the aerodynamic characteristics for the Orbiter Vehicle.



PREFACE

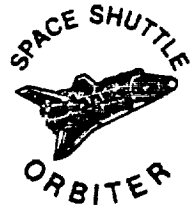
The purpose of this book is to present the STS-1 Orbiter Vehicle aerodynamic design data appropriate to full-scale flight performance and stability and control analyses. The data include configuration descriptions, aerodynamic force and moment coefficients (both static and dynamic), and control effectiveness. Data are provided throughout the flight speed regimes from subsonic to hypersonic and high altitude; rarefied atmospheric effects are provided as are the effects of aeroelastic deformation and reaction control flow-field interactions.

The book has been prepared to meet the needs of system design and analysis engineering, loads and structural engineering, performance analyses, and manned simulation studies. Data are based on the results of wind tunnel tests of various scale models of the Orbiter Vehicle. Model support system tare effects have been determined for corrections to provide, essentially, support-free aerodynamic characteristics. Corrections have also been made (where appropriate) for scale effects (Reynolds number) and for non-representation of actual full-scale geometric features such as small protuberance items, thermal protection system tile steps and gaps, surface roughness, and the like. All data are provided in a format which will allow a build-up from a basic configuration by means of contributing elements to each force or moment component such as control surface effectiveness, landing gear effects, etc. Data are presented in a manner which treats each force and moment separately and equations are provided to facilitate the build-up procedure, transfer of data to moment reference centers other than the basic reference center (most forward center-of-gravity location), and account for the effects of aeroelastic deformation, rarefied atmosphere, and combined reaction control-aerodynamic control in the low dynamic pressure regions.

This report has been prepared at the express direction of the NASA for a dedicated STS-1 Aerodynamic Design Data Book. The basic aerodynamic data were reviewed by JSC, ARC, LRC, and ARO-AEDC prior to its release. Particular attention was given to the transonic and supersonic flight regimes. Various interaction data, providing the bridging between viscous data and orbital aerodynamic characteristics, were supplied by LRC and JSC. Rockwell and JSC coordinated the approach and landing flight test results for incorporation into the low speed data. The Aero Technical Panel members (JSC, LRC, ARC, AEDC, and DFRC) all contributed to the data for this report.

Rockwell engineers under T. E. Surber (Supervisor) and D. C. Schlosser (Lead Engineer) prepared and analyzed the data with primary responsibilities going to D. C. Olsen, W. M. Zeman, D. G. Duhnke (longitudinal), F. F. Fitzgerald, H. Parrell, L. L. Landrum (lateral-directional), H. Parrell, F. C. Chinn (hinge moments), D. F. Dominik, K. F. Anderson (aeroelasticity), H. S. Dresser, Y. H. Kim, J. S. Stone, G. V. Owens (RCS). Digitized data, data tapes, and figures were the responsibilities of D. F. Dominik, J. M. Kelleher, T. Petrick, M. Kallanse, and G. V. Owens. The typed manuscript was prepared by Muriel Burke and Terri Harrison.

W. R. Russell: Editor



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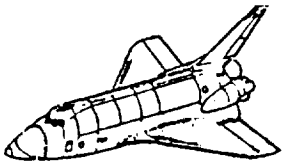

STS-1

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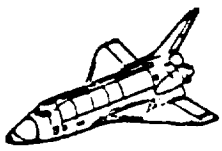


NOMENCLATURE

A. ACRONYMS

ADS	Air Data System
ADTA	Air Data Transducer Assembly
AFCS	Automatic Flight Control System
AMI	Alpha-Mach Indicator
A/S	Airspeed
BFCS	Backup Flight Control System
CCB	Configuration Control Board
CDR	Critical Design Review
CEI	Contractor End Item
CSS	Control Stick Steering
DFI	Development Flight Instrumentation
DOF	Degree(s)-of-Freedom
EAFB	Edwards Air Force Base
ET	External Tank
ETR	Eastern Test Range
F	Ferry
FAA	Federal Aviation Agency
FCF	Functional Checkout Flight
FCS	Flight Control System
FF	Free-Flight
FMOF	First Manned Orbital Flight
FOF	First Operational Flight
FRC	Flight Research Center
FRF	Flight Readiness Firing
FRR	Flight Readiness Review
FSSR	Functional Subsystem Software Requirement
FTR	Flight Test Requirement
GN&C	Guidance, Navigation, and Control
HAC	Heading Alignment Circle
HQ	Handling Qualities
HSI	Horizontal Situation Indicator
HW	Head Wind
I	Inert
ILS	Instrument Landing System
JSC	Johnson Space Center
KEAS	Knots-Equivalent Airspeed
KSC	Kennedy Space Center
LV	Launch Vehicle
M	Manned
MDM	Modulate-Demodulate
MML	Master Measurement List
MMLE	Modified Maximum Likihood Estimate
MRC	Moment Reference Center
NAV	Navigation (System)
OFI	Operational Flight Instrumentation
OFT	Orbital Flight Test
OMS	Orbital Maneuvering System
OV	Orbiter Vehicle
PDR	Preliminary Design Review
PTI	Programmed Test Input
RCS	Reaction Control System
RID	Review Item Disposition
RSS	Root-Sum-Square
SILTS	Shuttle Infrared Leeside Temperature Sensor
SPI	Surface Position Indicator
SPS	Samples per Second
SRB	Solid Rocket Booster
S/C	Spacecraft or Stability and Control
STC	Supplemental Type Certificate

A. ACRONYMS (Continued)

TAEM	Terminal Area Energy Management
TO	Take-Off
TOGW	Take-Off Gross Weight
TPS	Thermal Protection System
TBD	To Be Determined
T/W	Thrust-to-Weight Ratio
UHF	Ultra-High Frequency
VFT	Vertical Flight Test
VHF	Very-High Frequency
VOR/LOC	Visual Omni-Range/Localizer
WTR	Western Test Range

B. GENERAL

A	Acceleration	ft/sec^2 (also g's)
	Subscripts: X axial Y lateral Z normal	
BL	Buttock Line	
BP	Buttock Plane	
ℓ	Centerline	
F	Force	lb
	Subscripts: (see Acceleration, above)	
FRL	Fuselage Reference Line	
FRP	Fuselage Reference Plane	
FS	Fuselage Station	
H or HL	Hingeline	
M	Mach Number	
	Subscripts: D dive MO maximum operating	
P	Pressure	lbs/ft^2 (psf)
	Subscripts: ∞ ambient (or freestream) s static T total o, SL sea level	
R	Universal Gas Constant	
ReN	Reynolds Number	
T	Temperature	°F, °R, or °K
T	Thrust	lbs
$\bar{\ell}$	Thrustline	
V	Velocity	fps or knots
	u linear perturbed velocity along x-axis (positive forward) v linear perturbed velocity along y-axis (positive out right wing) w linear perturbed velocity along z-axis (positive downward)	
	Subscripts: c calibrated e equivalent i indicated D dive MCA minimum control in air MCG minimum control on ground MO maximum operating ∞ freestream	
$\bar{V}_\infty$	Viscous Parameter	
W	Weight	lbs
WL	Waterline	
WP	Water Plane	
WDP	Wing Datum Plane	

B. GENERAL (Continued)

a		Speed of Sound in Air	ft/sec or knots
a.c.		Aerodynamic Center	
b		Span	ft
c		Chord	inches
$\bar{c}$		or MAC - mean aerodynamic chord	
		Subscripts: bf body flap; e elevon; r rudder; sb speed brake; w wing	
cg		Center of gravity	
cp		Center of pressure	
g		Acceleration due to gravity	ft/sec^2
h		Altitude (or height)	ft or nautical miles
m		Mass	slugs
n		Load Factor	g's
$\bar{q}$		dynamic pressure = $1/2\rho V^2$	lb/ft^2 (psf)
t		time	secs, mins, hrs
Δ		Increment	
ζ		Nondimensional change in MRC with regard to WP; $(Z_{MRC} - Z_{\substack{MRC \\ REF}})/\bar{c}$	
η	(1)	Semi-Span Parameter = y/b/2	
	(2)	Flexible-to-Rigid Ratio	
i, ϵ		Incidence	degrees
Λ		Sweep Angle	degrees
λ		Taper Ratio	
λ_∞		Mean Free Path	inches
ξ		Nondimensional change to MRC with regard to Fuselage Station = $(X_{MRC} - X_{\substack{MRC \\ REF}})/\bar{c}$	
ρ	(1)	Mass density of air	$slug/ft^3$
	(2)	Correlation Coefficient	---
σ	(1)	Ratio of freestream density at a given altitude to standard sea level air density	
	(2)	Standard Deviation	
ω		Frequency	H_z (cycles/sec)
$\measuredangle$		Angle	
>		Greater than	
<		Less than	

C. CONFIGURATION

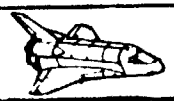
L_B		Body Length	inches
LE		Leading Edge	
S		Reference Area	
		Subscripts: a aileron; bf body flap; e elevon (elevator); r rudder; sb speed brake; w wing; v vertical tail	
TE		Trailing Edge	
X		Longitudinal axis	
Y		Lateral axis	
Z		Vertical axis	
δ	(1)	Control Surface Deflection	degrees
		Subscripts: a aileron (positive for positive rolling moment); bf body flap (positive for nosedown pitching moment); e elevon (positive for nosedown pitching moment); r rudder (positive for nose-left yawing moment); sb speed brake	
	(2)	Dihedral Angle	degrees

D. MOMENT & PRODUCTS OF INERTIA

1.	Moment of Inertia	$slug\text{-}ft^2$
	I_X rolling	
	I_Y pitching	
	I_Z yawing	
2.	Product of Inertia	$slug\text{-}ft^2$
	I_{XY}, I_{XZ}, I_{YZ}	

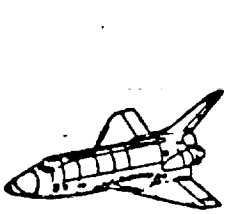
E. FORCES

A	Axial; aerodynamic force along the X-body axis (positive aft)	pounds
C_A	Axial force coefficient = $A/\bar{q}S$	
D	Drag; aerodynamic force along the total velocity vector in plane of symmetry (positive aft)	pounds
C_D	Drag coefficient = $D/\bar{q}S$	
L	Lift; aerodynamic force perpendicular to total velocity vector in plane of symmetry (positive upward)	pounds
C_L	Lift coefficient = $L/\bar{q}S$	
N	Normal; aerodynamic force along the Z-body axis (positive upward)	pounds
C_N	Normal force coefficient = $N/\bar{q}S$	
Y	Side; aerodynamic force along the Y-body axis (positive out right wing)	pounds
C_Y	Side force coefficient = $Y/\bar{q}S$	



INCORPORATION OF REVIEW ITEMS

D.R. NO.	REVIEW (DATE)	TITLE	SECTION AFFECTED	DISPOSITION
104	15 NOV '79	DEFINITION OF "SENSITIVITY STUDIES"	6.1	INCLUDED NEW DEFINITION AND EXAMPLE
106	"	LANDING GEAR INCREMENTS DCNLG & DCALG	4.1	CORRECTED ERROR IN C_N AND C_A
112	"	AERODYNAMIC DATA UNCERTAINTIES STATISTICAL CORRELATION	6.2	REVISED $\rho_{C_{n_\beta} C_{\ell_\beta}} = 0$
113	"	2σ RCS UNCERTAINTIES VERSUS 3σ AERO UNCERTAINTIES	6.6	REVISED TO STATE UNCERTAINTIES ARE 3σ
120	"	LACK OF RCS VARIATIONS	6.6	REVISED TO STATE UNCERTAINTIES ARE VARIATIONS
219	"	STATISTICAL DENSITY FUNCTIONS	6.0	ELIMINATED REFERENCE TO UNIFORM DISTRIBUTION
302	"	CONFIGURATION DESCRIPTION	3.0	INCLUDED ENLARGED THREE-VIEW CONTROL DRAWING
310	"	RCS JET THRUST	APP. B	REVISED REFERENCE TO JET THRUST TERMS
312	"	RCS PLUME INTERACTION UNCERTAINTIES	6.6	CORRECTED LABELING

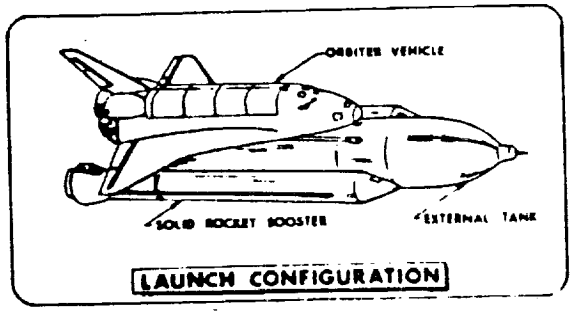


1.0 ORBITER MISSION

The Rockwell Space Shuttle Orbiter is designed to launch a variety of payloads into (and/or retrieve from) earth orbit. The Orbiter Vehicle will be launched in a vertical attitude and landing will be accomplished in a horizontal manner similar to conventional aircraft.

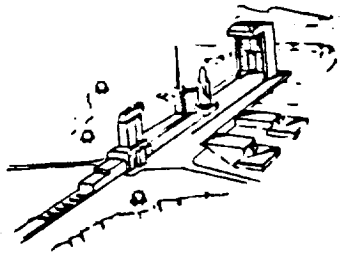
1.1 MISSION DESCRIPTION.

The Space Shuttle mission is summarized in Figure 1.1-1. Following flight readiness and checkout, the Space Shuttle will be launched by means of solid rocket boosters (SRB) and an external tank (ET) as shown in the sketch.



LAUNCH CONFIGURATION

Maximum payload capability is 65,000 pounds for an easterly launch from the Eastern Test Range (ETR) at Kennedy Space Center (KSC) and 32,000 pounds for a polar orbit launch from the Western Test Range (WTR) at Vandenburg Air Force Base.



Subsequent to separation from the ET, the Orbiter Vehicle will be inserted into earth orbit where a payload may be deployed and/or retrieved. The Orbiter Vehicle can also function as a space laboratory for a moderate duration and will provide accommodations for up to five mission specialists in addition to the normal crew of commander and co-pilot. An on-orbit stay period of seven days is required and could be extended for up to 30 days during the operational phase of the program.

After completion of the orbital operations phase, deorbit is accomplished by retro-fire of the Orbital Maneuvering System (OMS) and the Orbiter descends to the atmospheric entry interface (nominally, an altitude of 400,000 feet). The initial entry phase extends to a dynamic pressure level of 20 psf (approximately 250,000 feet) during which RCS attitude control from two aft OMS pods is blended with aerodynamic surface controls, the latter gaining in effectiveness as dynamic pressure increases.

The entry flight phase, from a dynamic pressure level of 20 psf to a Mach number of less than five, is accomplished at a high angle of attack during which the blanketing effect of the wing essentially precludes any rudder control. Coordinated lateral-directional control is provided by combined yaw RCS and aileron control. The terminal phase occurs as angle of attack is reduced below 18 degrees. As the Orbiter descends to altitudes where winds, in conjunction with vehicle speed, can result in relatively large errors in inertially derived air data, probes are extended ($M \approx 3.5$) to provide air data relative to the vehicle. During a typical normal entry, range control is achieved by bank angle while angle of attack follows a

predetermined schedule to achieve (at approximately M = 1.5) an angle somewhat smaller than that corresponding to maximum L/D. A downrange capability of up to 4300 nautical miles with a cross range capability of 980 nautical miles may be realized.

Equilibrium subsonic gliding flight is achieved at an altitude of approximately 40,000 feet. Range control during the gliding descent is obtained by angle of attack modulation with velocity control maintained by the speed brake. The approach and landing interface occurs at 10,000 feet above ground level and a preflare is initiated at an appropriate altitude, followed by a deceleration float and touchdown. The initial approach target and flare altitude will be scheduled to provide a minimum of 25 seconds between flare initiation and touchdown.

Representative time histories of five trajectory parameters — altitude, relative velocity, flight path angle, total load factor, and dynamic pressure — are shown in Figure 1.1-2. These time histories represent a high cross range return from a 100-nautical mile orbit with a 25,000-pound payload and an aft center of gravity. The trajectory (TPS design number 14414) is presented for the purpose of illustration only.

More complete and detailed mission data are available in the Mission Data Book, Reference 1-1. Detailed descriptions of launch trajectories are given in References 1-2 and 1-3 and additional entry trajectory data may be obtained from Reference 1-4. References 1-5 and 1-6 contain detailed information relative to separation and abort.

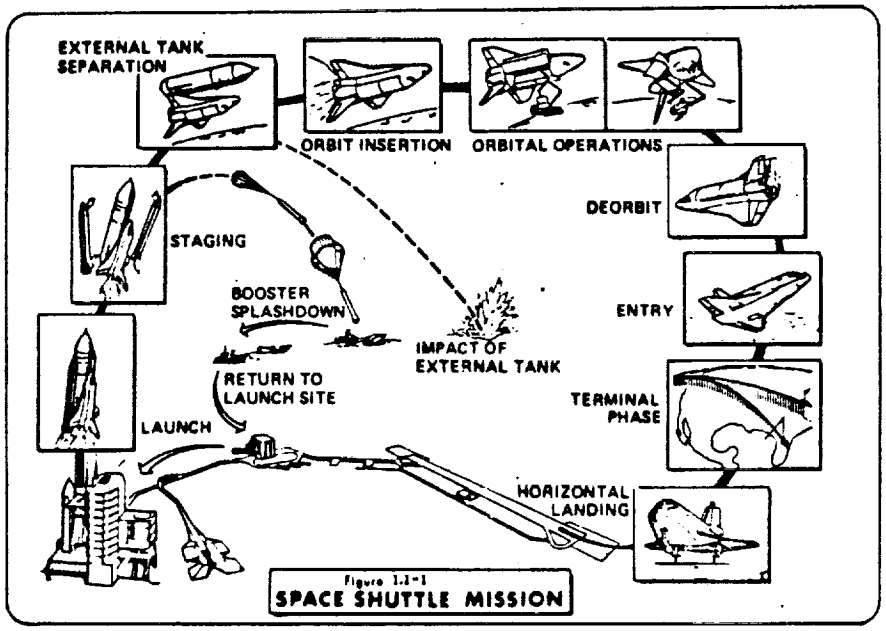


Figure 1.1-1
SPACE SHUTTLE MISSION

1.2 MISSION CAPABILITY. The Orbiter Vehicle "mission capability envelope" is defined by four baseline reference missions. Table 1.2-1 summarizes these baseline missions. From the standpoint of entry, these become essentially two types of missions — a ramped angle of attack, characterized by long range and high cross range and a high angle of attack characterized by short range and small cross range. Typical trajectories representing these two missions are presented in Figure 1.2-1 for the former (typical of mission 1) and Figure 1.2-2 for the latter (typical of mission 3B). Orbital Flight Test (OFT) requirements should fall within the baseline reference mission envelope of capability.

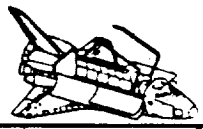


Table 1.2-1
BASELINE REFERENCE MISSIONS

BRM	OBJECTIVE	ORBIT		DURATION	PAYLOAD	
		INCLINATION, degrees	ALTITUDE, NM		ASCENT, 10^3 pounds	DESCENT, 10^3 pounds
1	PAYLOAD DELIVERY	28.5	150	7 Days	65.0	32.0
2	COMBINED REVISIT TO ORBITING ELEMENT & SPACELAB	55.0	270	7 Days	—	—
3	A PAYLOAD DELIVERY	104.0	100	1 Rev	32.0	2.5
	B PAYLOAD RETRIEVAL				2.5	25.0

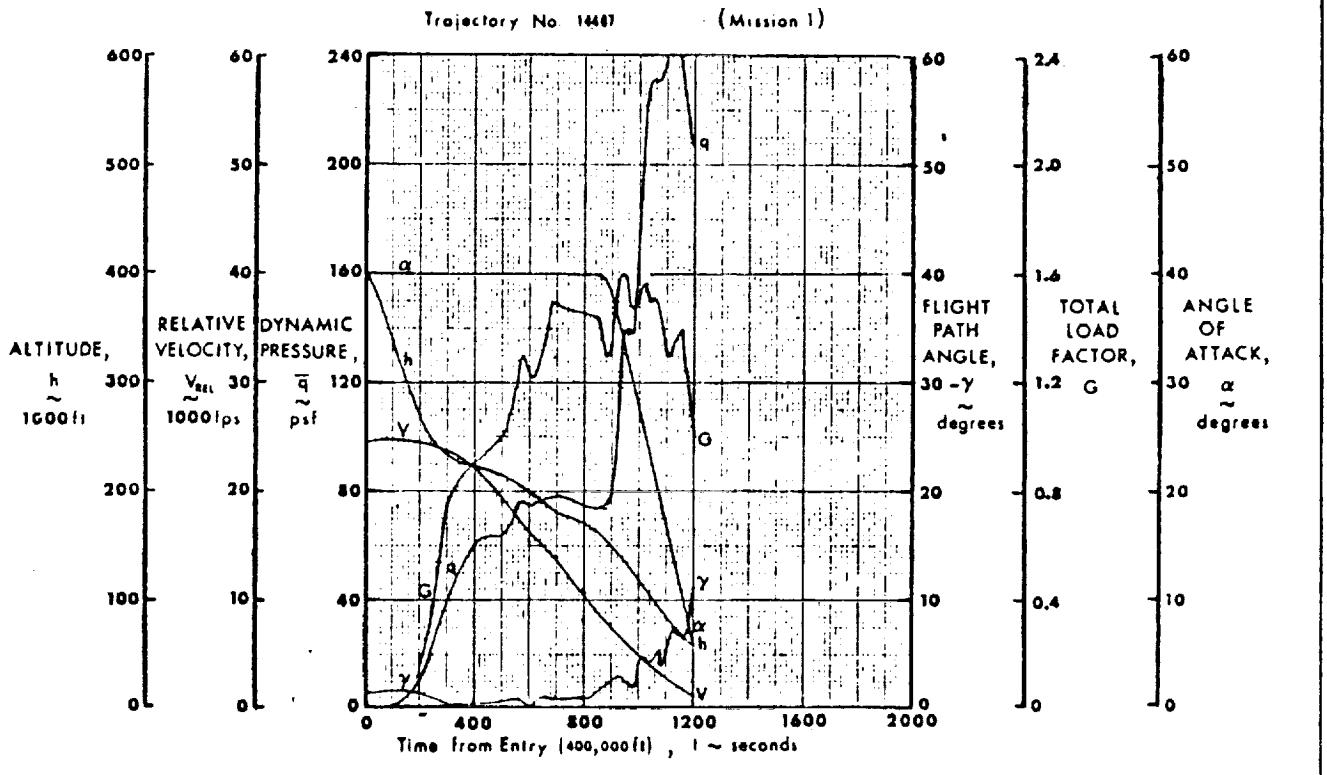


Figure 1.2-1
ORBITER ENTRY TRAJECTORY

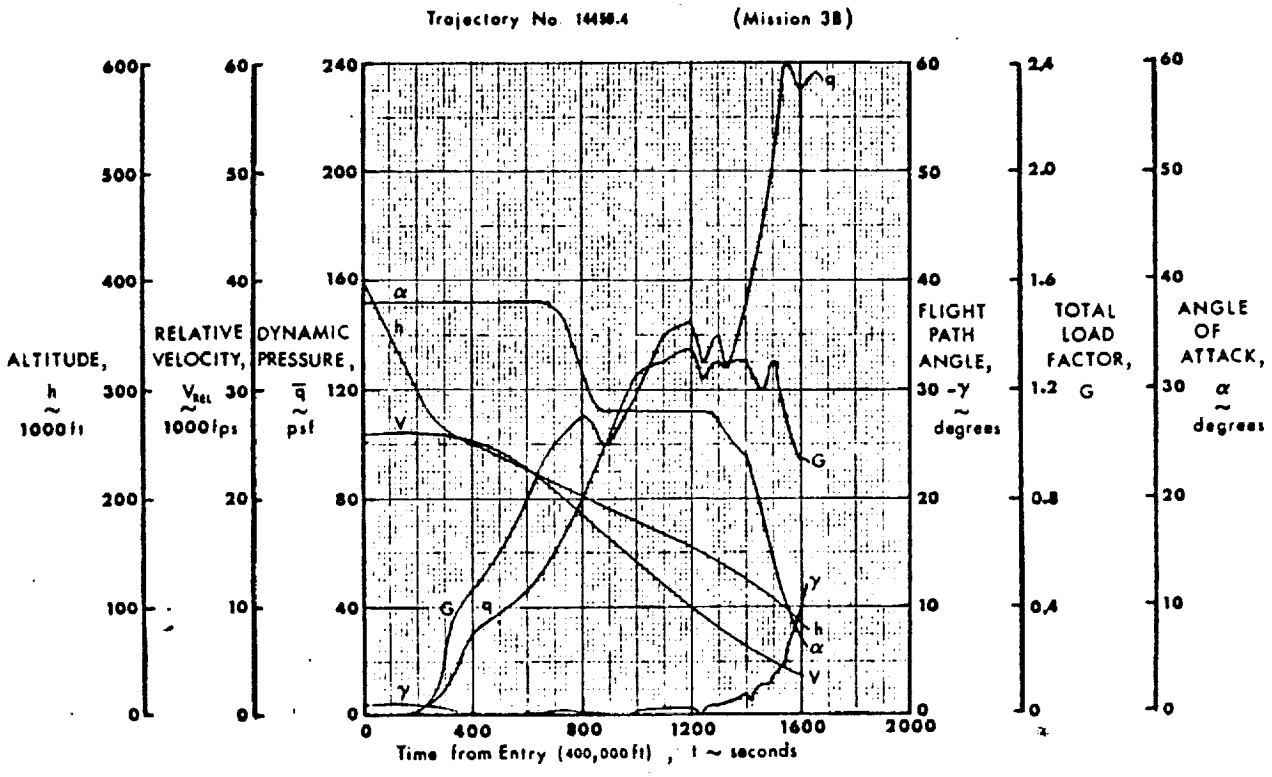
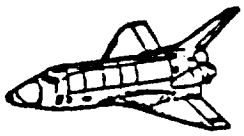


Figure 1.2-2
ORBITER ENTRY TRAJECTORY

1.3 FLIGHT TEST. The Orbital Flight Test (OFT) program is designed to substantiate the aerodynamic design of the Orbiter Vehicle throughout the expected flight regime. Flight test plans will be developed to satisfy multiple test objectives and to obtain a maximum data return. Testing will be consistent with the planned missions so that, insofar as possible, direct comparisons can be made. Verification of the aerodynamic design data will be accomplished by comparing the flight test derived aerodynamic data with results predicated on wind tunnel testing as presented in this report. The aerodynamic design data book will then be updated to reflect the flight results.



2.0 GROUND RULES

Major program requirements influencing the aerodynamic design of the delta wing Orbiter are defined in the Space Shuttle Program Request for Proposal as modified by SD MCR No. 0200 and Revisions (References 2-1 and 2-2). On March 3, 1975, MCR 1750 was initiated to replace MCR 0200. The former MCR, "Shuttle Baseline Control Drawings," assumed the function of the latter and will be revised (as required) to authorize release of baseline drawing changes.

2.1 DESIGN GROUND RULES. Aerodynamic design ground rules are summarized in Table 2.1-1.

Table 2.1-1 AERODYNAMIC DESIGN GROUND RULES

PARAMETER	VALUE
ANGLE OF ATTACK	
Hypersonic	25° to 50°
Supersonic	0° to 25°
Transonic	0° to 15°
Subsonic	-5° to 20°
LONGITUDINAL STABILITY	
STATIC MARGIN	
Hypersonic (Minimum)	Positive
Subsonic (Minimum)	-2% L_s
(Aft Center of Gravity)	(-5.45% MAC)
CENTER OF GRAVITY RANGE	
Design Range	0.650L_s to 0.675L_s
Minimum Travel	2% L_s
LIFT/DRAG MODULATION	
Subsonic Value - Peak	
(Gear-Up, δ_{ss} = 0°)	Not less than 4.4
(Gear-Up, δ_{ss} = 85°)	Not less than 2.5
LANDING PERFORMANCE	
MINIMUM DESIGN TOUCHDOWN SPEED (V_D)	171 knots
LANDING WEIGHT (WITH PAYLOAD)	187,900 pounds
PAYLOAD	32,000 pounds

2.2 FLIGHT ENVELOPES/CONDITIONS. Figure 2.2-1 presents the design center of gravity limits and static margin limits. A summary of the trim limits of Section 4.1.1.4 is also shown on the figure. The summary trim limits are based on the TPS design trajectory 14414.1 angle of attack schedule (also given in Section 4.1.1.4).

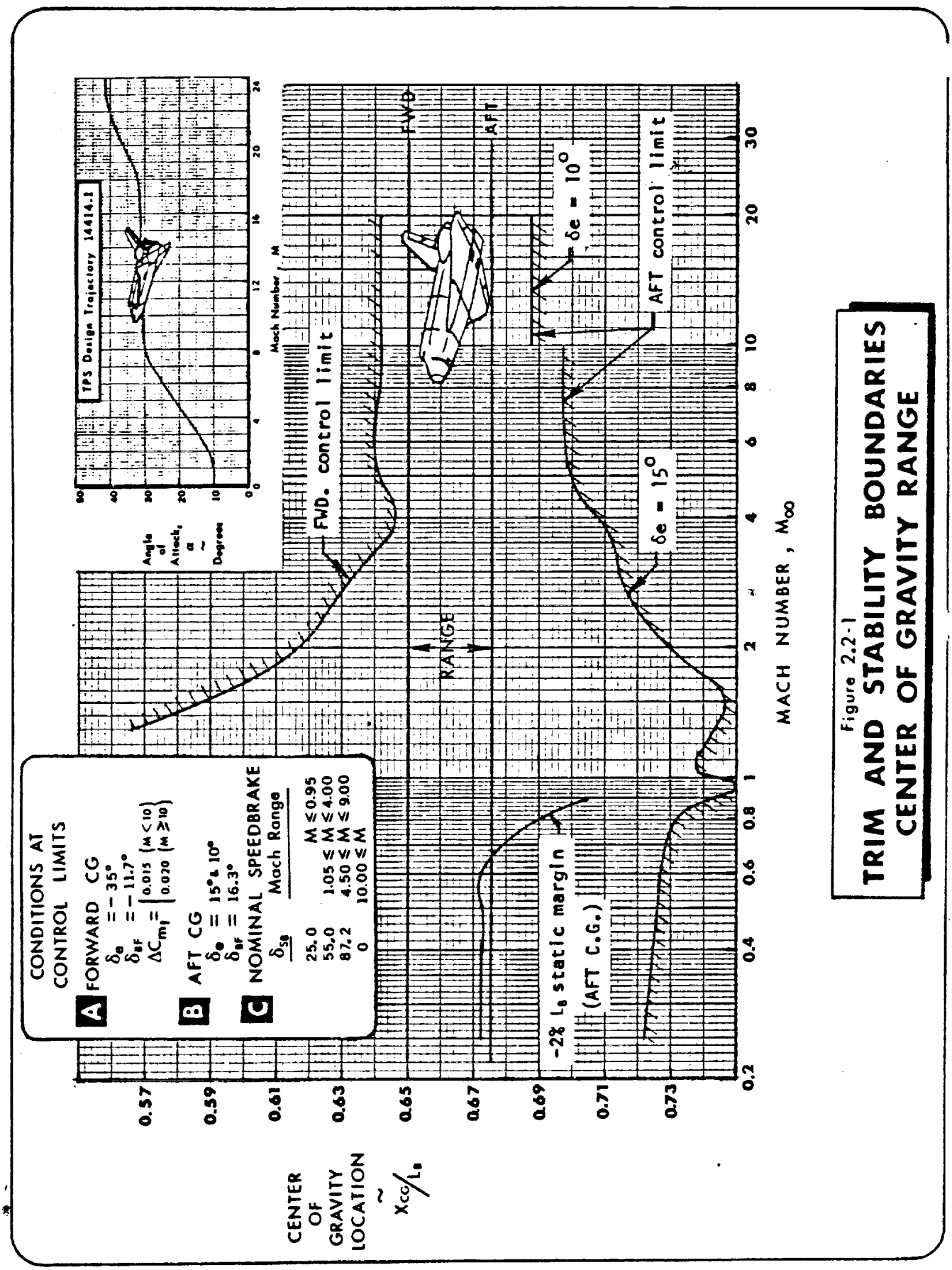
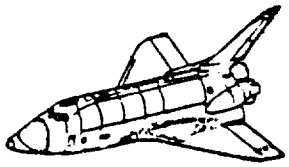


Figure 2.2-1
TRIM AND STABILITY BOUNDARIES CENTER OF GRAVITY RANGE



3.0 CONFIGURATION DESCRIPTION

The Orbiter Vehicle is configured to perform as both a spacecraft and an aircraft. To this end, the vehicle must provide the protection and versatility necessary for both orbital and atmospheric flight operations. Design of the vehicle is such that it will meet all requirements as set forth in the Orbiter Vehicle End Item Specification (Reference 3-1). Figure 3.0-1 presents a general arrangement, three-view drawing of the Orbiter Vehicle with reference dimensions and areas tabulated on the figure.

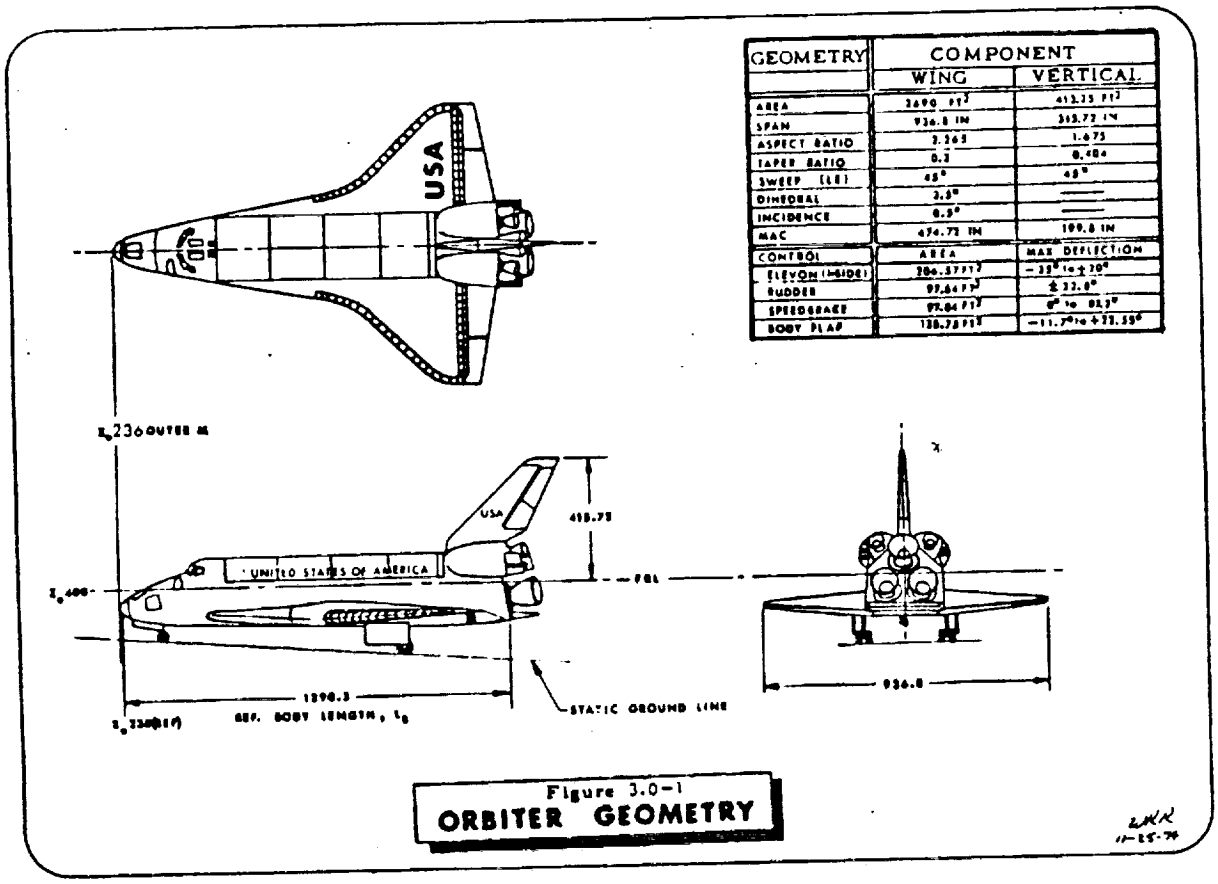


Figure 3.0-1
ORBITER GEOMETRY

Atmospheric (or aerodynamic) requirements are predicated, for the most part, on the entry phase of the Orbiter mission(s). The aerodynamic lines ensure acceptable performance over hypersonic, supersonic, transonic, and subsonic speed regimes while providing the specified downrange and cross range capabilities and meeting the specified landing requirements depicted in Figure 3.0-2.

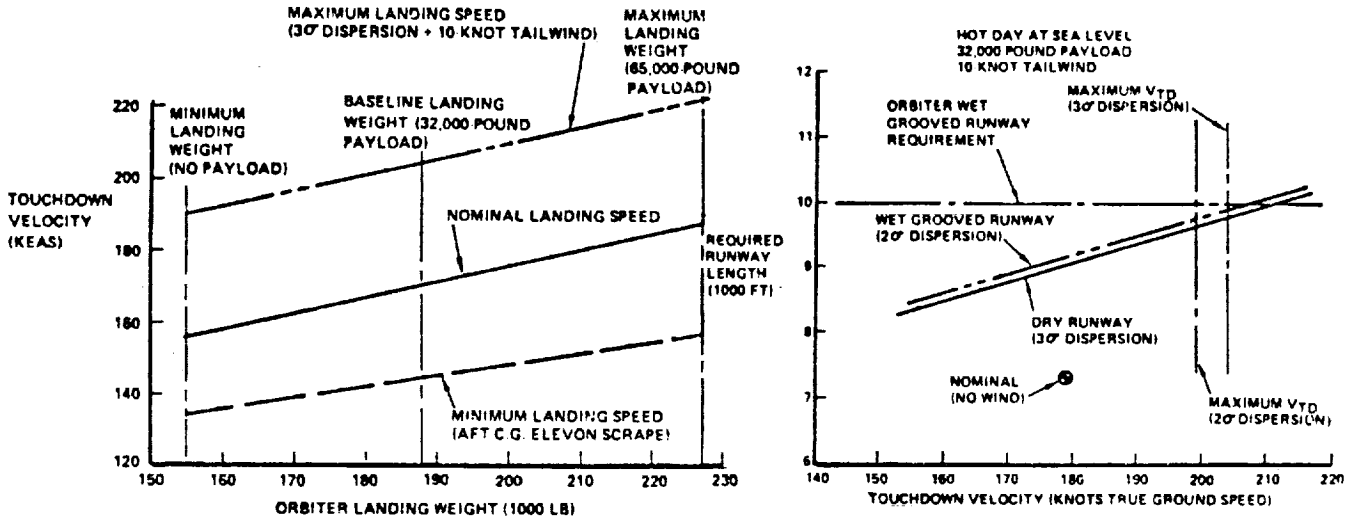


Figure 3.0-2 LANDING REQUIREMENTS

Evolution of the Orbiter Vehicle configuration from Authority to Proceed (ATP) to the present time is summarized in Figure 3.0-3. Major parameters influencing the design are noted on the figure.

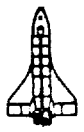
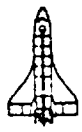
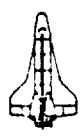
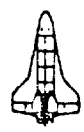
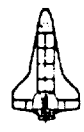
CONFIGURATION NUMBER	ATP	1	2A	3A	4	5
CONTROL DWG NO. / RCR NO.	— / VL70-000001 001	— / VL70-000040 0326	VL70-000089 0074	VL70-001478 0200	VL70-000140 A/B 0200 (REV 3)	VL70-000140C VC70-0000028 1750 (REV 2)
WING PLANFORM	50° BLENDED DELTA	50° BLENDED DELTA	45°/79° DBL DELTA	45°/81° DBL DELTA	45°/81° DBL DELTA	45°/81° DBL DELTA
PLAN VIEW						
DRY WEIGHT (LB)	170,000	170,000	150,000	150,000	150,000	150,000
LANDING WT (LB)	226,116	226,116	179,000	187,000	187,000	187,000
LANDING PAYLOAD (LB)	40,000	40,000	25,000	32,000	32,000	32,000
MIN DES TOUCHDOWN SPEED (KNOTS) / ANGLE OF ATTACK (DEG)	180 / 16	180 / 16	166 / 16	166 / 16	166 / 16	171 / 16

Figure 3.0-3 ORBITER VEHICLE EVOLUTION

3.1 CONFIGURATION AND DIMENSIONS. The configuration was selected to achieve high cross range aerodynamically and to be capable of trimmed flight over a wide range of angles of attack. The double-delta wing planform combined with a moderately low fineness ratio (approximately 5) body minimizes

interference heating effects, provides the required L/D ratio to meet cross range requirements, and possesses an acceptable trim range over the flight Mach number regime.

Aerodynamic design geometry of the Orbiter Vehicle is presented in Figure 3.1-1. The Master Dimensions Specification Manual, Reference 3-2, should be consulted for detailed lines drawings and dimensions. A summary breakdown of pertinent components is given in the ensuing paragraphs.

DESIGN DATA

INERT CONTROL WEIGHT
DESIGN LANDING WEIGHT
RUNWAY DOWN WEIGHT
DESIGN LANDING SPEED
} REFER TO CONTRACT END ITEM SPECIFICATION MJ070-0001-1A

PROPULSION	MAIN	OMS	RCS
THRUST-VACUUM-LBS.	470K	6K	0.9K
PROPELLANT TYPE	H_2/O_2	N_2O_4/MMH	N_2O_4/MMH
NUMBER	3	2	40 +6 VERNIERS 25LBF @

LINES & CONTOURS

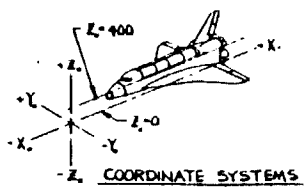
THIS DRAWING DEPICTS OUTER MOLD LINE(OML) ONLY
REFER TO MASTER DIMENSION SPEC. MJV70 FOR DEMA DATA

GEOMETRY

	WING	VERTICAL	FLAP$_o$
S_w FT.^{2}	2690	413.25	135.75
AR	2.265	1.675	
λ	0.20	0.404	
Λ L.E.	45°	45°	
DIHEDRAL (@ CHORD PLANE & TRAILING EDG.)	3° 30'		
α BASIC WING	+0° 30'		
%/c Y_w=0 (℄ BODY)	0.1137		
%/c Y_w= 199	0.113		
%/c Y_w= 468.34	0.12		
b IN.	936.68	315.72	
C_R IN.	689.24	268.50	
C_T IN.	137.85	108.47	
$\bar{C}$ IN.	474.81	199.81	
MAC AIRFOIL	Y_w=182.13 TIP 0012-64 MOD Y_w=199,.0010 MOD.	Z_v=635.52 10° SYM. 60-40 WEDGE	
V_v (TAIL VOLUME)		.0537	
S_w EXPOSED, FT.^{2} (TOTAL)	2012.4 (INC. ℄)	369.1	
$S_{w_{BODY}}$ EXPOSED FT.^{2} =	290.8		
S_w TOTAL WETTED FT.^{2}	4001.2	738.82	
$S_{e_{LEVON}}$ FT.^{2} (ONE SIDE)	206.57		
$S_{RUD.}$ FT.^{2}		97.148	

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
8C	A	1. CARGO DOOR AFT TRIM X_o 1306.9 WAS 1307	9/12/74	
5G		2. REVISED GEO NOTES		
7B		3. MPS VERT. ENG. SPACING 108 CORRECTED TO READ 103.		
9F		4. 2446 NOTE WAS 2448 ℄ MANIP.		
8F		5. C/A DIM. 1136.83 WAS 1136.64		
7D		6. E.T. ATTACH LOC. AFT 955 CORR'D TO READ 965.		
9G		7. ADDED X_o 238 AS FWD LOC. OF REF. BODY LENGTH 1290 S		
15E		8. REMOVED H42°45' DIM. FROM SEC. X_o 630S		
15E		9. ADDED 37°50' FOR RAD. DEPLOY ANGLE @ SEC. X_o 630.5		
13G, 13F		10. REMOVED "NOT TO EXCEED ∠" FROM SEC. VIEW X_o 630.5 & X_o 1072		
	B	SEE E.O. B01 FOR ASBUILT DRAWING CHANGES INCORPORATED & RELEASED AT "B" REVISION	11/14/75	[illegible]
	C	SEE E.O. C01 FOR DIRECT DRAWING CHANGES INCORPORATED & RELEASED AT "C" REVISION	3/4/77	J.T. Green
	D	SEE E.O. D01 FOR DIRECT DRAWING CHANGES INCORPORATED & RELEASED AT "D" REVISION	9/14/77	J.T. Green
	E	SEE E.O. E01 FOR DIRECT DWG CHANGES INCORPORATED AND RELEASED AT "E" REVISION	5/30/78	J.E. COX J.T. GREEN



COORDINATE SYSTEMS

Figure 3.1-1
DESIGN GEOMETRY ORBITER

2. TRACEABILITY NOT REQ'D.

⚠ 1. MPS GIMBAL ANGLES SHOWN INCLUDE 0°30' DYNAMICS OVERTRAVEL & 0°30' THRUST MISALIGNMENT

NOTES: UNLESS OTHERWISE SPECIFIED.

						DR BY HORSTMAN 4-10-74	Rockwell International Corporation Space Division
						CHK BY	DESIGN GEOMETRY - ORBITER
						APPROVED BY	SIZE J · CODE IDENT NO 03953 · DRAWING NO VC70-000002
ITEM	QTY	NEXT ASSY	USED ON	102 END ITEM NO	1 SCHED THRU		SCALE NOTED · SHEET
REQD PER END ITEM		APPLICATION		EFFECTIVITY			

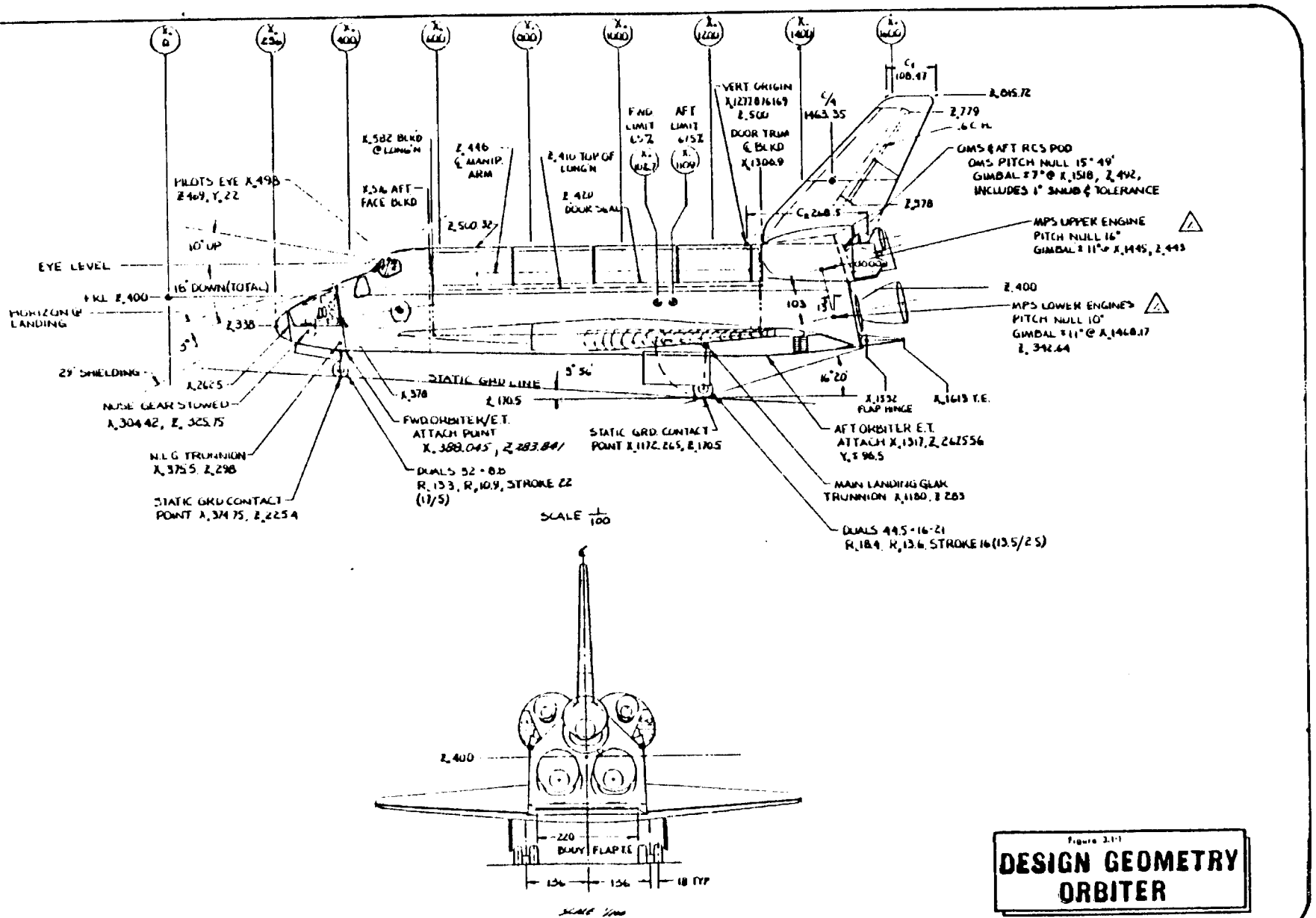


Figure 3.1-1

DESIGN GEOMETRY ORBITER

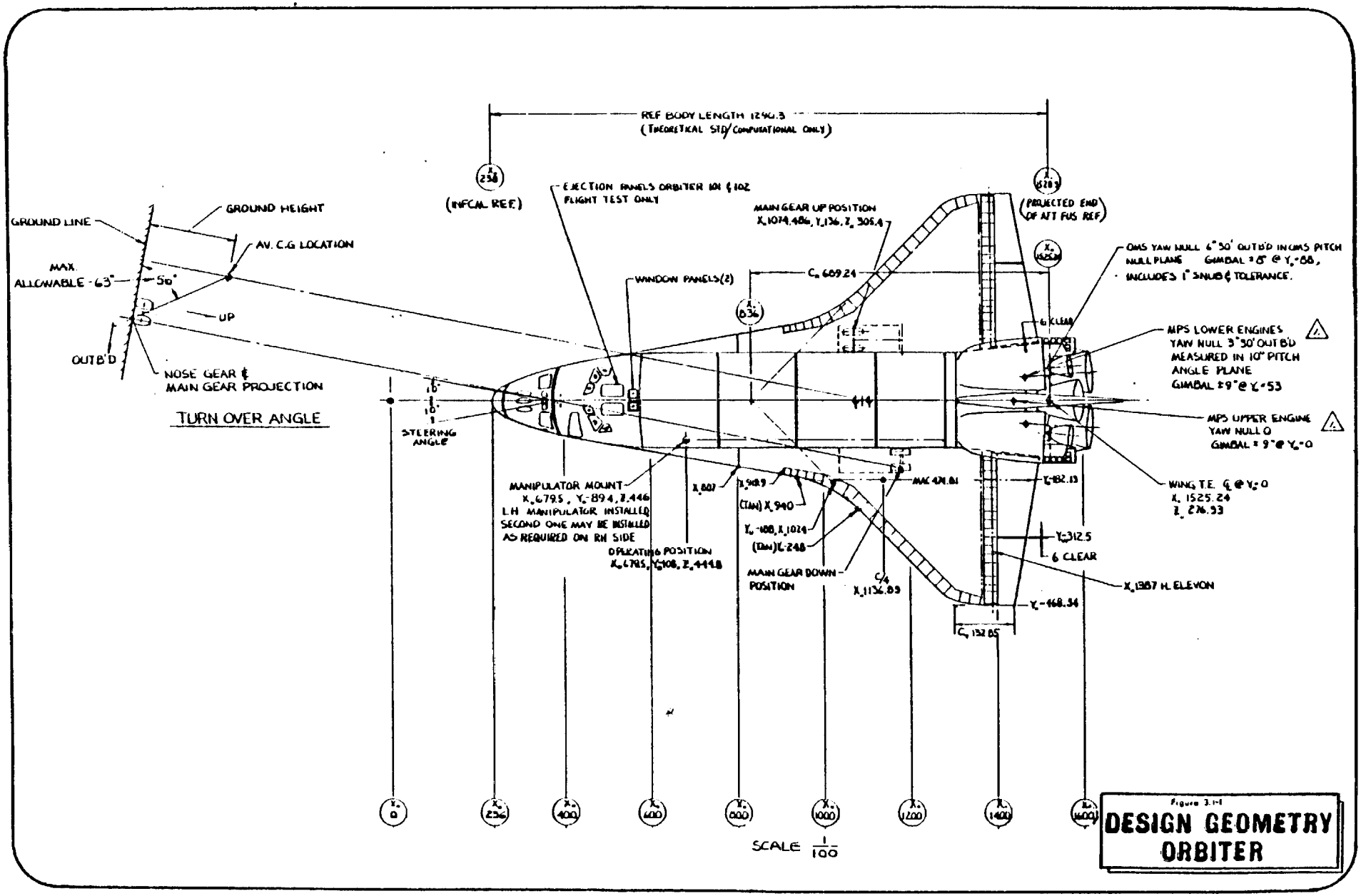
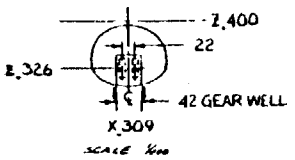
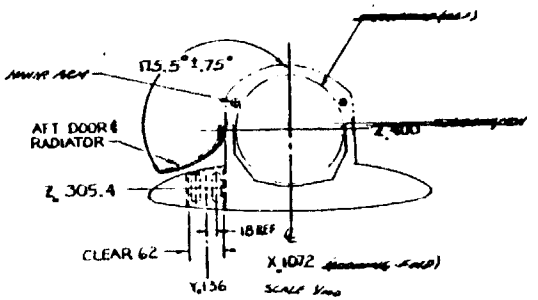
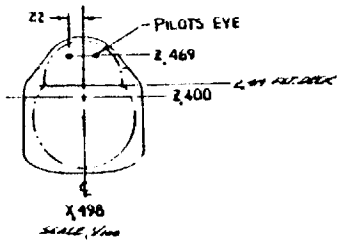
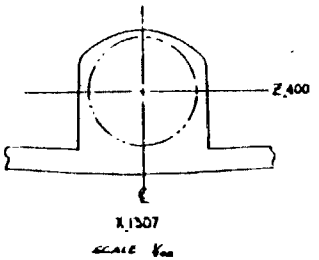


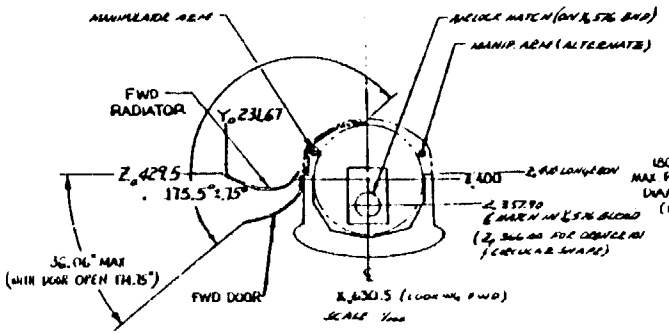
Figure 3.1-1
DESIGN GEOMETRY ORBITER

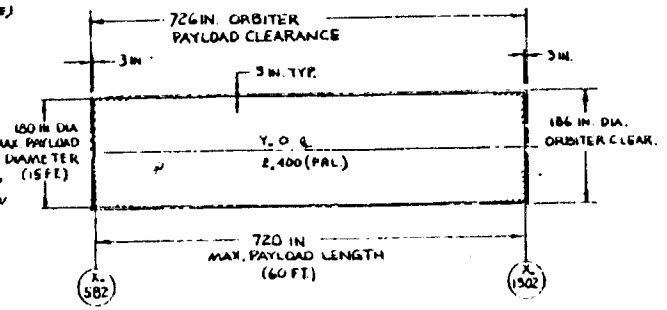






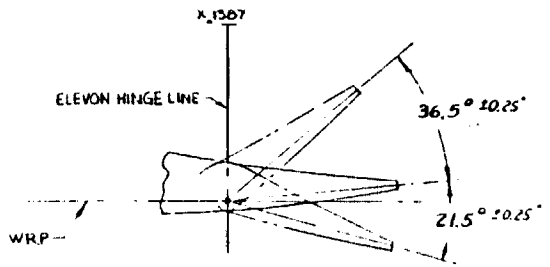




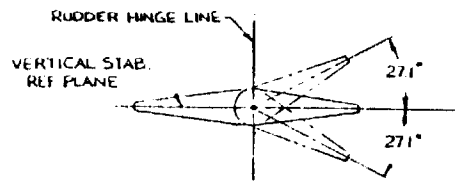


PAYLOAD ENVELOPE/ORBITER CLEARANCE

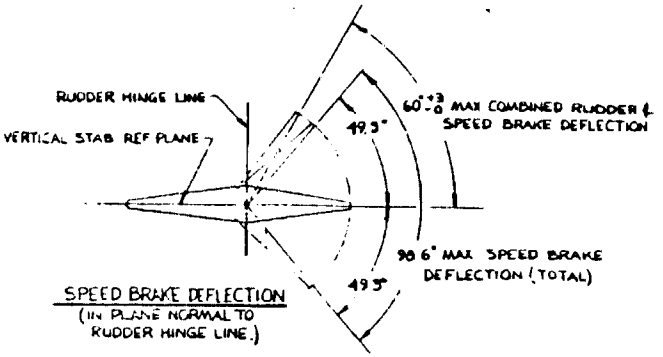
Figure 3.1-1
DESIGN GEOMETRY ORBITER



ELEVON DEFLECTIONS

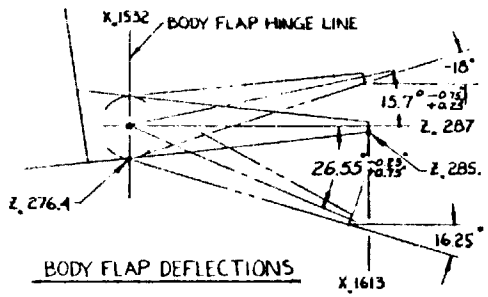


RUDDER DEFLECTION
(IN PLANE NORMAL TO RUDDER HINGE LINE)

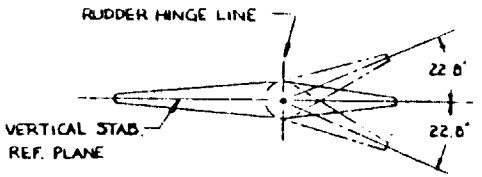


SPEED BRAKE DEFLECTION
(IN PLANE NORMAL TO RUDDER HINGE LINE.)

SCALE $\frac{1}{20}$

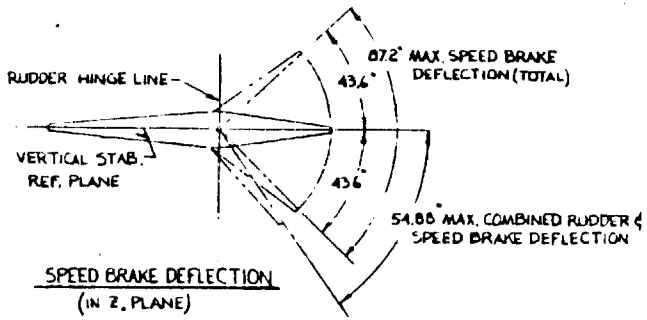


BODY FLAP DEFLECTIONS



RUDDER DEFLECTION
(IN Z. PLANE)

SCALE $\frac{1}{40}$



SPEED BRAKE DEFLECTION
(IN Z. PLANE)

SCALE $\frac{1}{40}$

Figure 3.1-1

DESIGN GEOMETRY ORBITER

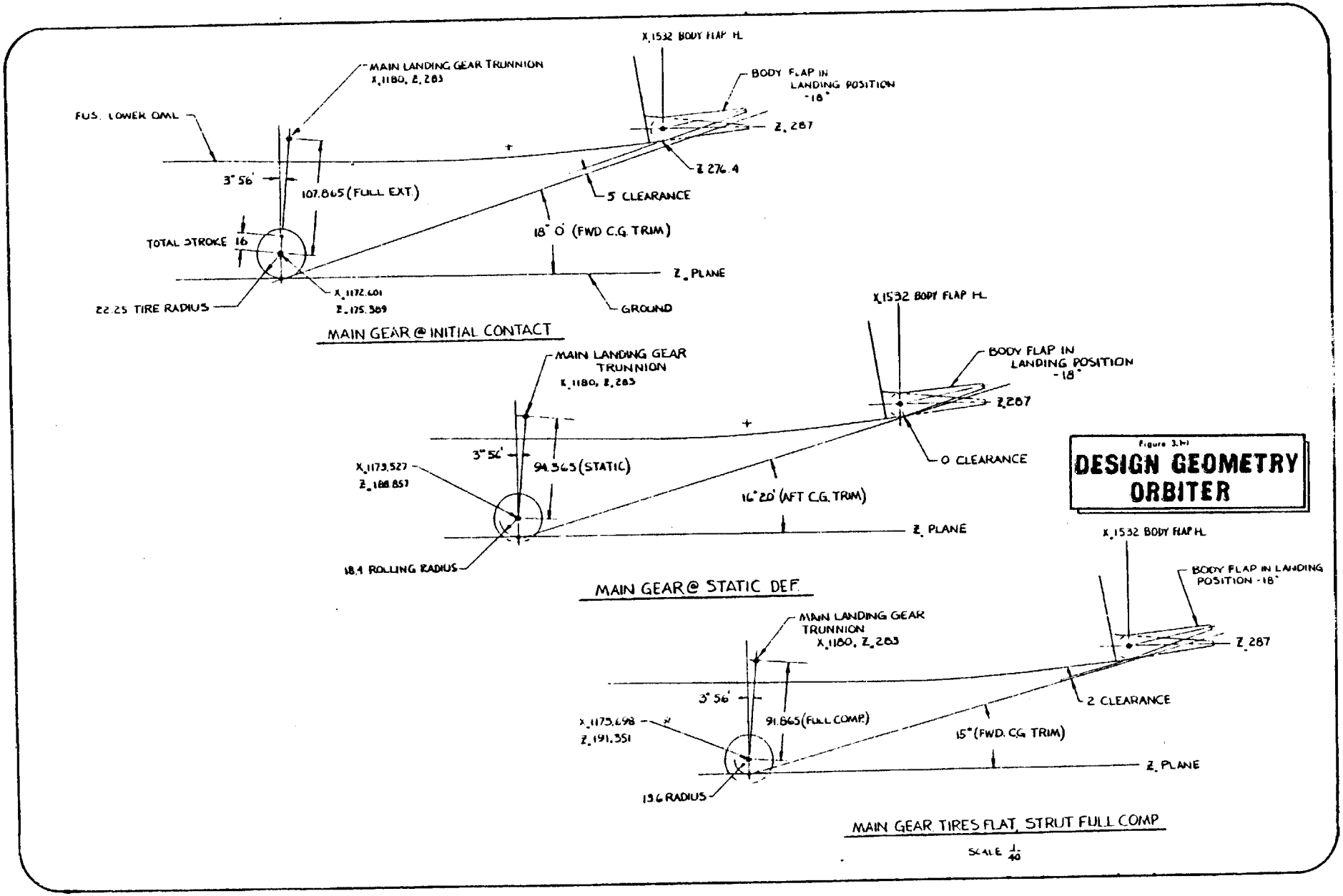
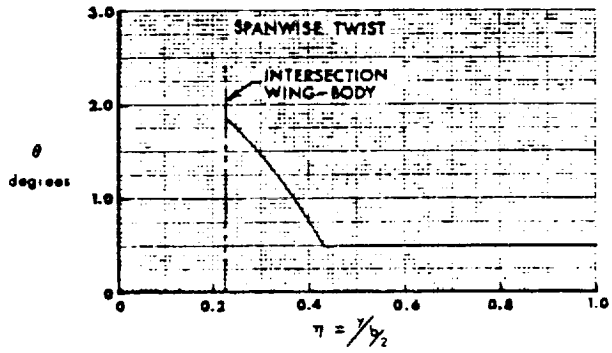


Figure 3.1-1

DESIGN GEOMETRY ORBITER

3.1.1 WING. The Orbiter wing was sized to provide a 171-knot touchdown speed (V_D) at a 15-degree angle of attack (tail scrape attitude for main gear strut compressed, tire flat) with body flap retracted and the center of gravity at the forward limit. The leading edge sweep (45 degrees) and aspect ratio (2.265) were selected on the basis of aero-thermodynamic trade studies to provide the design touchdown speed for a center of gravity at the forward limit with minimum wing size and to optimize the wing leading edge thermal protection system (TPS) for a reuse cycle of 100 flights prior to major rework. Spanwise twist distribution and chordwise camber are shown on Figure 3.1.1-1.



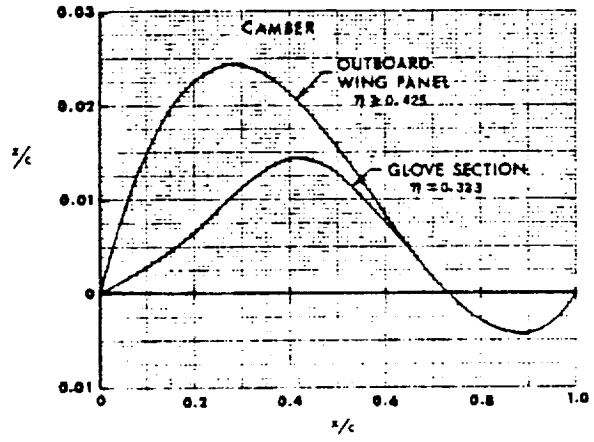
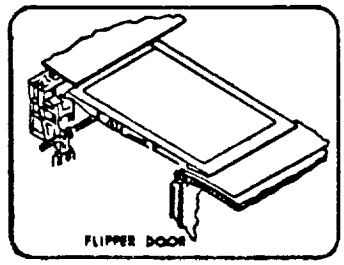


Figure 3.1.1-1
WING TWIST AND CAMBER

Control surfaces located in the wing consist of the elevons (elevator-allerons) weith elevon seal (or "flipper") doors which effectively seal the resultant gaps when the elevons are deflected by *following* the control surface leading edge.



The wing planform reference area (2690 ft) includes that portion of the basic planform covered by the fuselage. It does NOT include the areas formed by wing-body fairings or areas clipped from the equivalent "delta" by the faired wing tips. Pertinent dimensional parameters are summarized in Table 3.1.1-1 (see also, Figures 3.1.4-1 through 3.1.4-4 for areas and perimeters.

Table 3.1.1-1 WING DIMENSIONAL PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
AIRFOIL SECTION			
(Y_o 199.045)	—	0.0010 (mod)	---
(Y_o 468.340)	—	0012 - 64 (mod)	---
DIHEDRAL (at trailing edge)	δ_{TE}	3.5	degrees
AREA			
Planform (total)	S_{REF}	2690	ft^2
Planform (exposed)	S_{EXP}	2012.4	ft^2
Wetted Surface (exposed)	S_{WET}	4001.2	ft^2
SPAN	b_w	78.056 (936.68)	ft (inch)
ASPECT RATIO	AR_w	2.265	---
TAPER RATIO	$\lambda = c_t/c_r$	0.20	---
SWEEP			
Leading Edge	Λ_{LE}	45	degrees
Trailing Edge	Λ_{TE}	-10	degrees
CHORD			
Root (theoretical)			
Fuselage Station (0.25c) (F.S.)	X_o	1008.31	inches
Buttock Line (B.L.)	Y_o	0	inches
Length	$c_{r_{THEOR}}$	57.44 (689.24)	ft (inch)
Root (exposed)			
Fuselage Station (0.25c) (F.S.)	X_o	778.5	inches
Buttock Line (B.L.)	Y_o	108.0	inches
Length	c_r	80.83 (970)	ft (inch)
Tip			
Fuselage Station (0.25C) (F.S.)	X_o	1338.80	inches
Buttock Line (B.L.)	Y_o	468.34	inches
Length	c_t	11.48 (137.85)	ft (inch)
Mean Aerodynamic	MAC		
Fuselage Station (0.25c) (F.S.)	X_o	1136.83	inches
Buttock Line (B.L.)	Y_o	182.13	inches
Length	$\bar{c}_w$	39.56 (474.81)	ft (inch)
GLOVE			
Sweep	Λ_{GLOVE}	81	degrees
Theoretical Intersection			
Fuselage Station (F.S.)	X_o	1024.0	inches
Buttock Line (B.L.)	Y_o	188.0	inches
ELEVON (one side)			
Inboard/Outboard Split (BL)	Y_o	311	inches
Area	S_e	206.57	ft^2
Span	b_e	28.87	ft
Aspect Ratio	AR_e	4.03	---
Chord	MAC, $\bar{c}_e$	7.46 (89.5)	ft (inch)
Fuselage Station (0.25c) (F.S.)	X_o	1409.375	inches
Distance (centroid to hingeline)	—	44.75	inches

3.1.2 FUSELAGE (OR BODY). The Orbiter fuselage was designed to accommodate a variety of payloads and house the crew and maneuvering control systems. Nose camber, cross section, and upward sloping forebody sides were selected to improve hypersonic pitch trim and directional stability and in conjunction with wing-body blending, to reduce entry heating on the body sides. Attitude Control Propulsion System (ACPS) pods have been incorporated with the OMS and are located in the aft body fairings. Hinged surfaces attached to the fuselage include the cargo bay doors and the body flap. The cargo bay doors have 13 hinges on each side of the fuselage. The six forward hinges on each side are covered with TPS and faired fore and aft. The aft seven hinges have no TPS and no fairings. The body flap is used to protect the Shuttle main engines (SME) during entry and to provide trim capability to relieve elevon loads. Pertinent dimensional parameters are summarized in Table 3.1.2-1.

Table 3.1.2-1 FUSELAGE DIMENSIONAL PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
LENGTH			
Reference	L_B	1290.3	Inches
Nose Fuselage Station (F.S.)	X_O	238	Inches
DEPTH	h_B	19.92 (239)	ft (Inch)
Maximum at F.S.	X_O	1280	Inches
WIDTH	w_B	22.0 (264)	ft (Inch)
Maximum at F.S.	X_O	1528.3	Inches
AREA			
Planform	S_B	1914.4	ft^2
Wetted Surface	$S_{B_{WET}}$	5634	ft^2
Base	$S_{B_{BASE}}$	365.7	ft^2
OMS Pods	S_{POD}	71.0	ft^2
CARGO BAY			
Diameter	d_{CB}	15	ft
Length	ℓ_{CB}	60	ft
GLOVE			
Fuselage Intersection (F.S.)	X_O	500	Inches
(B.L.)	Y_O	102	Inches
(Based on OML - TPS Included)			
BODY FLAP			
Area (planform)	S_{BF}	135.75	ft^2
Span (equivalent)	b_{BF}	241.33	Inches
Chord	c_{BF}	81	Inches
Hinge Line (F.S.)	X_O	1532	Inches

3.1.3 VERTICAL TAIL. The vertical tail has been sized to provide a low-speed C_{n_β} of 0.0013 at an angle of attack of 13 degrees about a center of gravity located at the aft limit and has a reference area of 413.25 ft^2, including the rudder/speed brake. The rudder is split along the Orbiter buttock plane to provide directional stability augmentation in the hypersonic/supersonic flight regimes and to apply drag modulation for the subsonic flight phases, approach and landing. The section profile is a five-degree half-angle, 60 to 40 percent double wedge airfoil. Dimensional parameters are summarized in Table 3.1.3-1.

Table 3.1.3-1 VERTICAL TAIL DIMENSIONAL PARAMETERS
(Including rudder/speed brake)

PARAMETER	SYMBOL	VALUE	UNITS
AIRFOIL SECTION (root-tip)	---	10° Symmetrical 60% - 40% double wedge	---
AREA	S_v	413.25	ft^2
SPAN	b_v	26.31 (315.72)	ft (inch)
ASPECT RATIO	AR	1.675	---
TAPER RATIO	$\lambda_v = c_t/c_r$	0.404	---
SWEEP			
Leading Edge	$\Lambda_{v_{LE}}$	45	degrees
Trailing Edge	$\Lambda_{v_{TE}}$	26.2	degrees
CHORD			
Root	c_r	22.37 (268.5)	ft (inch)
Tip	c_t	9.04 (108.47)	ft (inch)
Mean Aerodynamic	$\bar{c}_v$	16.65 (199.81)	ft (inch)
Fuselage Station (0.25C) F.S.	X_o	1463.35	inch
Waterline W.L.	Z_o	635.5	inch
RUDDER/SPEED BRAKE			
AREA	S	97.84	ft^2
SPAN	b	16.55 (198.61)	ft (inch)
CHORD			
Mean Aerodynamic	$\bar{c}$	6.07 (72.84)	ft (inch)
Fuselage Station (0.25c) F.S.	X_o	1575.77	inch
Waterline W.L.	Z_o	670.41	inch

3.1.4 TOTAL VEHICLE. Cross sectional data defining the total Orbiter Vehicle geometry are presented in Figures 3.1.4-1 through 3.1.4-4. These figures provide the cross sectional area variation for components and total vehicle and the perimeter distribution for components and total vehicle. Total vehicle dimensional parameters are summarized in Table 3.1.4-1.

Table 3.1.4-1 TOTAL VEHICLE DIMENSIONAL PARAMETERS
(fuselage plus exposed wing)

PARAMETER	SYMBOL	VALUE	UNITS
AREA			
Planform	S_{TOTAL}	3952	ft^2
Wetted Surface	$S_{WET_{TOTAL}}$	11,136	ft^2
LENGTH			
Overall	L	122.0 (1464)	ft (inch)
Reference	L_B	107.5 (1290.3)	ft (inch)
SPAN	b_w	78.056 (936.68)	ft (inch)
HEIGHT			
Gear-Up	$h_{GEAR\ UP}$	46.14 (553.68)	ft (inch)
Gear-Down (static position)	$h_{GEAR\ DOWN}$	53.76 (645.12)	ft inch)

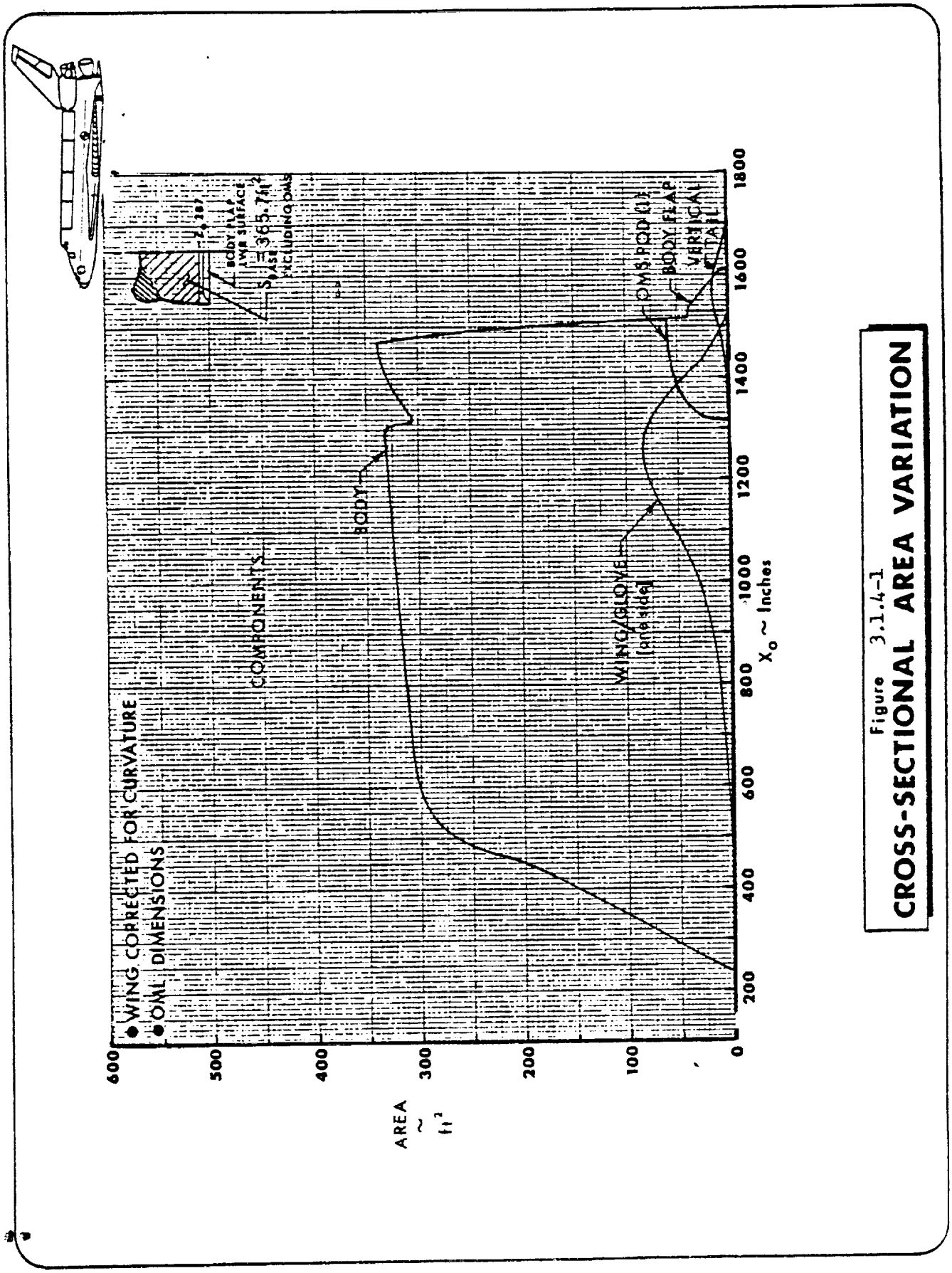


Figure 3.1.4-1
CROSS-SECTIONAL AREA VARIATION

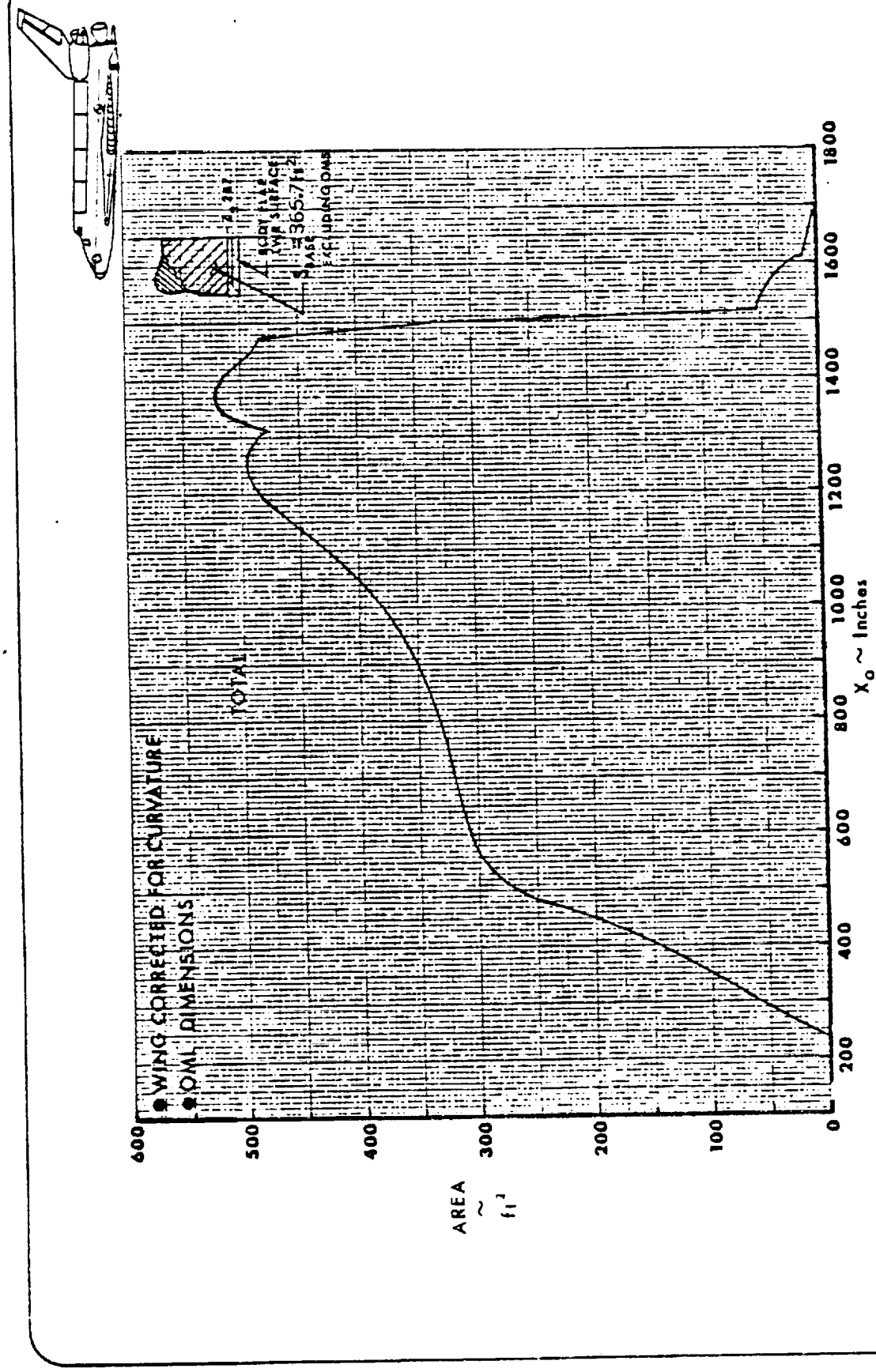
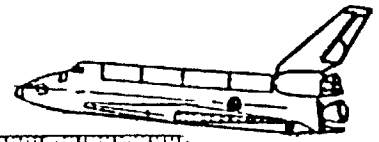


Figure 3.1.4-2
CROSS-SECTIONAL AREA VARIATION



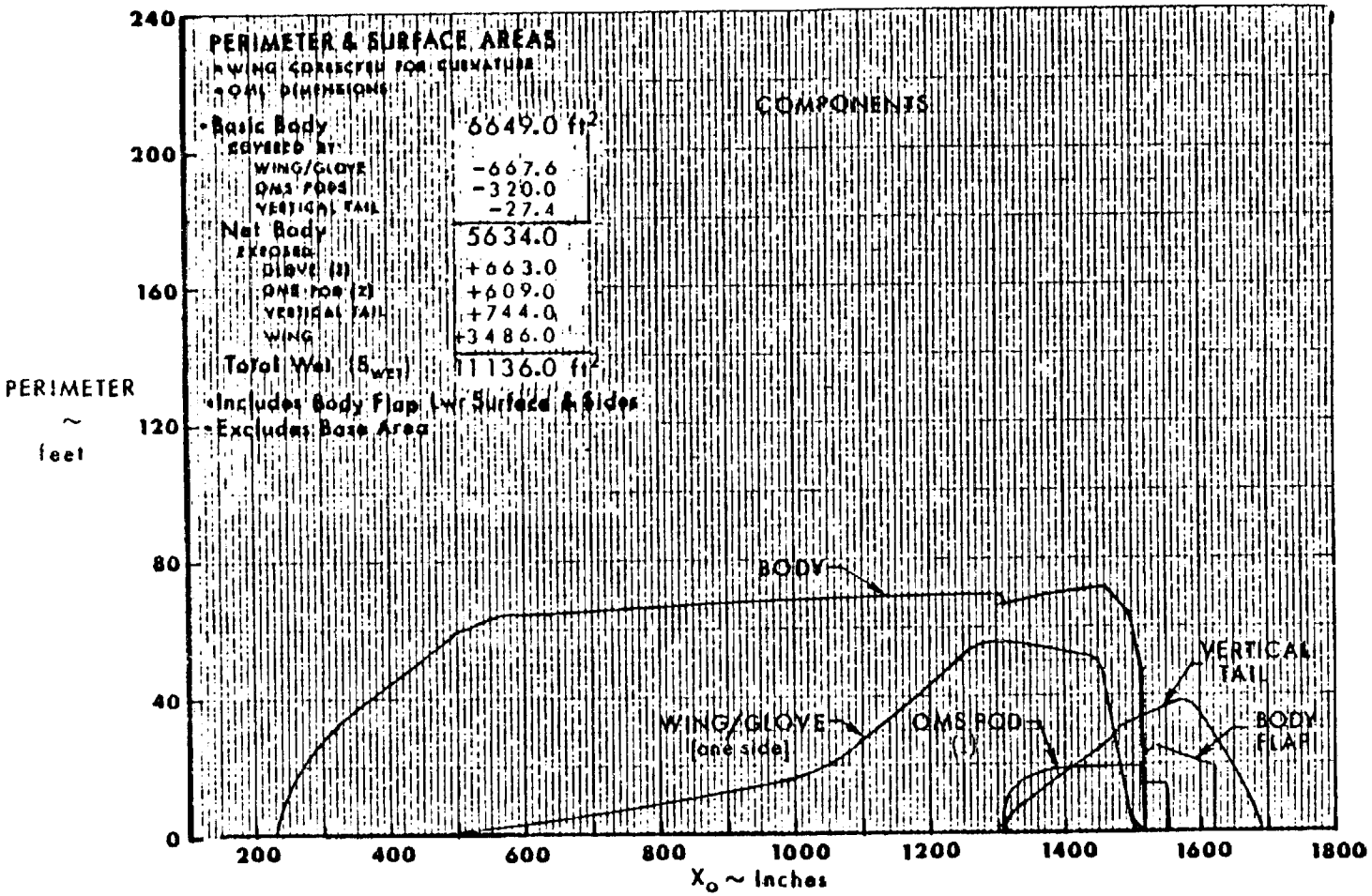


Figure 3.1.4-3
PERIMETER DISTRIBUTION

Rockwell International
Space Division

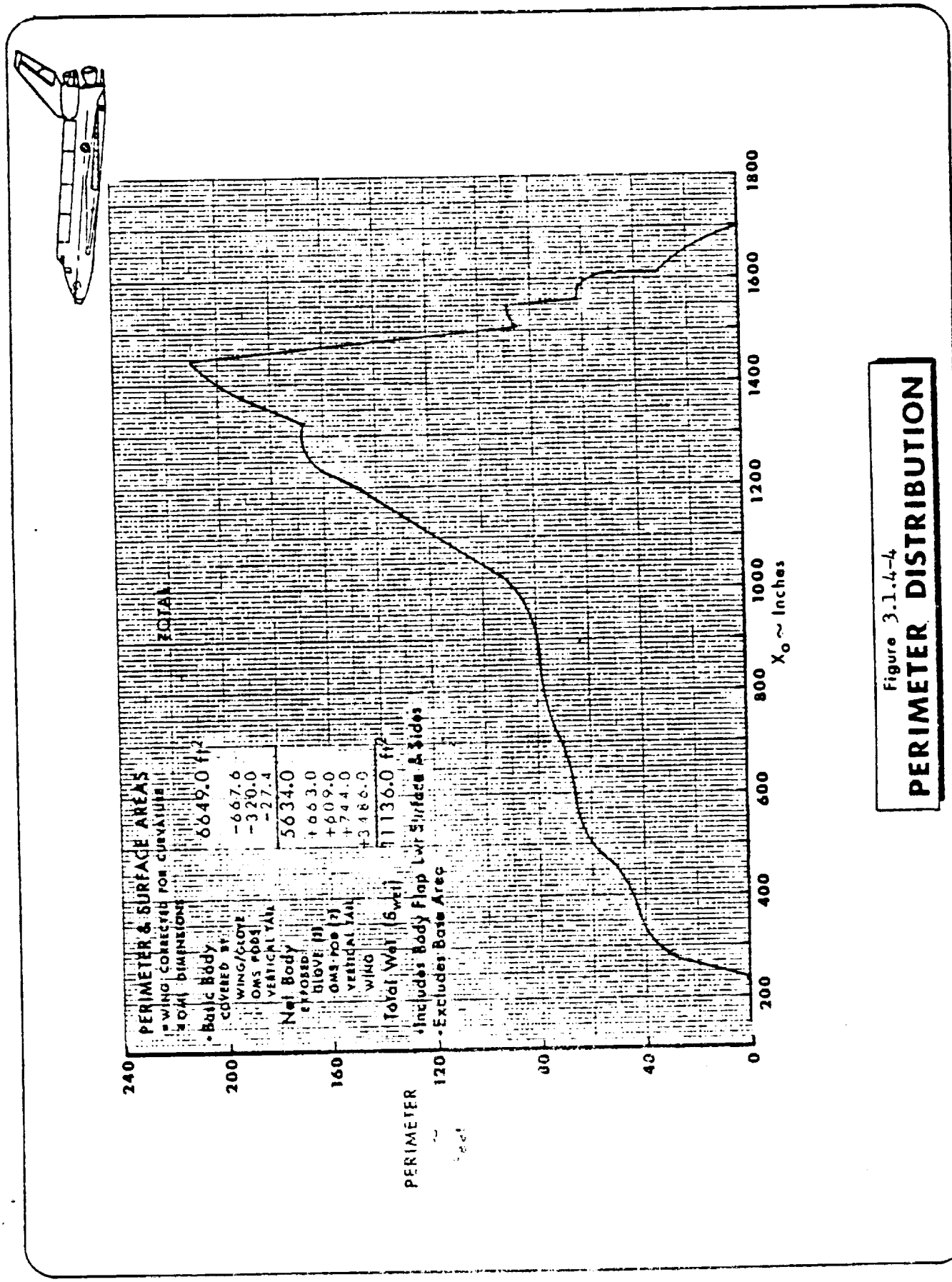
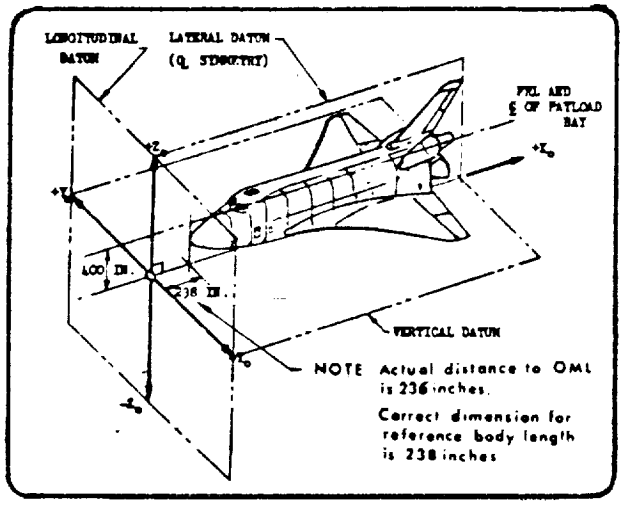


Figure 3.1.4-4
PERIMETER DISTRIBUTION

3.2 REFERENCE AXES AND SIGN CONVENTION

Reference axes and sign conventions are consistent with those for conventional aircraft. The Orbiter Vehicle axis system for vehicle design drawings and mass properties statements is illustrated in the sketch. This axis system is defined in the Space Shuttle Master Dimensions Specification, Reference 3-2, and on Figure 3.1-1. All vehicle design drawing axes systems are in accordance with NASA Phase B Technical Directives 2519 and 2519A.



3.2.1 AERODYNAMIC REFERENCE AXIS SYSTEMS. Definitions of the Orbiter Vehicle aerodynamic reference axis systems are illustrated in Figure 3.2.1-1. The positive X-axis for the Orbiter body axis system is shown parallel to the Fuselage Reference Line (FRL). Sign conventions for forces, moments, velocities, and accelerations are also shown on the figure. The aerodynamic reference axis systems are sets of conventional, right-hand, orthogonal axes with the X- and Z-axes in the plane of symmetry and with the positive X-axis directed out the nose (in the body axis system) or pointing into the component of the wind (in the stability axis system) which lies in the plane of symmetry.

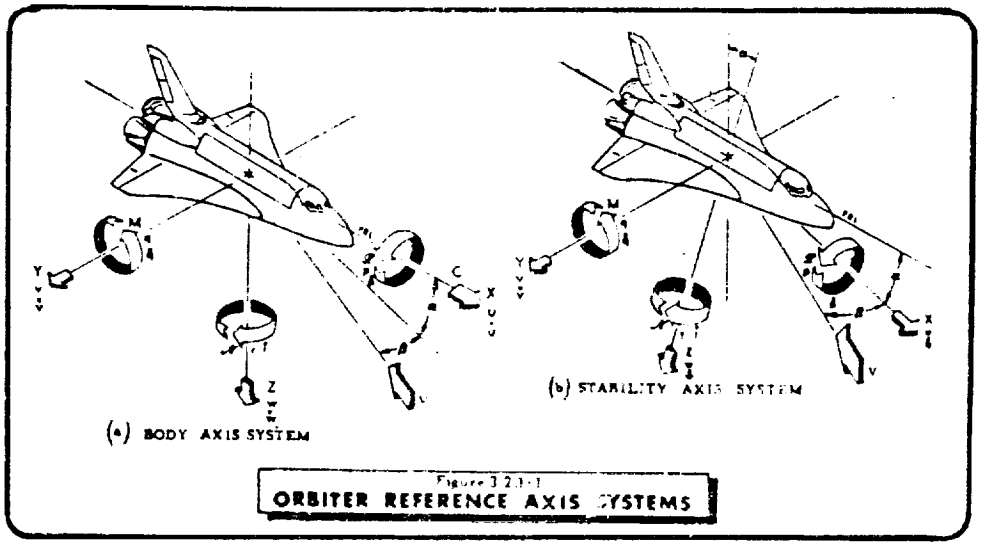


Figure 3.2.1-1
ORBITER REFERENCE AXIS SYSTEMS

3.2.2 AERODYNAMIC SIGN CONVENTION. Sign conventions for the aerodynamic force and moment coefficients used in this report are illustrated in Figure 3.2.2-1 for the stability axis system. Directions on the figure are positive as shown.

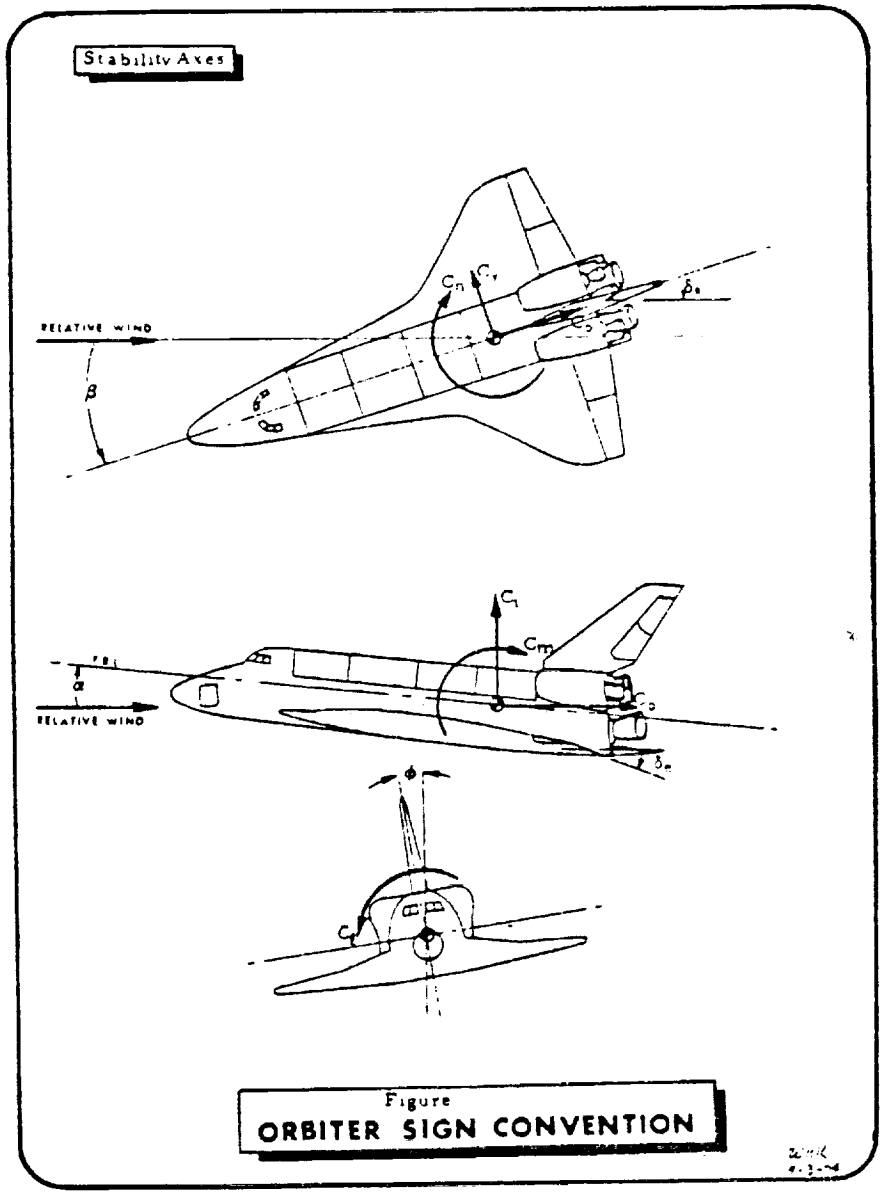
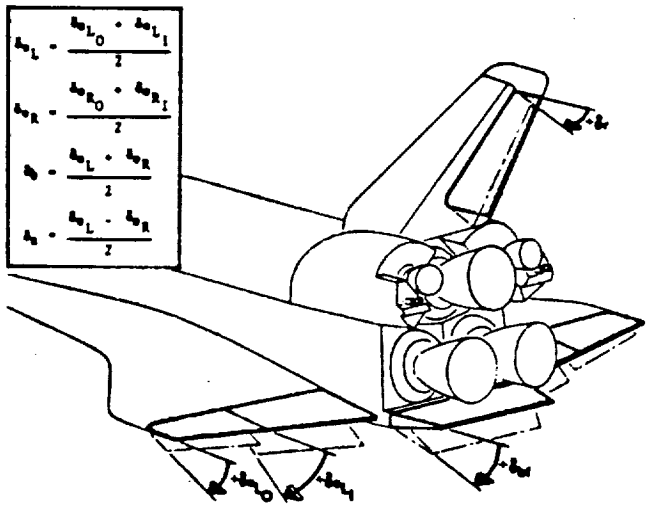


Figure
ORBITER SIGN CONVENTION

3.3 AERODYNAMIC CONTROL

Orbiter Vehicle aerodynamic control surface deflections, forces, and hinge moments are summarized and illustrated in the sketch. In general, control surface deflection angles are measured in a plane perpendicular to the control surface hinge axis. An exception is the rudder/speed brake control surface (s) deflections which are measured in a plane parallel to the fuselage reference plane (FRP). Each aerodynamic control surface and deflection is discussed separately in the ensuing paragraphs of this section.



$$\delta_{e_L} = \frac{\delta_{e_{L_O}} + \delta_{e_{L_I}}}{2}$$

$$\delta_{e_R} = \frac{\delta_{e_{R_O}} + \delta_{e_{R_I}}}{2}$$

$$\delta_e = \frac{\delta_{e_L} + \delta_{e_R}}{2}$$

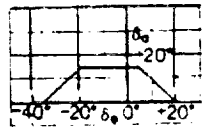
$$\delta_a = \frac{\delta_{e_L} - \delta_{e_R}}{2}$$

3.3.1 ELEVONS.

The elevons are divided into four segments, right- and left-inboard and right- and left-outboard. Gaps between the fuselage and elevon and between the inboard segments to which the data herein are applicable are those baselined in MCR 0315. A typical elevon control installation is shown in Figure 3.3.1-1.

Positive Deflection of	Angle	Aero Forces and Moments	Hinge Moment
Rudder, δ_r	$+\beta$, $-\psi$	$+C_Y$, $-C_n$	$-C_{h_r}$
Elevon, δ_e	$-\alpha$, $-\theta$	$-C_m$	$+C_{h_e}$
Right, δ_{e_R}	$-\phi$	$-C_\ell$	$-C_{h_{e_R}}$
Left, δ_{e_L}	$+\phi$	$+C_\ell$	$-C_{h_{e_L}}$
Aileron, δ_a	$+\phi$	$+C_\ell$	
Body Flap, δ_{bf}	$-\alpha$, $-\theta$	$-C_m$	$-C_{h_{bf}}$

Table 3.3-1 MAXIMUM CONTROL SURFACE DEFLECTIONS AND RATES

CONTROL SURFACE	DEFLECTION SYMBOL	DISPLACEMENT "MAXIMUM" degrees	RATE (NORMAL OPERATION) deg/sec
ELEVONS Elevator	δ_e	-35 TE UP +20 TE DOWN	20
Aileron	$\delta_a = \frac{1}{2}(\delta_{e_L} - \delta_{e_R})$		20
RUDDER	δ_r	± 22.8	10
SPEEDBRAKE	δ_{sb}	0 to 87.2	5
BODY FLAP	δ_{bf}	-11.7 TE UP +22.55 TE DOWN	1.3

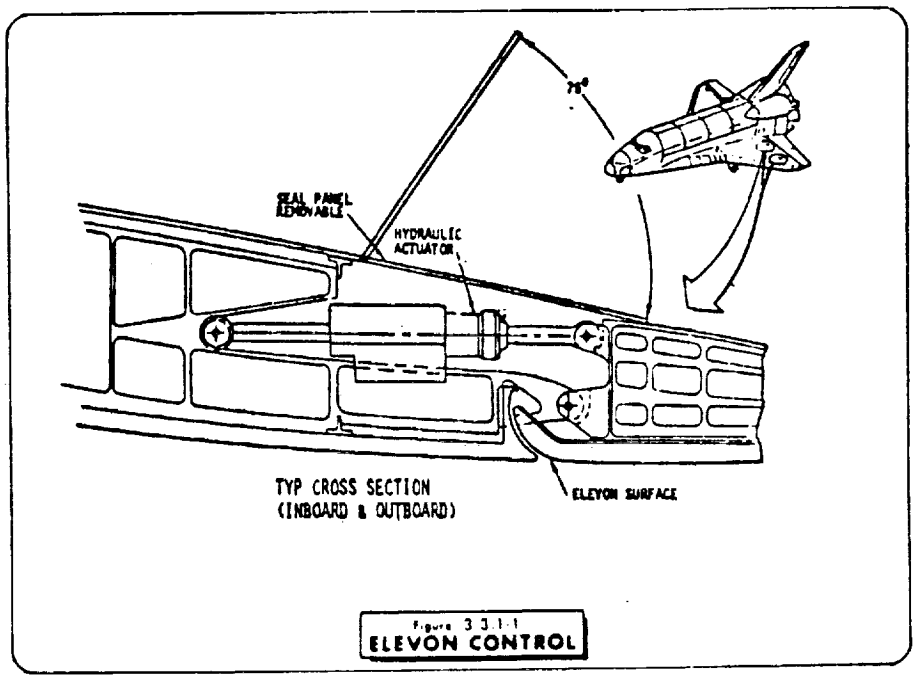


Figure 3.3.1-1
ELEVON CONTROL

The surfaces are servo-actuated with four actuators to control the four segments. These surfaces are employed for pitch and roll control and pitch and roll trim. Maximum control surface deflections and rates are given in Table 3.3-1. The elevon deflection range is -35 degrees (trailing edge up) to +20 degrees (trailing edge down) except during entry where it is limited to +10 degrees to prevent excessive heating. The aileron function deflections are shown on the table.

3.3.2 RUDDER/SPEED BRAKE. Directional control of the Orbiter is achieved aerodynamically by means of the rudder. During entry, at high angles of attack, the rudder is augmented by RCS (see section 3.6). The rudder is split into four panels, two per side (upper and lower), which are deflected together for yaw control and deployed symmetrically, in opposition, for drag modulation (speed brake function). Each pair (upper and lower) of panels is actuated by power hinges driven by a common torque shaft as illustrated in Figure 3.3.2-1.

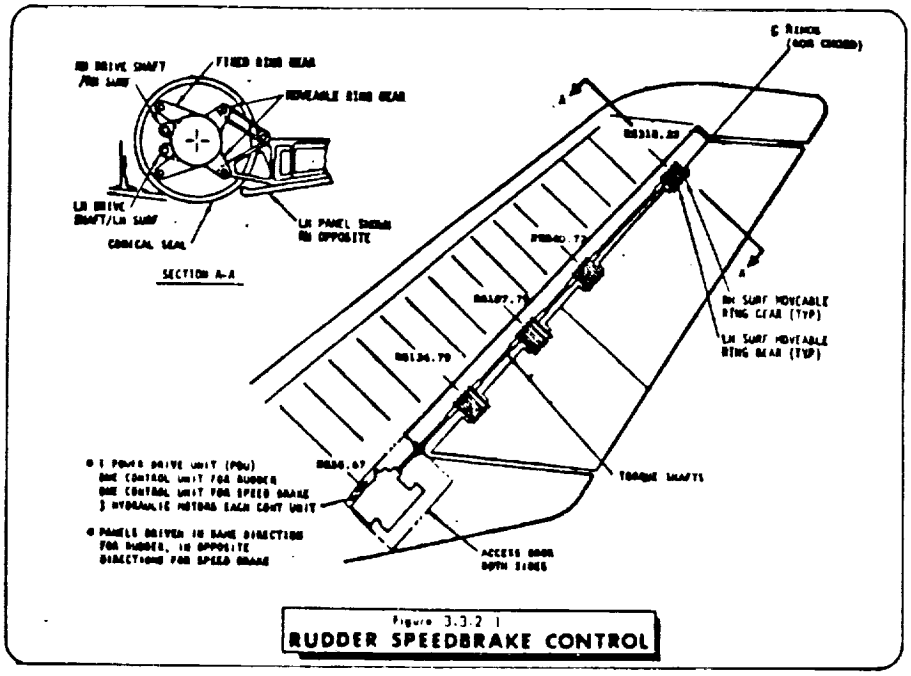


Figure 3.3.2-1
RUDDER SPEEDBRAKE CONTROL

Rudder/speed brake deflections are given in Figure 3.3.2-2 and in Table 3.3-1.

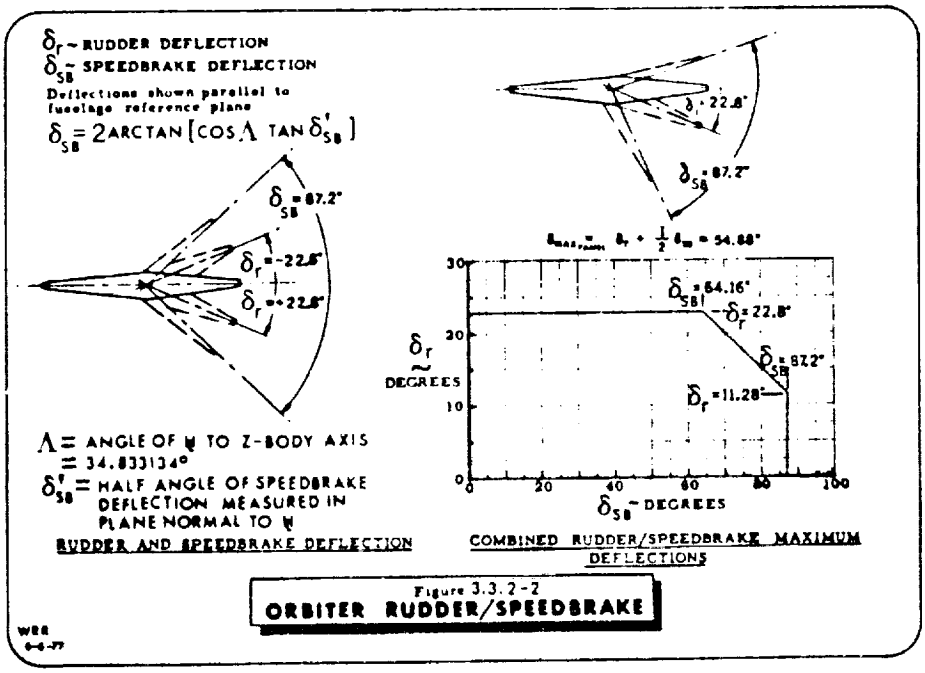


Figure 3.3.2-2
ORBITER RUDDER/SPEEDBRAKE

3.3.3 BODY FLAP. Trim capability to relieve elevon loads is obtained by body flap deflection actuated by power hinges as shown in Figure 3.3.3-1.

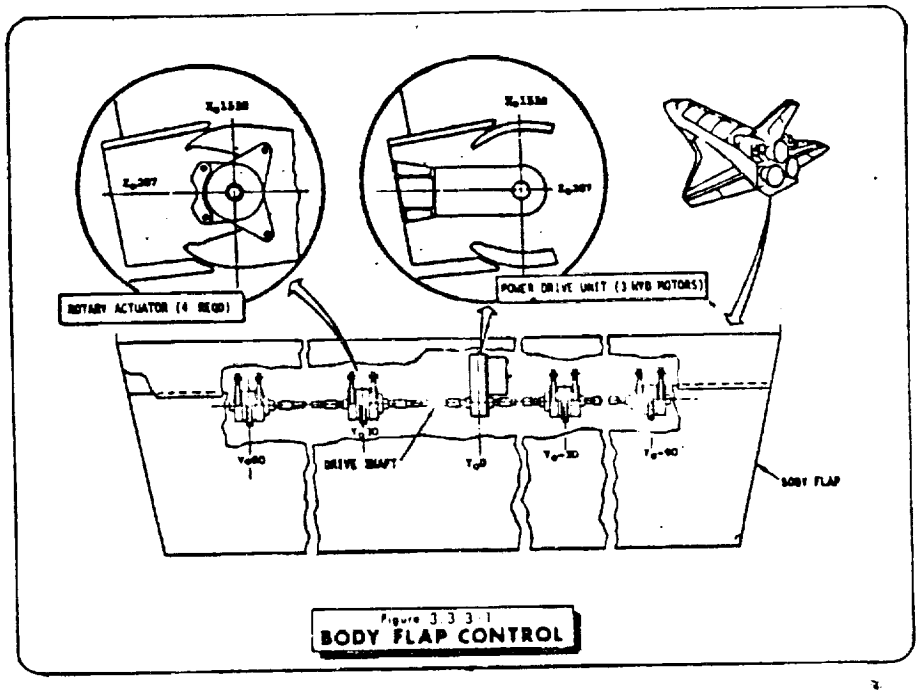


Figure 3.3.3-1
BODY FLAP CONTROL

Body flap deflection is from -11.7 degrees (trailing edge up) for entry with a forward center of gravity to +16.3 degrees (trailing edge down) for entry with an aft center of gravity. Maximum positive body flap deflection is +22.55 degrees as shown in Figure 3.3.3-2.

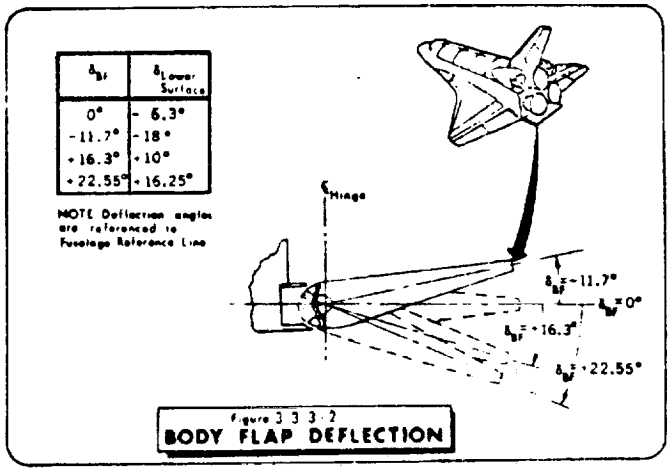


Figure 3.3.3-2
BODY FLAP DEFLECTION

3.4 LANDING GEAR AND GROUND CLEARANCE. The Orbiter Vehicle landing gear consists of a double-wheel steerable nose gear and two, double-wheel, wing-mounted, main gear. The gear is designed for a maximum landing weight of 227,000 pounds and a maximum landing velocity of 221 knots. Maximum allowable sink rate for the Orbiter Vehicle with a 65,000-pound payload is 6.0 fps. Gear deployment velocity is 300 knots maximum. Steering capability is ±10 degrees and the crosswind constraint is 20 knots maximum. The landing gear installation is illustrated in Figure 3.4-1.

Ground effect, as shown in the data sections of this report, is given as a function of the ratio of height-above-ground to wing span. The height-above-ground is measured to a point on the vehicle just aft of the trailing edge of the inboard section of the elevon (FS 1506.84, WL 282.71). Height-above-ground as a function of angle of attack is given in Figure 3.4-2 for various values of the ratio h/b.

The touchdown attitude is restricted by the ground scrape angle (α_s) as illustrated on Figure 3.4-2. Scrape angle(s) is given for three landing gear strut conditions: fully extended; static; and fully compressed-tires flat when the body flap is in the landing position (-11.7 degrees). The effect of elevon deflection (trailing edge down) is to further restrict the touchdown attitude as shown on the figure.

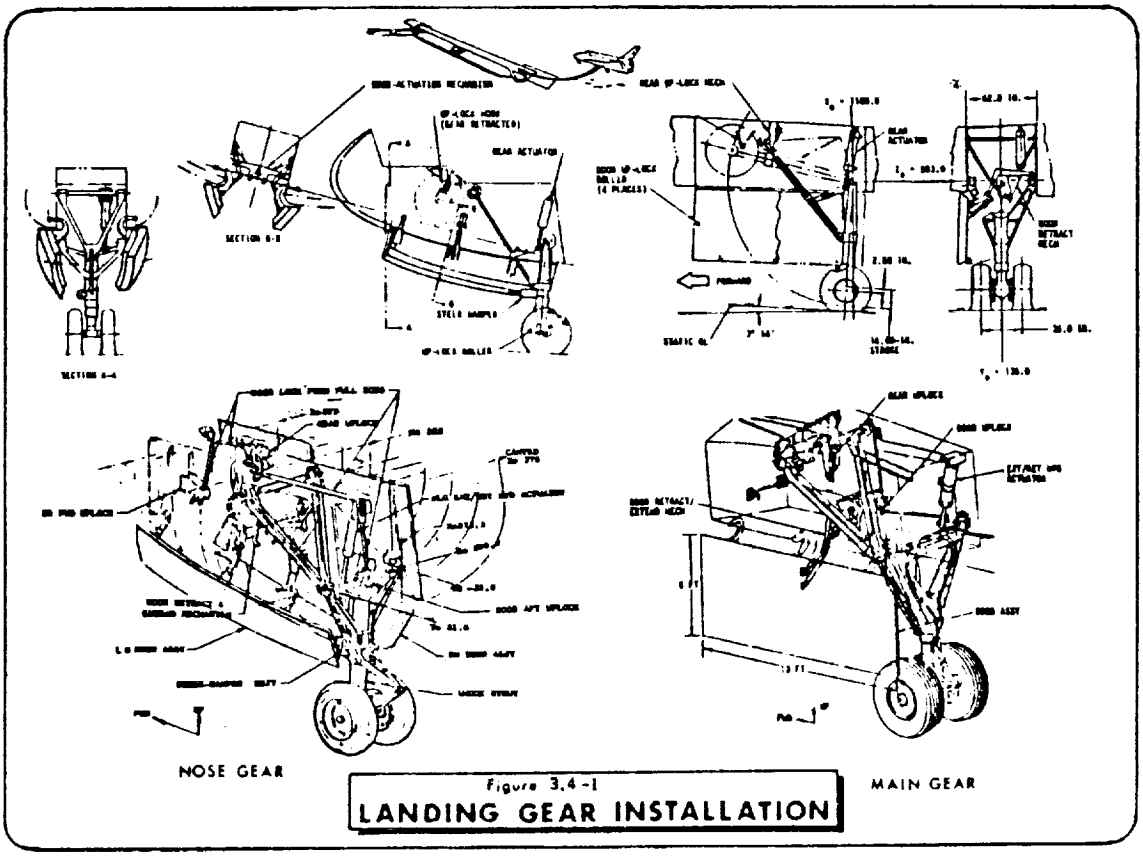
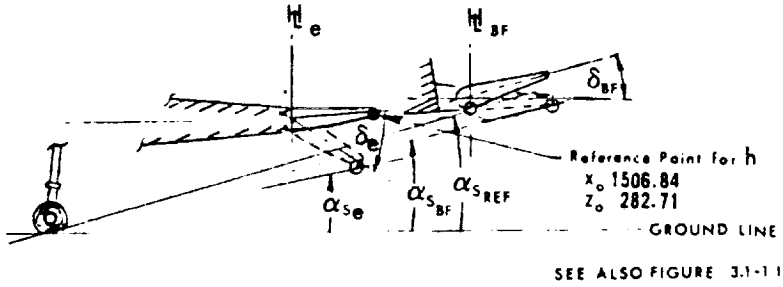


Figure 3.4-1
LANDING GEAR INSTALLATION



SEE ALSO FIGURE 3.1-1 INSET]

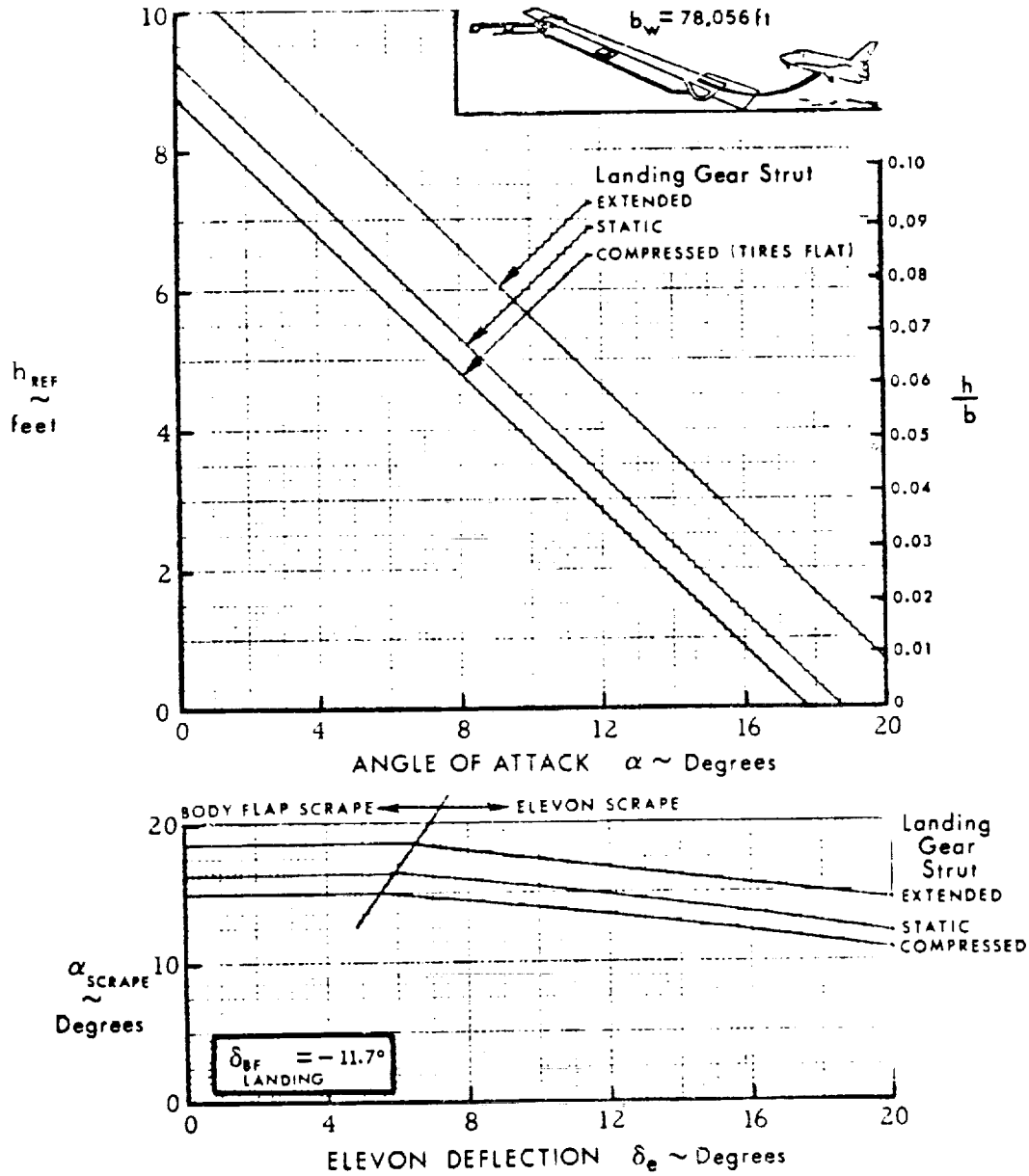


Figure 3.4-2
GROUND CLEARANCE

3.5 THERMAL PROTECTION SYSTEM. The Thermal Protection Subsystem (TPS) is designed to protect the primary airframe structure from the effects of aerodynamic heating during ascent and entry. In general, the TPS consists of reusable surface insulation (RSI) 'tiles' of three types having a 100-mission capability. The three types of insulation used are:

FRSI (flexible RSI) to 700°F (entry) and 750°F (ascent)

LRSI (low temperature RSI) 700°F to 1200°F (nominal)

HRSI (high temperature RSI) 1200°F to 2300°F (nominal)

The TPS is required to provide adequate capability for assuring safe earth return and intact landing of the Orbiter Vehicle following abort-once-around(AOA) and return-to-launch-site (RTLS) abort. General area TPS installation is shown in Figure 3.5-1.

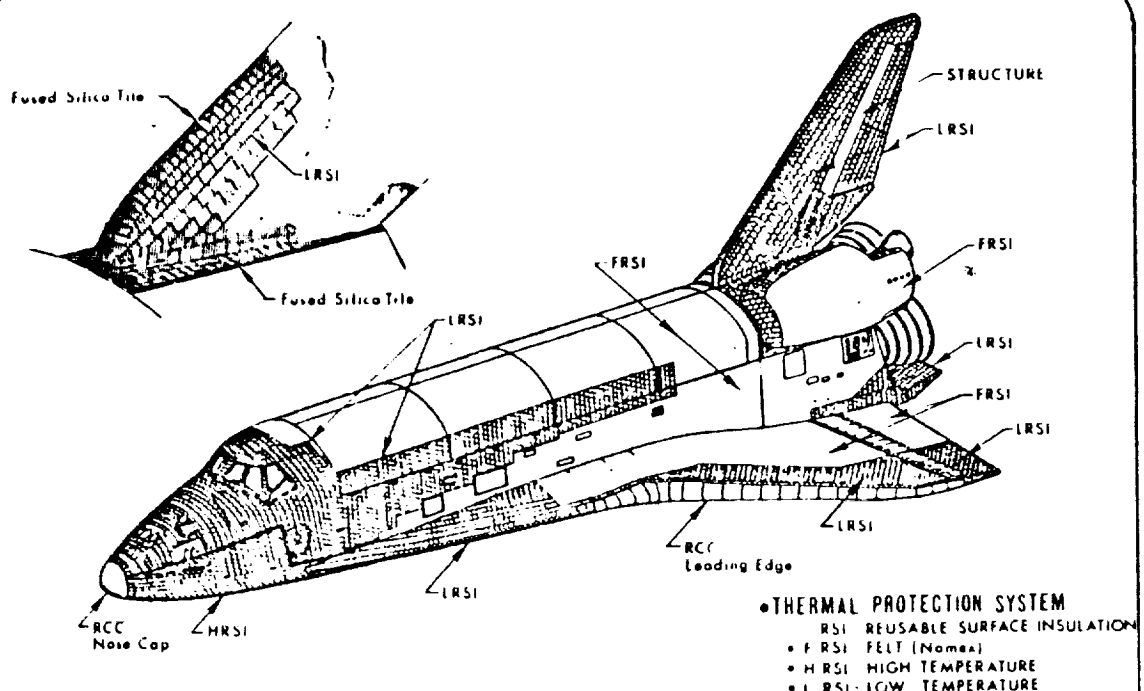


Figure 3.5-1
ORBITER VEHICLE 102

Tile gaps and steps influence the aerodynamic characteristics (particularly drag) as shown in Section 4.0 (where applicable). Orbiter moldline criteria are shown in Figure 3.5-2. A more detailed description of the TPS can be found in Reference 3-3.

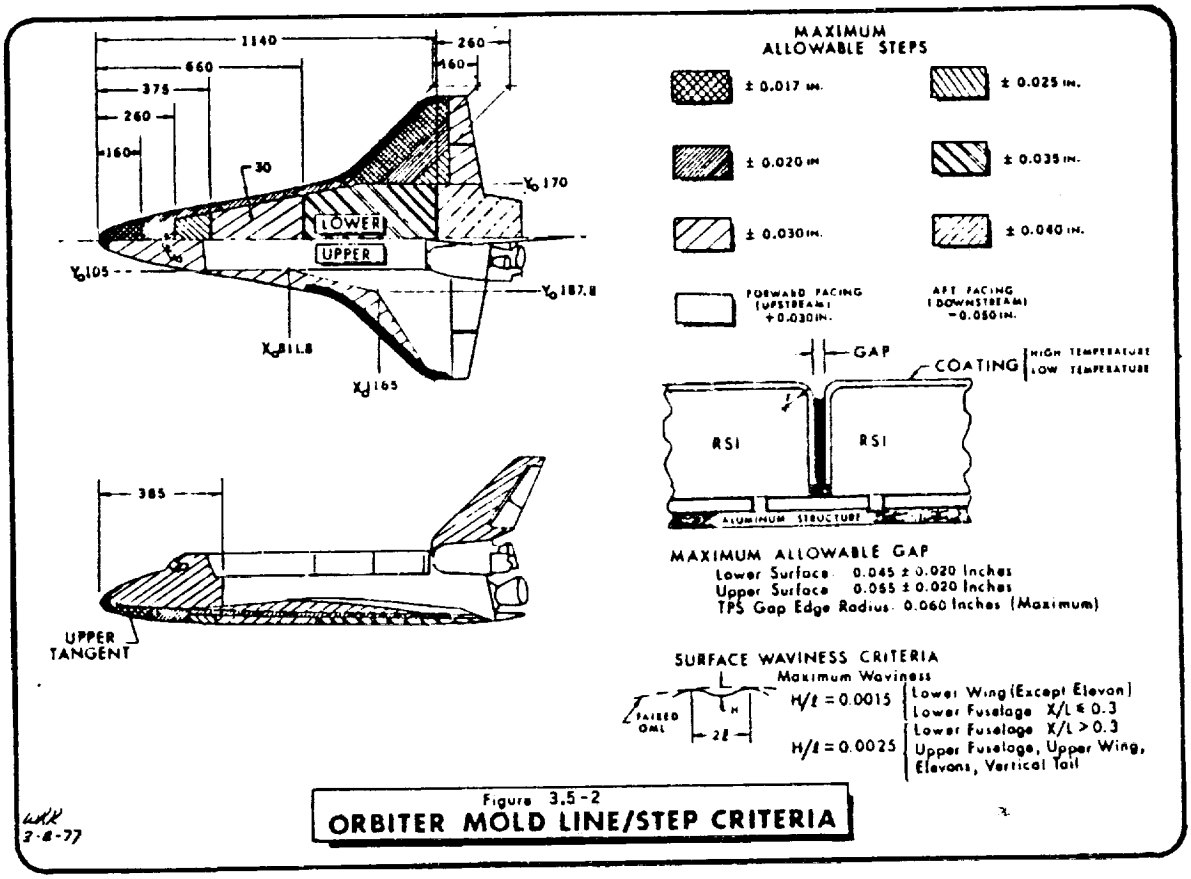
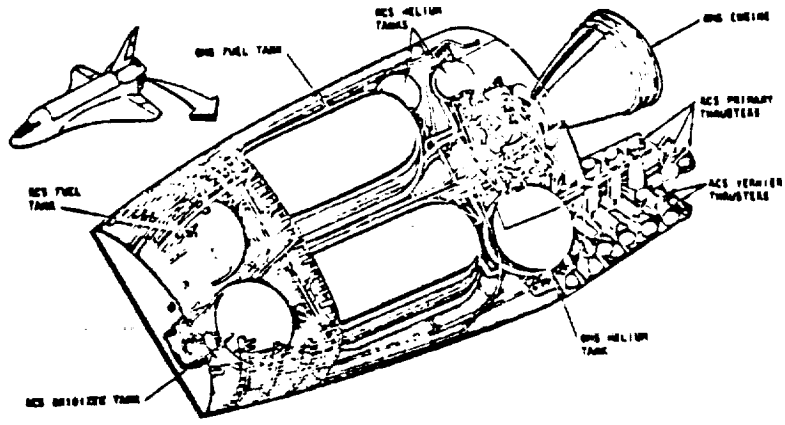
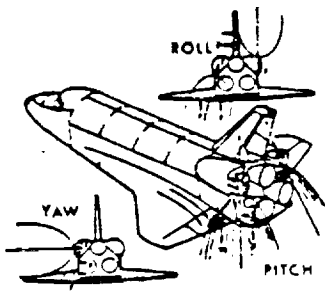


Figure 3.5-2
ORBITER MOLD LINE/STEP CRITERIA

3.6 REACTION CONTROL SYSTEM. Attitude control of the Orbiter during entry is provided by the aft reaction control system (RCS) in roll and pitch up to dynamic pressure levels of 10 and 20 psf, respectively. The RCS thrusters are located in the OMS pods as shown in the sketch. For dynamic pressure levels exceeding 20 psf, sufficient elevon (elevator-aileron) control authority is available and the roll and pitch thrusters are deactivated. The blanketing effect of the wing at high angles of attack necessitates the use of yaw thrusters to augment the rudder control until the angle of attack is reduced to approximately ten degrees. Aft RCS jet/aerodynamic interaction, illustrated in the sketch at left, is discussed in Appendix B and data are presented in Section 4.0 (where applicable).





3.7 AIR DATA SYSTEM. The air data system (ADS) is designed to provide air data relative to the vehicle at altitudes where winds, in conjunction with vehicle speeds, can produce relatively large errors in inertially derived air data. At approximately 100,000 feet of altitude (M ≈ 3.5) two air data probes are extended from the Orbiter forebody (FS 299, WP 324) to sense vehicle flight conditions. One probe is located on each side of the orbiter forebody canted 10 degrees, nosedown, relative to the FRL. The ADS probe is illustrated in Figure 3.7-1. The air data probe is instrumented to measure total temperature (T_T), local static pressure (P_S), and angle of attack from three pressure ports (P_1, P_2, and P_T).

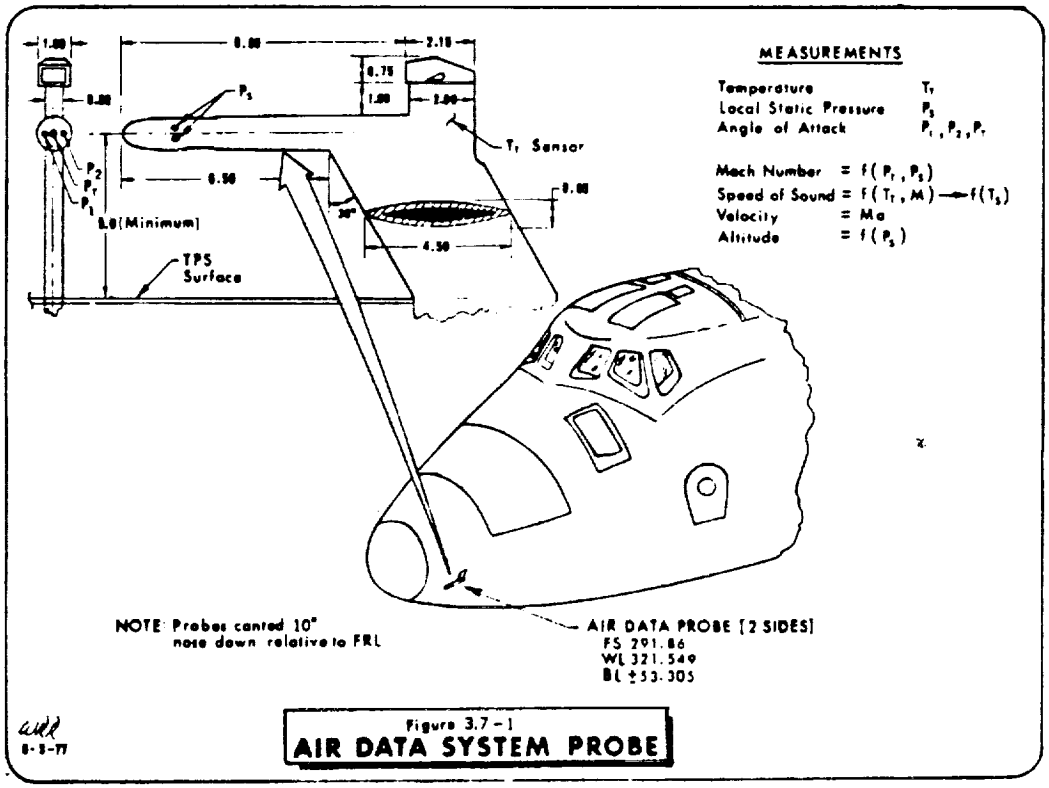


Figure 3.7-1
AIR DATA SYSTEM PROBE

3.8 CREW ESCAPE SYSTEM. The Crew Escape System (CES) is designed to provide safe egress and recovery for two crewmen to a maximum altitude of 75,000 feet. A sketch of the CES is given in Figure 3.8-1 which also provides the aerodynamic sign convention for the man/seat configuration. Free-air and proximity aerodynamic data for use in simulation studies of man/seat motion following ejection are provided in Section 4.3.

Components integral to the CES are two rocket-powered ejection seats mounted side-by-side and two ejection panels integral with the overhead structure. The ejection seats have powered, integrated, torso restraint harness systems utilizing single release controls with stabilization drogue parachute systems. The overhead ejection panels are equipped with a pyrotechnic train for severing the inner and outer crew module structure and the outer structure of the forward fuselage to provide an unobstructed path for the man/seat. The hatches are also equipped with thrusters and hinges necessary to propel the hatches clear of the man/seat trajectory. OV102 also includes a ballistic guillotine for severing overhead displays and controls electrical cable.

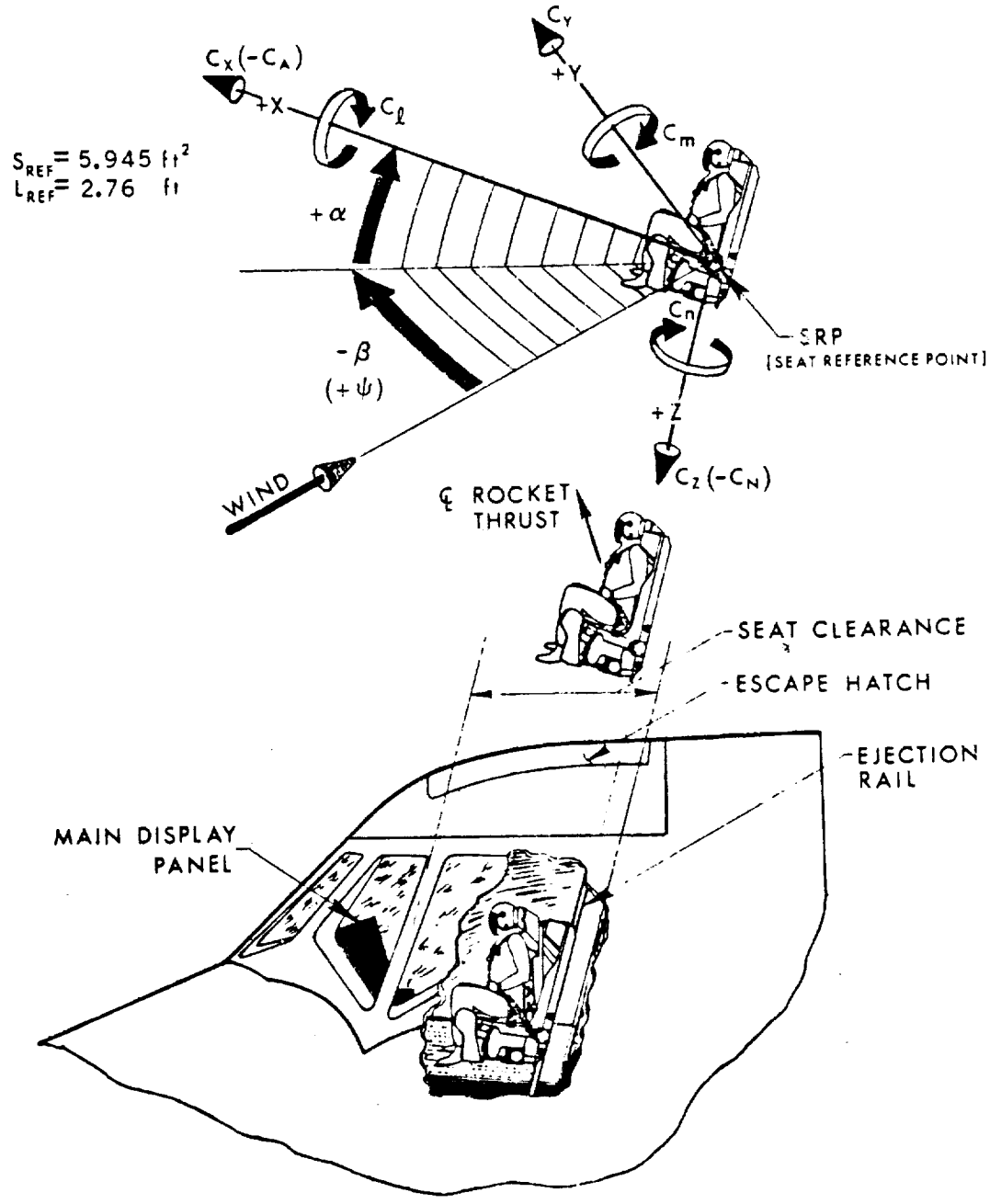


Figure 3.8-1
CREW ESCAPE SYSTEM

WRR
6-15-77

3.9 SHUTTLE INFRARED LEESIDE TEMPERATURE SENSING. The Shuttle Infrared Leeside Temperature Sensing (SILTS) experiment is designed to obtain detailed temperature maps of the Orbiter Vehicle wing and fuselage upper surface for the entire entry heating period. The experiment is located in the SILTS fin tip assembly which replaces the baseline Orbiter fin tip. The forward portion is a hemispherical dome containing two double-pane windows for viewing forward and to the lift-side of the Orbiter. The dome contains window covers and a window cooling system. The exterior surface of the SILTS fin tip is covered with high-temperature reusable surface insulation (HRSI) tiles. During entry the IR camera is positioned alternately at the two windows at seven-second intervals. The objective of the experiment is to identify areas where reductions in TPS weight might be realized. Figure 3.9-1 presents a sketch of the experiment.

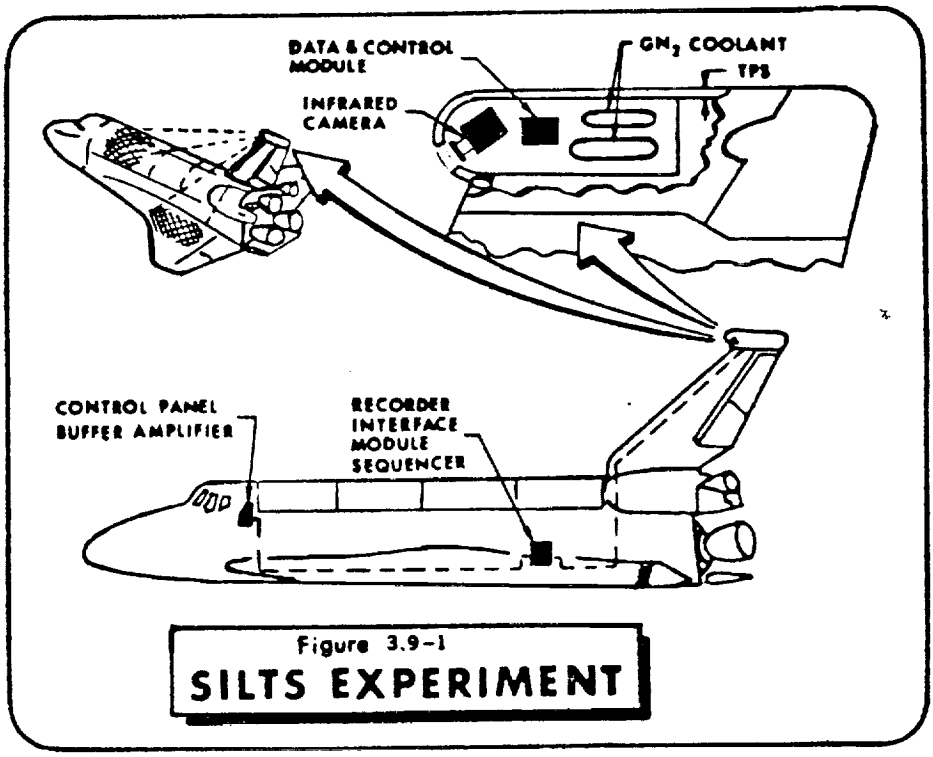


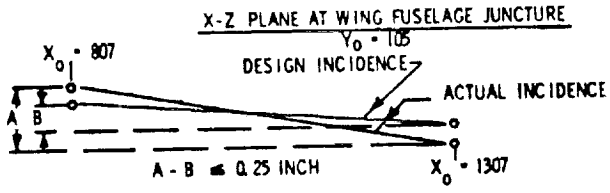
Figure 3.9-1
SILTS EXPERIMENT

3.10 MASS PROPERTIES. Mass properties data for the Orbiter Vehicle should be obtained from current Space Shuttle Mass Properties Status Reports for the Orbiter Vehicle. These status reports are Rockwell International, Space Division reports and are published monthly (e.g., see Reference 3-4).

3.11 SURFACE DESIGN REQUIREMENTS. The aerodynamic integrity of the Orbiter Vehicle is dependent on the efficiency of all surfaces exposed to the air flow such that surface design requirements are critical to the definition of the vehicle aerodynamic characteristics. The allowable aerodynamic surface alignments, Outer Mold Line (OML) fairing and smoothness requirements, and the sealing requirements which established deviations affecting both aerodynamic and aerothermodynamic characteristics of the Orbiter Vehicle are discussed in this subsection.

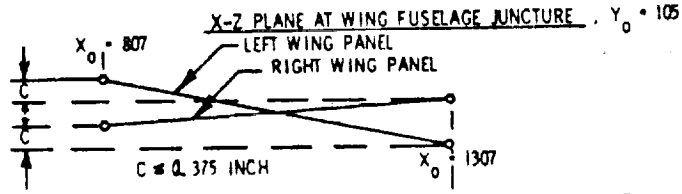
Aerodynamic surface alignments are outlined below.

WING INCIDENCE TOLERANCE



	CRITERIA	RATIONALE
● MAXIMUM ALLOWABLE WING INCIDENCE TOLERANCE AT WING-FUSELAGE JUNCTURE FOR THE LEADING EDGE ELEMENT RELATIVE TO THE TRAILING EDGE ELEMENT (FUSELAGE AND WING SUPPORTED IN MATING TOOLING)	≤ 0.25 INCH	MAINTAIN ACCEPTABLE IMPACT ON ELEVON REQUIREMENTS* DUE TO STRUCT. MISALIGNMENTS

WING DIFFERENTIAL INCIDENCE TOLERANCE

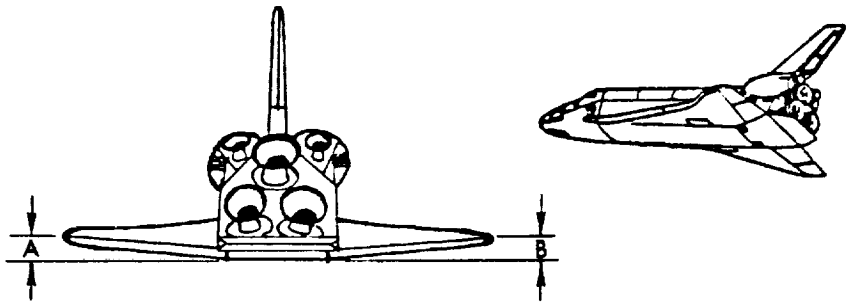


	CRITERIA	RATIONALE
● MAX ALLOWABLE DIFFERENTIAL INCIDENCE BETWEEN THE LEFT AND RIGHT WING PANELS AT THE WING-FUSELAGE JUNCTURE (VEHICLE SUPPORTED IN TOOLING JIG)	≤ 0.375 INCH FOR THE LEADING EDGE ELEMENT OF ONE PANEL RELATIVE TO THE TRAILING EDGE ELEMENT FOR THE OTHER PANEL	MINIMIZE DEGRADATION OF AILERON EFFECTIVENESS DUE TO STRUCTURAL MISALIGNMENT

WING'S DIFFERENTIAL INCIDENCE TOLERANCE EQUALS LEFT WING'S INCIDENCE TOLERANCE MINUS RIGHT WING'S INCIDENCE TOLERANCE OR,

$$C = (A-B)_{\text{LEFT WING}} - (A-B)_{\text{RIGHT WING}}$$

DIFFERENTIAL DEFLECTION OF WING TIPS

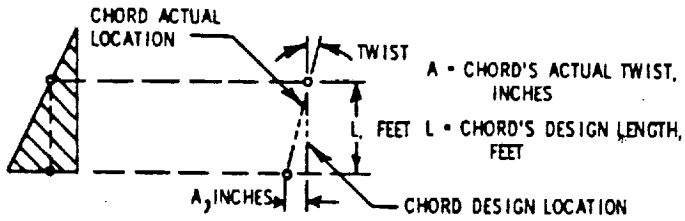


$A - B \leq 1.0$ Inch

MAXIMUM DIFFERENTIAL DEFLECTION OF WING TIPS (FUSELAGE AND WING SUPPORTED IN MATING TOOLING)

RATIONALE: MINIMIZE ASYMMETRIC LIFT & ROLL

MAXIMUM ALLOWABLE TWIST TOLERANCE



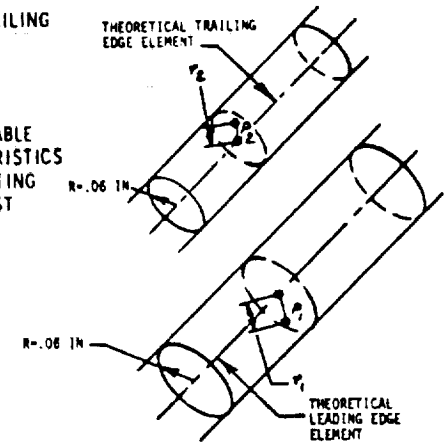
LIFTING SURFACE TWIST TOLERANCE = $\frac{A}{L}$, INCHES/FOOT

	CRITERIA	RATIONALE
● MAXIMUM ALLOWABLE TWIST TOLERANCE FOR ANY LIFTING SURFACE (WING OR TAIL) (VEHICLE IN TOOLING JIG)	≤ 0.005 INCH PER FOOT	MAINTAIN SURFACE AERO EFFICIENCY AND REDUCE CONTROL REQUIREMENTS
● THE MAXIMUM ALLOWABLE DIFFERENTIAL TWIST TOLERANCE PER 12 INCH SPANWISE DISTANCE (VEHICLE IN TOOLING JIG)	≤ 0.005 INCH PER FOOT	↓

ERROR IN LOCATION OF LEADING AND TRAILING EDGES

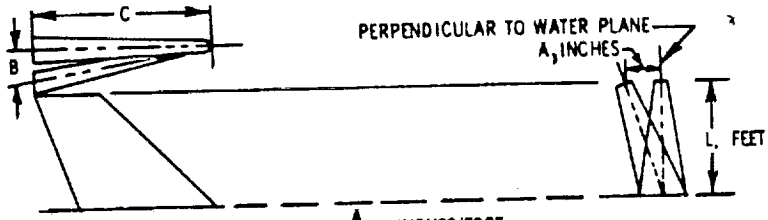
ERROR IN LOCATION OF LEADING AND TRAILING EDGES

CRITERIA	RATIONALE
● ACTUAL L.E. ELEMENT SHOULD LIE WITHIN AN 0.06 INCH-RADIUS CYLINDER FROM THE DESIGN LEADING EDGE ELEMENT	PROVIDE ACCEPTABLE AERO CHARACTERISTICS WITHOUT IMPACTING WEIGHT AND COST
● ACTUAL T.E. SHOULD LIE WITHIN 0.06 INCH-RADIUS CYLINDER FROM THE THEORETICAL TRAILING EDGE	
● REQUIREMENTS CHECKED AFTER LEADING AND TRAILING EDGE ASSEMBLIES HAVE BEEN FULLY FASTENED TO CENTER SECTION OF THE SURFACE	



p_1 = LOCATION OF A POINT ON ACTUAL LEADING EDGE ELEMENT
p_2 = LOCATION OF A POINT ON ACTUAL TRAILING EDGE ELEMENT
r_1 = DEVIATION ERROR OF p_1 IN INCHES
r_2 = DEVIATION ERROR OF p_2 IN INCHES
R = MAXIMUM ALLOWABLE DEVIATION ERROR

VERTICAL TAIL CANT AND INCIDENCE TOLERANCE



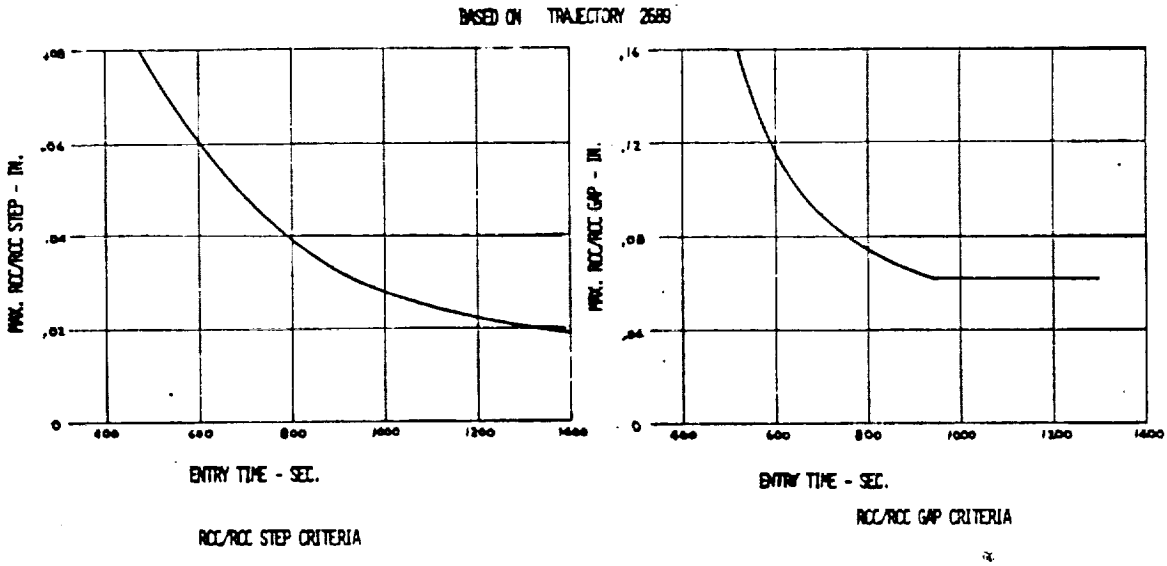
CANT TOLERANCE = $\frac{A}{L}$, INCHES/FOOT

INCIDENCE TOLERANCE = $\frac{B}{C}$, INCHES/FOOT

	CRITERIA	RATIONALE
● MAXIMUM ALLOWABLE VERTICAL TAIL CANT (VEHICLE IN TOOLING JIG)	≤ 0.025 INCH PER FOOT	MAINTAIN VERTICAL TAIL AERO EFFICIENCY AND REDUCE CONTROL REQUIREMENTS
● MAXIMUM ALLOWABLE INCIDENCE TOLERANCE OF THE VERTICAL TAIL (VEHICLE IN TOOLING JIG)	≤ 0.0125 INCH PER FOOT	

The aerothermodynamic criteria pertaining to surface discontinuities and waviness are based on aerodynamic efficiency requirements of lifting surfaces and the prevention of premature transition from laminar to turbulent boundary layers during the high heating portion of entry. The prevention of premature separation of the boundary layer on all fixed and movable lifting surfaces is also important. Aerodynamic efficiency is affected to a much greater extent by surface conditions over forward regions of components rather than aft regions. Tolerance criteria are, therefore, generally more severe for forward sections of the vehicle surfaces and are somewhat relaxed for aft portions.

Surface discontinuities consist of steps and gaps. A step is an abrupt deviation from the faired contour; e.g., a lap joint ( ). The tolerance for a forward facing step is generally the same as for a rearward facing step unless specifically noted otherwise. The step requirements (cf. Figure 3.5-2) apply to all surface irregularities which have a dimension normal to the OML except RCC areas. RCC step and gap criteria are shown below based on trajectory 2689.



A gap is defined as an abrupt negative deviation from a faired contour followed by an abrupt positive deviation such as is caused by a poorly matched butt joint ( ) or spaces between TPS tiles. TPS gap criteria are outlined below and apply to all surface gaps with the exception of RCC areas (given above) and control surface gaps. Gaps shall not allow any increase in air leakage.

TPS GAP CRITERIA (PRE-FLIGHT)

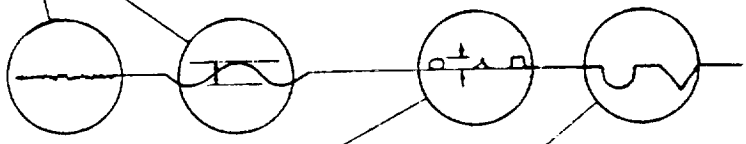
- BASIC REQUIREMENT: MINIMIZE GAP WIDTH AT THE AERODYNAMIC SURFACE
- LOWER SURFACE: 0.045 ± 0.020 INCHES
  (BELOW A LINE: $X_{0_1} = 238$, $Z_0 = 336$ TO $X_0 = 582$, $Z_0 = 320$
  AND $X_0 > 582$, $Z_0 = 320$; LOWER SURFACE OF WING;
  GLOVE L.E. TO LRSI; UPPER AND LOWER BODY FLAP;
  BASE HEAT SHIELD)
- UPPER SURFACES: 0.055 ± 0.020 INCHES (ALL SURFACES NOT DEFINED ABOVE)
- TILE PATTERNED SO THAT NO GAPS ARE ALIGNED WITH LOCAL SURFACE STREAMLINES DURING ENTRY
- TPS GAP EDGE RADIUS: 0.06 INCHES (MAXIMUM)

A wave is defined as a smooth variation from a faired contour. The wave height (H) is the distance measured normal to the surface between a low point on the surface and an adjacent high point. The wavelength (2ℓ) is twice the distance from a low point on the surface to an adjacent high point. (Refer to Figure 3.5-2 for maximum allowable gaps and surface waviness criteria.) The waviness requirement applies to all external surfaces.

The master lines OML fairing requirements permit no reflex fairing on lower surfaces. Reflex fairing is permitted on upper surfaces. Continuous second derivatives of equations defining the surface of the lower forward fuselage are required. The maximum manufacturing fairing deviation from the theoretical fairing is ±0.06 inch consistent with the OML smoothness requirements, TPS thickness requirements, and aerodynamic surface alignment requirements. Maximum surface irregularities, including RMS surface finish, are defined below.

MICRO SURFACE FINISH CRITERIA DURING ENTRY

- APPLIES TO ALL EXTERNAL SURFACES (HRSI, LRSI, FRSI, RCC, AND METALLIC TPS)
- DEFINITION OF MAXIMUM ALLOWABLE SMALL SCALE IRREGULARITIES
  - 300 μ IN. RMS SURFACE FINISH
  - 0.002 IN. AMPLITUDE SMALL SCALE WAVINESS (IN ANY DIRECTION)



- PROTUBERANCES 0.001 IN.
- HOLES, SCRATCHES, CRACKS 0.005 IN. WIDTH
  0.005 IN. DEPTH

Penetration criteria during entry are outlined below.

- NOSE LANDING GEAR DOOR OML
  - STEPS - ± 0.017 IN. MAXIMUM ANY DIRECTION
  - LONGITUDINAL GAPS - 0.054 IN. WIDE X 0.054 IN. DEEP OR EQUIVALENT AREA, ONE GAP PER DOOR INTERFACE
  - TRANSVERSE GAPS - 0.046 ± 0.020 IN. (FILLED WITH HIGH PRESSURE GRADIENT THERMAL BARRIER)
- FORWARD EXTERNAL TANK ATTACHMENT OML
  - STEPS - ± 0.017 IN. MAXIMUM
  - GAPS - 0.090 IN. MAXIMUM (BASED ON 3.0 IN. MAXIMUM CIRCLE DIAMETER)

Surface irregularities due to protuberances such as air data probes, umbilical attachment, vents, and nozzle ports must be assessed on an individual basis. Such items are shown on Figure 3.11-1 and are assessed in Section 4.1 (Table 4.1-1).

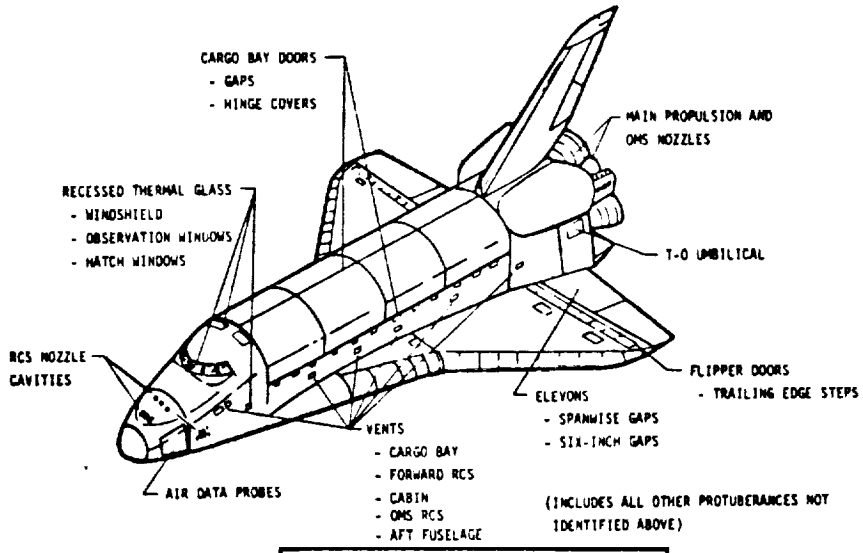


Figure 3.11-1
PROTUBERANCE ITEMS REQUIRING SPECIAL TREATMENT

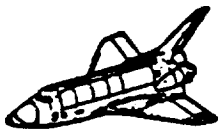
The prevention of unprogrammed air leakage from inside the Orbiter or through lifting surfaces is important in maintaining lift effectiveness and minimum total drag. An unsealed surface has more profile drag and drag-due-to-lift than a sealed surface.

OUTER MOLD LINE SEALING REQUIREMENTS DURING ENTRY

- TPS ACREAGE
  - SEALED (SEALING BENEATH RSI IS ACCEPTABLE FOR LOW PRESSURE GRADIENT REGIONS, HIGH SURFACE PRESSURE GRADIENT REGIONS REQUIRE OML THERMAL BARRIERS)
- TPS ACREAGE PENETRATION INTERFACES (ACCESS PANELS, DOORS, HATCHES, VENTS, WINDOWS, MODULES, THRUSTERS, DUMPS, AND DRAINS)
  - 0.003 IN^2/IN OF INTERFACE MAXIMUM INTO COMPARTMENTS (NO CONCENTRATED HOLES ALLOWED)
- RCC/HRSI INTERFACES - WING LEADING EDGE AND ORBITER NOSE
  - LOWER SURFACE SEALED WITH THERMAL BARRIER (EQUIVALENT LEAK AREA 0.010 IN^2/IN SPAN, REQUIREMENT FOR RCC ATTACHMENT AREAS TBD)
  - UPPER SURFACE AREA TO BE LESS THAN 0.065 IN^2/IN AND GREATER THAN 0.035 IN^2/IN.
- RCC/RCC INTERFACES
  - LOWER SURFACE - NO INTENTIONAL LEAKS (OVERLAPPING EXPANSION JOINTS ALLOWED)
  - UPPER SURFACE - 0.015 IN^2/IN MAXIMUM, 0.013 IN^2/IN MINIMUM VENT GAPS
- RSI TPS GAPS MUST BE FILLED IN ALL HIGH SURFACE PRESSURE GRADIENT REGIONS
  - FUSELAGE CHINE, WING GLOVE, VERTICAL STABILIZER LEADING EDGE, WINDOW FRAMES, ALL TRAILING EDGES, ELEVON COVE, VERTICAL TAIL/RUDDER COVE, BODY FLAP COVE, ETC.

CONTROL SURFACE SEALING REQUIREMENTS DURING ASCENT AND ENTRY (ORBITER 102 AND SUBS)

SEAL LOCATION	DESIGN REQUIREMENT	
	IN^2/IN SPAN MAX.	IN^2/IN SPAN MIN.
· WING/ELEVON		
· LOWER SURFACE AND END SEALS	0.003 (TOTAL COVE LEAK)	0
· UPPER SURFACE		
· FLIPPER DOOR FORWARD SEAL	0.003	0
· FLIPPER DOOR TOTAL EQUIVALENT LEAKAGE AREA (INCLUDES TRAILING EDGE, PANEL TO PANEL, ETC.	0.003	0
· BODY FLAP		
· LOWER SURFACE AND END SEALS	0.003	
· UPPER SURFACE	0.5 AND 3.0 INCH MINIMUM COVE OVERLAP	0.038
· VERTICAL STABILIZER/RUDDER/SPEED BRAKE		
· VERTICAL STAB./RUDDER	0.003	0
· SPEED BRAKE/SPEED BRAKE (CLOSED POSITION)		
· TRAILING EDGE - THERMAL BARRIER	0.003	0
· STREAMWISE EDGES	REQUIRE PRESSURE SEAL	REQUIRE PRESSURE SEAL



4.0 AERODYNAMIC DATA

This section contains the Orbiter Vehicle Aerodynamic data to be used for entry trajectory analyses, subsystem design and analyses, flight control analyses, and manned simulation studies. The data presented herein represent the best available predictions of the full-scale flight characteristics of the Orbiter Vehicle.

The aerodynamic characteristics are presented in a form which will allow a *build-up* to any desired configuration and/or flight condition by incremental addition to the basic coefficient. Longitudinal characteristics are presented for both body-axis and stability-axis systems. Lateral-directional characteristics are presented in the body-axis system only. Aeroelastic data, assuming a quasi-static vehicle, and the effects of hypersonic and high altitude are also provided. Prescribed use of the data is to begin with the altitude table (or convert to the viscous parameter, $\bar{V}_\infty^1$) down to 300,000 feet ($\bar{V}_\infty^1 = 0.08$), use viscous parameter tables to a value of 0.005, and transition to the Mach number tables. Altitude may be converted to viscous parameter by use of Figure 4.0-1 (see also Appendix C). Where additional information is considered desirable, explanatory material has been provided in Appendices.

These data are given in the following subsections:

4.1 LONGITUDINAL AERODYNAMIC CHARACTERISTICS

4.2 LATERAL-DIRECTIONAL AERODYNAMIC CHARACTERISTICS

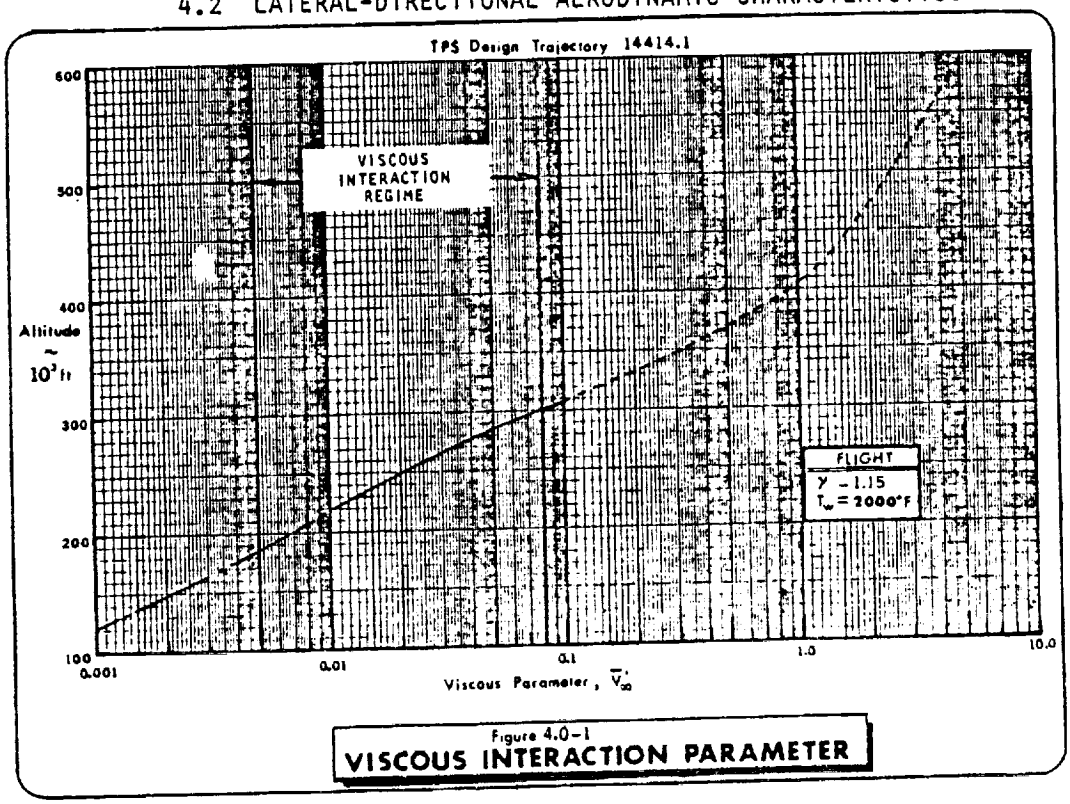


Figure 4.0-1
VISCOUS INTERACTION PARAMETER

4.1 LONGITUDINAL AERODYNAMIC CHARACTERISTICS. Aerodynamic characteristics pertaining to the longitudinal degrees of freedom are presented as full-scale rigid and elastic force and moment coefficients. The longitudinal aerodynamic coefficients are presented in the following subsections:

4.1.1 BODY AXIS DATA

4.1.2 STABILITY AXIS DATA

Each subsection is then divided into the pertinent coefficients which are considered separately and prefaced by the appropriate equation for obtaining the total coefficient for any selected flight condition. Each element of the equation is defined and referenced to its associated figure (or table) for obtaining the corresponding numerical values, which comprise the remainder of the subdivisions.

The aerodynamic data are based on wind tunnel test data involving scale models at various attitudes, Reynolds numbers, and Mach numbers. The aerodynamic axial and drag force coefficients have been based on wind tunnel test data of the 140A/B and 140C scale models having six-inch (full-scale) elevon gaps and the short OMS pods. The data have been corrected for Reynolds number (skin friction) along the TPS design trajectory (14414.1) as shown in Figure 4.1-1. Skin friction drag and forebody axial force coefficients are shown on Figure 4.1-2. Corrections for outer-mold-line (OML) surface conditions (TPS tiles and protuberances) are also included as shown in Table 4.1-1 and Figure 4.1-3. Base drag characteristics were computed using wind tunnel test measurements of fuselage base pressure as given in Figure 4.1-4.

Figure 4.1-1
FLIGHT REYNOLDS NUMBER

Figure 4.1-2
SKIN FRICTION DRAG & FOREBODY AXIAL FORCE

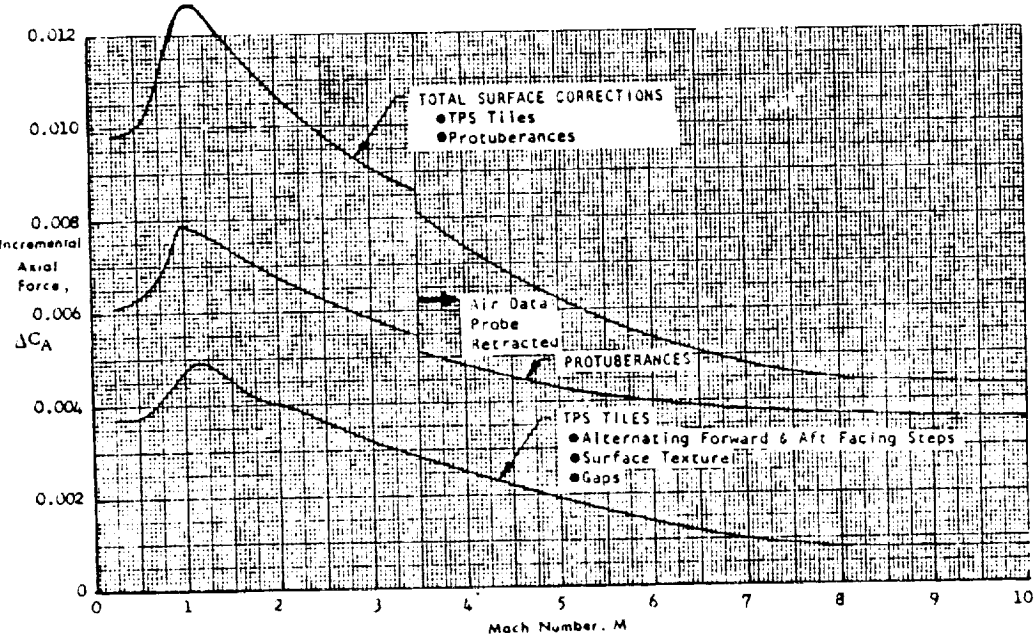


Figure 4.1-3
SURFACE IRREGULARITIES

Table 4.1-1
PROTUBERANCE AND TPS ROUGHNESS DRAG

ITEM	MACH NUMBER														
	0.25	0.60	0.80	0.90	0.95	1.05	1.10	1.20	1.30	1.50	2.0	3.0	4.0	5.0	8.0	10.0 to end of mission
	DRAG COUNTS (1count = 0.0001)															
PROTUBERANCES*													{For M>3.5, Probes Retracted}			
AIR DATA PROBES																
CREW ESCAPE DOOR HINGE																
RCS NOZZLE PORTS																
RECESSED THERMAL GLASS																
(a) Windshield																
(b) Observation Windows																
(c) Side Hatch Window																
SPANWISE GAPS																
(a) Vertical Tail & Rudder																
(b) Elevon Seal Doors																
(c) Body to Body Flap																
T-O UMBILICAL																
VENTS																
(a) Cargo Bay													{All Vents closed for M>1.52}			
(b) Forward RCS																
(c) Cabin																
(d) OMS RCS																
(e) Aft Fuselage																
SUBTOTAL	61.17	64.47	70.81	75.99	78.46	78.54	77.66	77.04	75.99	73.92	67.53	58.81	48.58	43.59	36.34	35.35
TPS ROUGHNESS (STEPS & GAPS)																
TOTAL	98.2	102.5	113.8	121.0	124.5	126.5	126.7	126.0	124.0	118.9	107.5	90.8	73.6	62.8	44.3	43.4

*Reference Drawings: VL70-009028 Rev. "G" - TPS Penetration Diagram - Double Delta, Lightweight Orbiter, MCR 0200R6 Baseline 6/11/74
VC70-004002 - Mid-Fuselage Active Vent System, Structural Skin Cutout Interface
VC70-000007 - Requirements - Orbiter Vent System - Non-Pressured Compartments

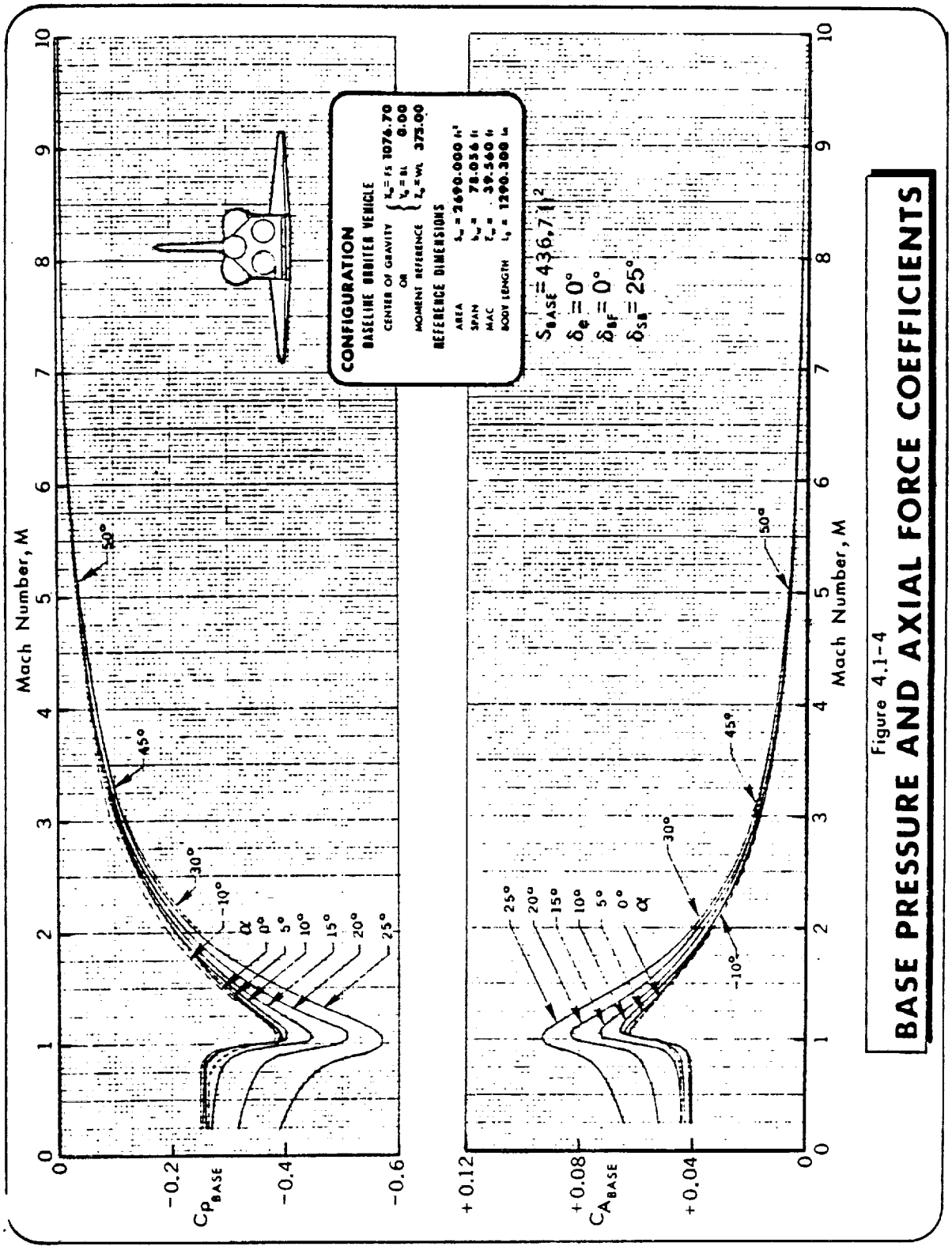


Figure 4.1-4

BASE PRESSURE AND AXIAL FORCE COEFFICIENTS

$$\Delta C_{A_{BASE}\delta_{SB}} = C_{A_{BASE}\delta_{SB}=\delta_{SB}} - C_{A_{BASE}\delta_{SB}=25°}$$

$S_{REF} = 2690\ ft^2$
$S_{BASE} = 436.7 ft^2$

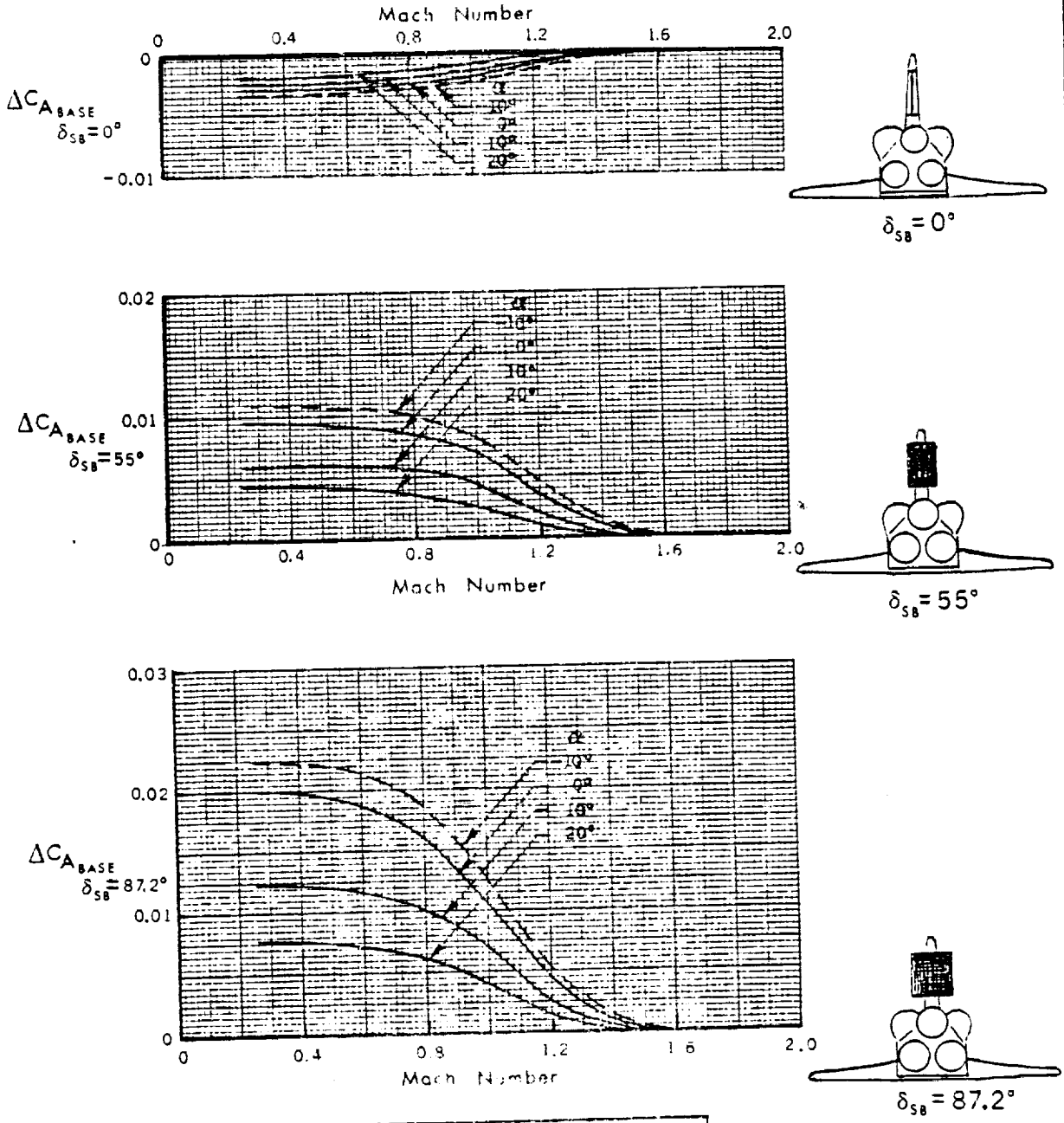


Figure
EFFECT OF SPEEDBRAKE

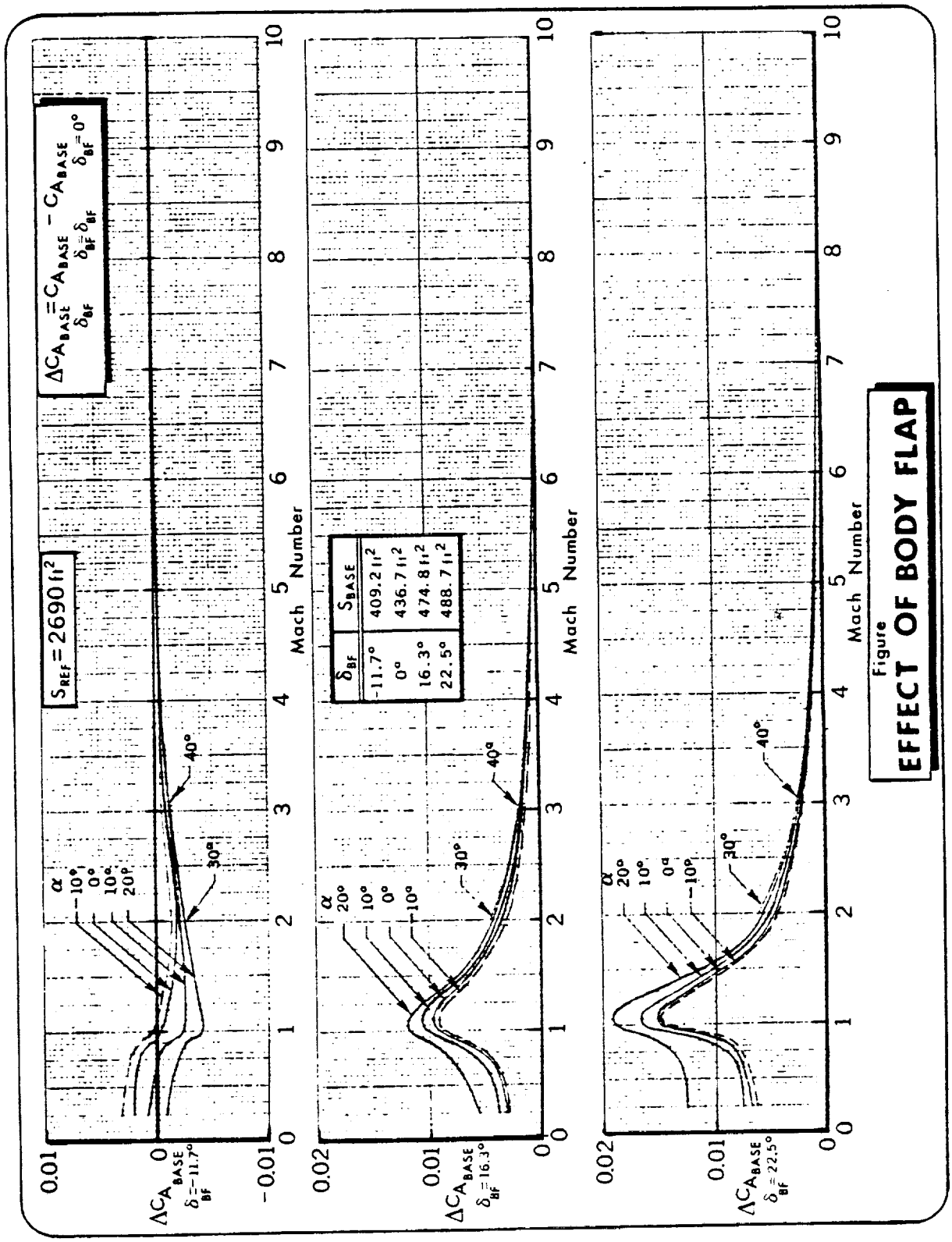


Figure
EFFECT OF BODY FLAP

4.1.1 BODY AXIS DATA. The longitudinal aerodynamic characteristics in the body axis system are:

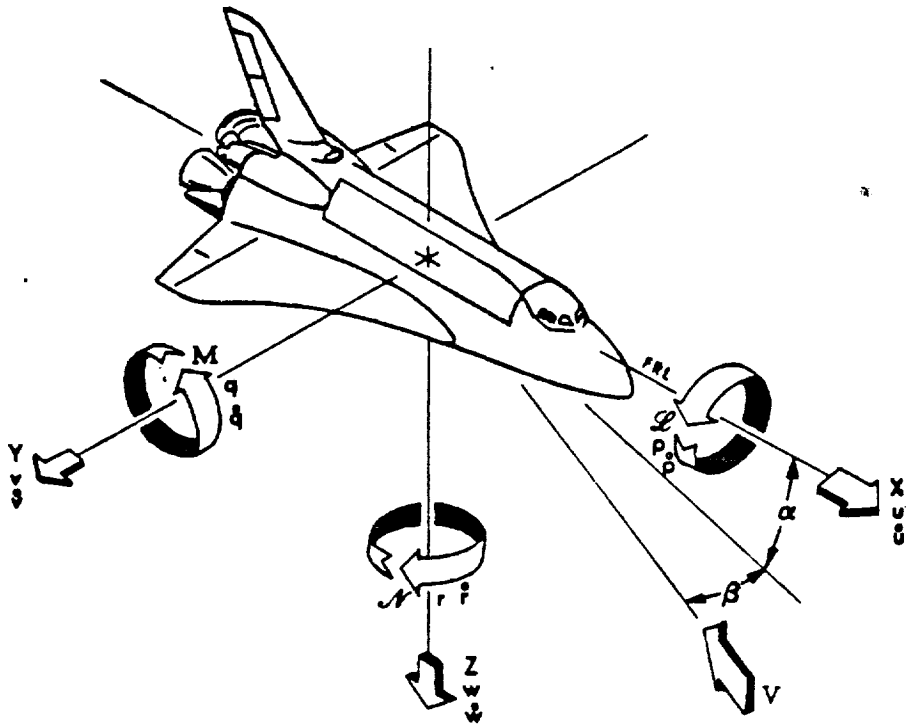
4.1.1.1 NORMAL FORCE COEFFICIENT

4.1.1.2 AXIAL FORCE COEFFICIENT

4.1.1.3 PITCHING MOMENT COEFFICIENT

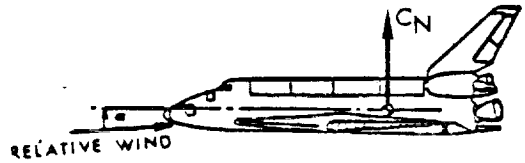
4.1.1.4 TRIM AND STABILITY

The pertinent equation for obtaining the total coefficient for any given flight condition precedes the presentation of data. Each element of the equation is defined and referenced to the appropriate figures and/or tables for obtaining the corresponding numerical values. Where additional information is considered beneficial (e.g., aeroelastic deformation, hypersonic viscous interaction, and RCS impingement), Appendices have been included for reference.



BODY AXIS SYSTEM

4.1.1.1 NORMAL FORCE COEFFICIENT. The Orbiter Vehicle aerodynamic normal force coefficient is defined in this section. The basic aerodynamic normal force coefficient data are presented in three forms: 1) as a function of angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty^1$) from 0.005 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet through 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.1.1.1]. Uncertainties associated with the normal force characteristics are available in Section 6.0



The RCS flow field interaction data are presented as a contribution to the normal force (N) rather than the coefficient (C_N) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where the RCS is used in conjunction with the aerodynamic force (cf Section 3.6); i.e., the aerodynamic coefficient must be converted to a dimensional force *before* adding the RCS flow field interaction effect (see also Appendix B).

The total normal force is:

$$N_{TOTAL} = \bar{q}\, S\, C_{N_{\substack{TOTAL \\ AERO}}} + N_{RCS}$$

*The total aerodynamic normal force coefficient is obtained by the following equation:

$$C_{N_{\substack{TOTAL \\ AERO}}} = C_{N_{BASIC}} + [\Delta C_{N_{ELEVATOR}} + \Delta C_{N_{AILERON}}]_{ELEVON} + \Delta C_{N_{\substack{BODY \\ FLAP}}} + \Delta C_{N_{RUDDER}} + \Delta C_{N_{\substack{SPEED \\ BRAKE}}}$$

$$+ C_{N_{\dot{\alpha}}} \frac{\dot{\alpha}\bar{c}}{2V} + C_{N_{\hat{q}}} \frac{q\bar{c}}{2V} + \Delta C_{N_{FLEX}} + \Delta C_{N_{\substack{LANDING \\ GEAR}}} + \Delta C_{N_{\substack{GROUND \\ EFFECT}}} + \Delta C_{N_{\substack{SILTS \\ POD}}}$$

where,

$C_{N_{BASIC}}$ = Basic, full-scale, freestream, rigid body normal force coefficient. (Figures 4.1.1.1-1 through-6)

NOTE: 1. All control surfaces neutral *except* $\delta_{SB} = 25°$

*Refer to Appendix D when using digitized data.

NOTE: The increment presented in Appendix E should be added to the total from above calculations to account for OV102 manufacturing misalignments.

$\Delta C_{N_{ELEVATOR}}$ = Change in normal force coefficient due to elevon (elevator) deflection, δ_e, when inboard and outboard angles are equal. (Figures 4.1.1.1-7 through -36)

NOTE: 1. Partial span factor, K_N, to be used for elevon-body flap interconnect flight system where δ_e is limited to ±5° and inboard and outboard angles are not equal. (Figure 4.1.1.1-37)

$$\Delta C_{N_{e_{\delta_{e_i} \neq \delta_{e_o}}}} = K_N \; \Delta C_{N_{e_{\delta_e = \delta_{e_i}}}} + (1 - K_N) \; \Delta C_{N_{e_{\delta_e = \delta_{e_o}}}}$$

$\Delta C_{N_{AILERON}}$ = Change in normal force coefficient due to aileron deflection, δ_a.

$$= \frac{1}{2}\left[K_{N_{(\delta_{e_L})}} \Delta C_{Ne_{L_I}} + (1-K_{N_{(\delta_{e_L})}}) \Delta C_{Ne_{L_O}} + K_{N_{(\delta_{e_R})}} \Delta C_{Ne_{R_I}} + (1-K_{N_{(\delta_{e_R})}}) \Delta C_{Ne_{R_O}}\right] - \Delta C_{N_{ELEVATOR}}$$

$\Delta C_{N_{BODY\ FLAP}}$ = Change in normal force coefficient due to body flap deflection, δ_{BF}. (Figures 4.1.1.1-38 through -66)

$\Delta C_{N_{RUDDER}}$ = Change in normal force coefficient due to rudder deflection, δ_r. (Assume zero)

$\Delta C_{N_{SPEED\ BRAKE}}$ = Change in normal force coefficient due to speed brake deflection, δ_{SB}. (Figures 4.1.1.1-67 through -93)

$C_{N_{\dot{\alpha}}}$ = Change in normal force coefficient due to rate of change of angle of attack, $\dot{\alpha}$, (per radian).* (Assume zero)

$C_{N_{\hat{q}}}$ = Change in normal force coefficient due to pitch rate, q, (per radian).* (Assume zero)

$\Delta C_{N_{FLEX}}$ = Change in normal force coefficient due to aeroelastic deformation.

$$= \Delta C_{L_{FLEX}} \cos \alpha + \Delta C_{D_{FLEX}} \sin \alpha$$

$\Delta C_{L_{FLEX}}$ = flexible lift increment (cf. Section 4.1.2.1)

$\Delta C_{D_{FLEX}}$ = flexible drag increment (cf. Section 4.1.2.2)

*For rotary derivative transfer equations see NASA SP-3070, "Summary of Transformation Equations and Equations of Motion Used in Free Flight and Wind Tunnel Data Reduction and Analysis," Gainer, T. G., and S. Hoffman, Langley Research Center, Hampton, Virginia (1972).

$\Delta C_{N_{\substack{\text{LANDING}\\\text{GEAR}}}}$ = Change in normal force coefficient due to fully extended landing gear. (Figure 4.1.1.1-94)

$\Delta C_{N_{\substack{\text{GROUND}\\\text{EFFECT}}}}$ = Change in normal force coefficient due to proximity of ground, f(h/b) (Figures 4.1.1.1-95 through -104)

NOTE: 1. See Section 3.4 for ground clearance and scrape attitude.

$\Delta C_{N_{\substack{\text{SILTS}\\\text{POD}}}}$ = Change in normal force coefficient due to addition of SILTS pod.

$= \Delta C_{L_{\substack{\text{SILTS}\\\text{POD}}}} \cos\alpha + \Delta C_{D_{\substack{\text{SILTS}\\\text{POD}}}} \sin\alpha$

$\Delta C_{L_{\substack{\text{SILTS}\\\text{POD}}}}$ = SILTS pod lift increment (cf. Section 4.1.2.1)

$\Delta C_{D_{\substack{\text{SILTS}\\\text{POD}}}}$ = SILTS pod drag increment (cf. Section 4.1.2.2)

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

The effect of the RCS may be described as a dimensional normal force (pounds) in terms of the significant contributing elements by:

$$N_{RCS} = N_{JT} + [N_{SURF} + \Delta N_{ELEVON} + \Delta N_{\substack{\text{BODY}\\\text{FLAP}}}]_{IMP} + \bar{q}\, S[\Delta C_N + \Delta C_{N_{ELEVON}} + \Delta C_{N_{\substack{\text{BODY}\\\text{FLAP}}}} + \Delta C_{N_{\substack{\text{DOWN}\\\text{FIRING}\\\text{CARRYOVER}\\\text{2 SIDES}}}}]_{JI}$$

where,

N_{JT} = Normal force resulting from number (n) of jets being fired (cf. Appendix B)

$= \sum_{OJG} [N_{JET} \cdot n]$ ~ lb

NOTE: 1. OJG = operating jet group
2. Values given in Figure B-1 are for reference only

$N_{\substack{\text{SURF}\\\text{IMP}}}$ = Normal force resulting from jet impingement on OV surface(s). (Figure 4.1.1.1-105)

$= \sum_{OJG} [N_{\substack{\text{SURF}\\\text{IMP}}} \cdot \quad n \quad]$ ~ lb

$\Delta N_{\substack{ELEVON \\ IMP}}$ = Change in normal force due to effect of impingement on elevon effectiveness. (Figure 4.1.1.1-106)

$$= \sum_{OJG} \left[\frac{\partial N}{\partial \delta_e} \delta_e \cdot \quad n \right] \sim lb$$

$\Delta N_{\substack{BODY \\ FLAP \\ IMP}}$ = Change in normal force due to effect of impingement on body flap effectiveness. (Figure 4.1.1.1-107)

$$= \sum_{OJG} \left[\frac{\partial N}{\partial \delta_{BF}} \delta_{BF} \cdot \quad n \right] \sim lb$$

$\Delta C_{N_{JI}}$ = Change in normal force coefficient due to jet interaction. (Figures 4.1.1.1-108 through -110)

$$= \sum_{OJG} [\Delta C_{N_{JI}}]$$

$\Delta C_{N_{\substack{ELEVON \\ JI}}}$ = Change in normal force coefficient due to jet interaction on elevon effectiveness.

$$= \sum_{OJG} \left[(\Delta C_N)_{\delta_{e_{REF}}} \left(\frac{\delta_e}{\delta_{e_{REF}}} \right)^{0.75} \right]$$

NOTE: 1. Down-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.1-111)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.1-112)

2. Side-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.1-113)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.1-114)

3. Up-firing jets (No effect)

$\Delta C_{N_{\substack{\text{BODY FLAP} \\ JI}}}$ = Change in normal force coefficient due to jet interaction on body flap effectiveness.

$$= \sum_{OJG} \left[(\Delta C_N)_{\delta_{BF}} \left(\frac{\delta_{BF}}{\delta_{BF_{REF}}} \right)^{0.75} \right]$$

(Figure 4.1.1.1-115)

NOTE: 1. Down-firing jets
$\delta_{BF} < 0°$, $\delta_{BF_{REF}} = -14.25°$
$\delta_{BF} > 0°$ (No effect)
2. Side-firing jets (No effect)
3. Up-firing jets (No effect)

$\Delta C_{N_{\substack{\text{DOWN FIRING CARRYOVER} \\ JI \\ \text{2 SIDES}}}}$ = Effect of carry-over between left- and right-down firing jet groups due to jet interaction.

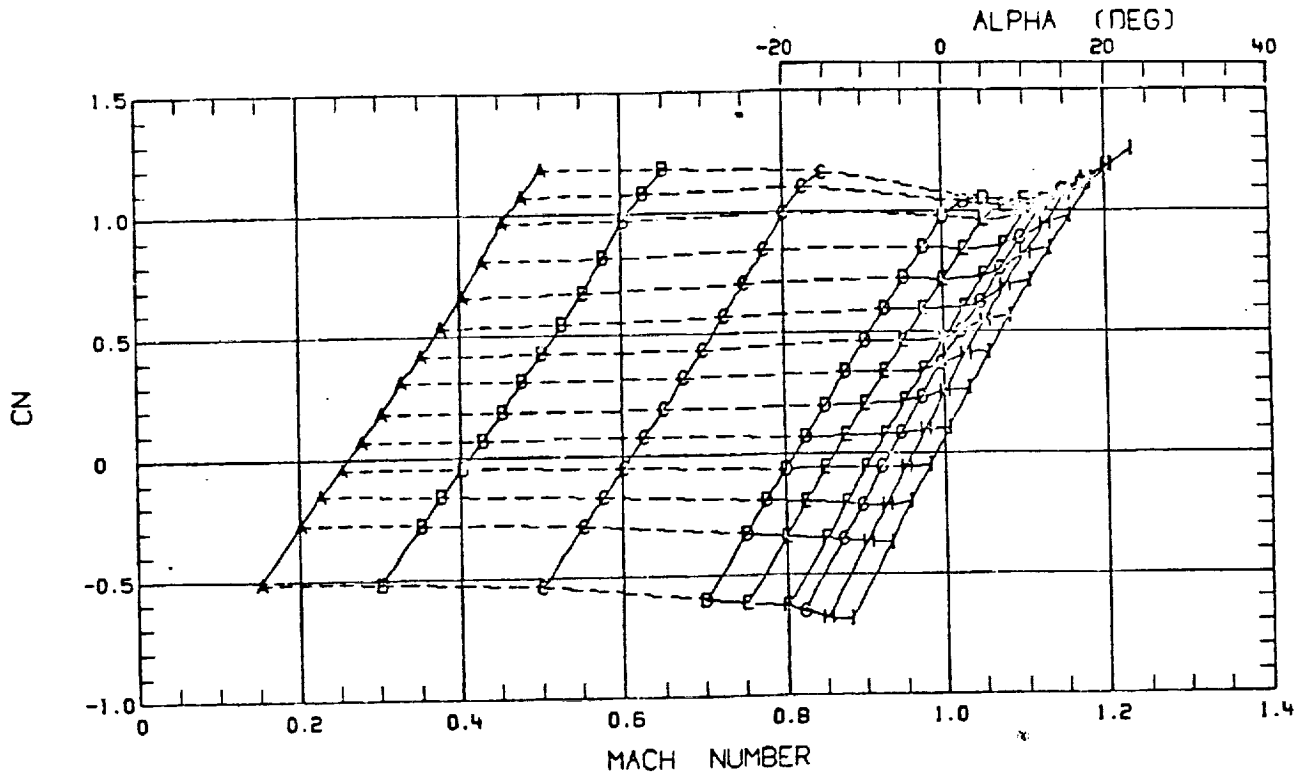
(Figure 4.1.1.1-116)

$$= \left[\frac{\partial \Delta C_{N_{JI}}}{\partial (\phi_j/\phi_\infty)} \right] \left[\overline{(\phi_j/\phi_\infty)} \right]$$

NOTE: 1. $\phi_j/\phi_\infty = (0.1543/\bar{q}_\infty)n$
2. This term is zero when down-firing jet group is inoperative on one side.
3. $\overline{(\phi_j/\phi_\infty)} = \frac{1}{2} \left[(\phi_j/\phi_\infty)_{LD} + (\phi_j/\phi_\infty)_{RD} \right]$

where: $0 < \overline{(\phi_j/\phi_\infty)} < 0.03$

The total RCS effect, N_{RCS}, during thrust build-up and decay is obtained by reducing the full thrust value by the ratio of momentary thrust (see Ref. 4-3) to full thrust.



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	0.250 A	0.400 B	0.600 C	0.800 D	0.850 E	0.900 F	0.920 G	0.950 H	0.980 I
ALPHA (DEG)	NORMAL FORCE COEFFICIENT								
-10.000	-0.51500	-0.52400	-0.54500	-0.60500	-0.62000	-0.63500	-0.65500	-0.68500	-0.69000
-5.000	-0.27500	-0.28000	-0.29500	-0.33504	-0.34600	-0.35500	-0.36000	-0.37000	-0.37500
-2.500	-0.15500	-0.16500	-0.17500	-0.19500	-0.20000	-0.21000	-0.22000	-0.22000	-0.20500
0.0	-0.05000	-0.05000	-0.05500	-0.06500	-0.06200	-0.06000	-0.06000	-0.06000	-0.05500
2.500	0.06500	0.06500	0.07500	0.06500	0.07000	0.07500	0.08000	0.09000	0.10000
5.000	0.18000	0.18000	0.18500	0.19500	0.20000	0.21200	0.22500	0.25000	0.26000
7.500	0.30502	0.30500	0.31500	0.33000	0.33000	0.33800	0.36500	0.40500	0.41000
10.000	0.41500	0.42000	0.43000	0.46000	0.46000	0.46700	0.50000	0.54500	0.56000
12.500	0.53000	0.54200	0.56500	0.59000	0.59400	0.60000	0.62000	0.68500	0.70500
15.000	0.65500	0.67000	0.70000	0.72000	0.71500	0.73000	0.75500	0.82000	0.84000
17.500	0.80500	0.81300	0.84000	0.84700	0.84000	0.86000	0.88500	0.94000	0.97500
20.000	0.96000	0.97000	0.99400	0.97508	0.96000	0.98500	1.01000	1.06500	1.11000
22.500	1.07000	1.08000	1.10000	1.03500	1.02000	1.03500	1.08000	1.13000	1.19000
25.000	1.18000	1.18000	1.16000	1.05000	1.04000	1.08000	1.11500	1.18000	1.25000
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

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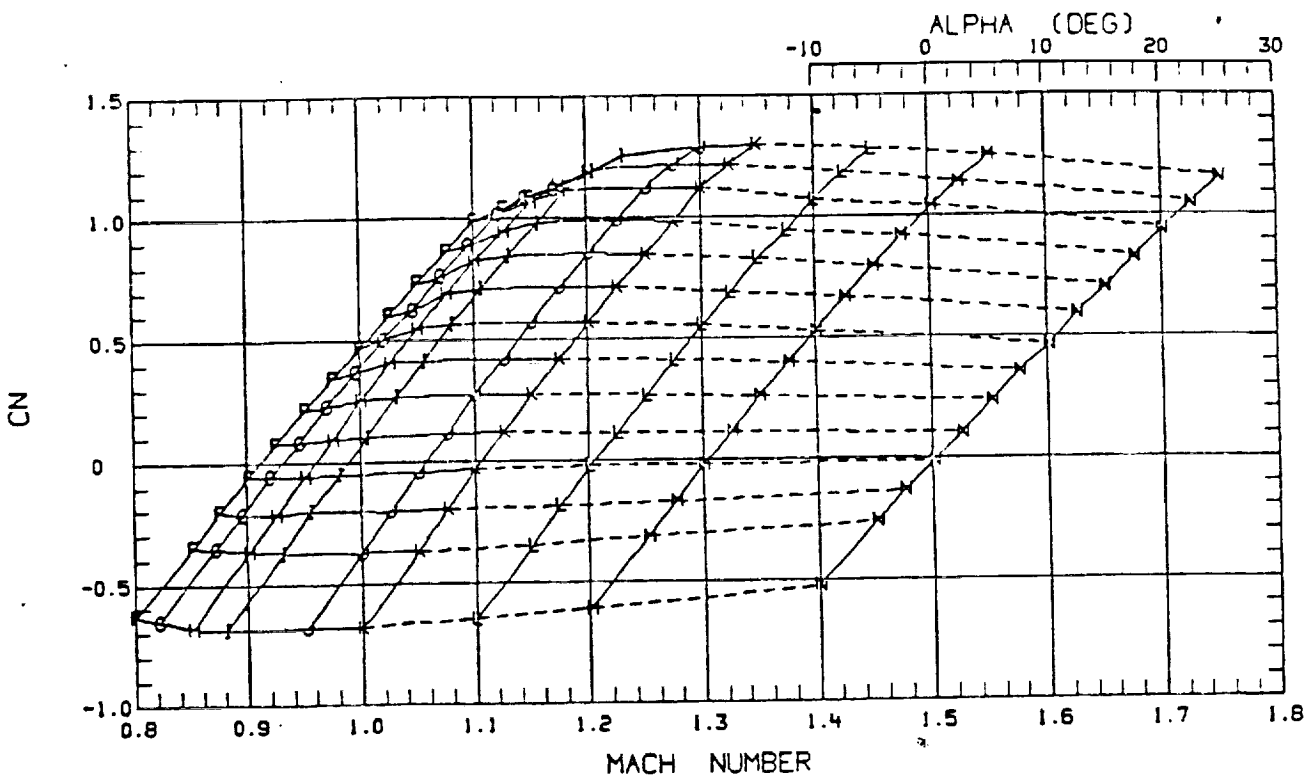
FIGURE 4.1.1.1 - 1
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.055 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	0.900 F	0.920 G	0.950 H	0.980 I	1.050 J	1.100 K	1.200 L	1.300 M	1.500 N
ALPHA (DEG)	NORMAL FORCE COEFFICIENT								
-10.000	-0.63500	-0.65500	-0.68500	-0.69000	-0.68500	-0.68000	-0.65000	-0.61500	-0.52500
-5.000	-0.35500	-0.36000	-0.37000	-0.37500	-0.37500	-0.37200	-0.35000	-0.32000	-0.25700
-2.500	-0.21000	-0.22000	-0.22000	-0.20500	-0.21000	-0.20000	-0.19000	-0.17500	-0.13700
0.0	-0.06000	-0.06000	-0.06000	-0.05500	-0.04700	-0.03600	-0.02500	-0.02300	-0.01500
2.500	0.07500	0.08000	0.09000	0.10000	0.11000	0.11500	0.11170	0.11000	0.10000
5.000	0.21200	0.22500	0.25000	0.26000	0.27000	0.27000	0.26500	0.26500	0.23000
7.500	0.33800	0.36500	0.40500	0.41000	0.41500	0.41500	0.41000	0.39500	0.35000
10.000	0.46700	0.50000	0.54500	0.56000	0.57000	0.56500	0.55200	0.52500	0.46000
12.500	0.60000	0.62000	0.68500	0.70500	0.71200	0.71200	0.68700	0.66500	0.59000
15.000	0.73000	0.75500	0.82000	0.84000	0.85000	0.84500	0.82500	0.79000	0.70200
17.500	0.86000	0.88500	0.94000	0.97500	0.98500	0.98000	0.94300	0.91500	0.82000
20.000	0.98500	1.01000	1.06500	1.11000	1.12000	1.12000	1.07000	1.03500	0.93800
22.500	1.03500	1.08000	1.13000	1.19000	1.21500	1.21500	1.18000	1.14000	1.04500
25.000	1.08000	1.11500	1.18000	1.25000	1.29500	1.29500	1.28000	1.24500	1.15000
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

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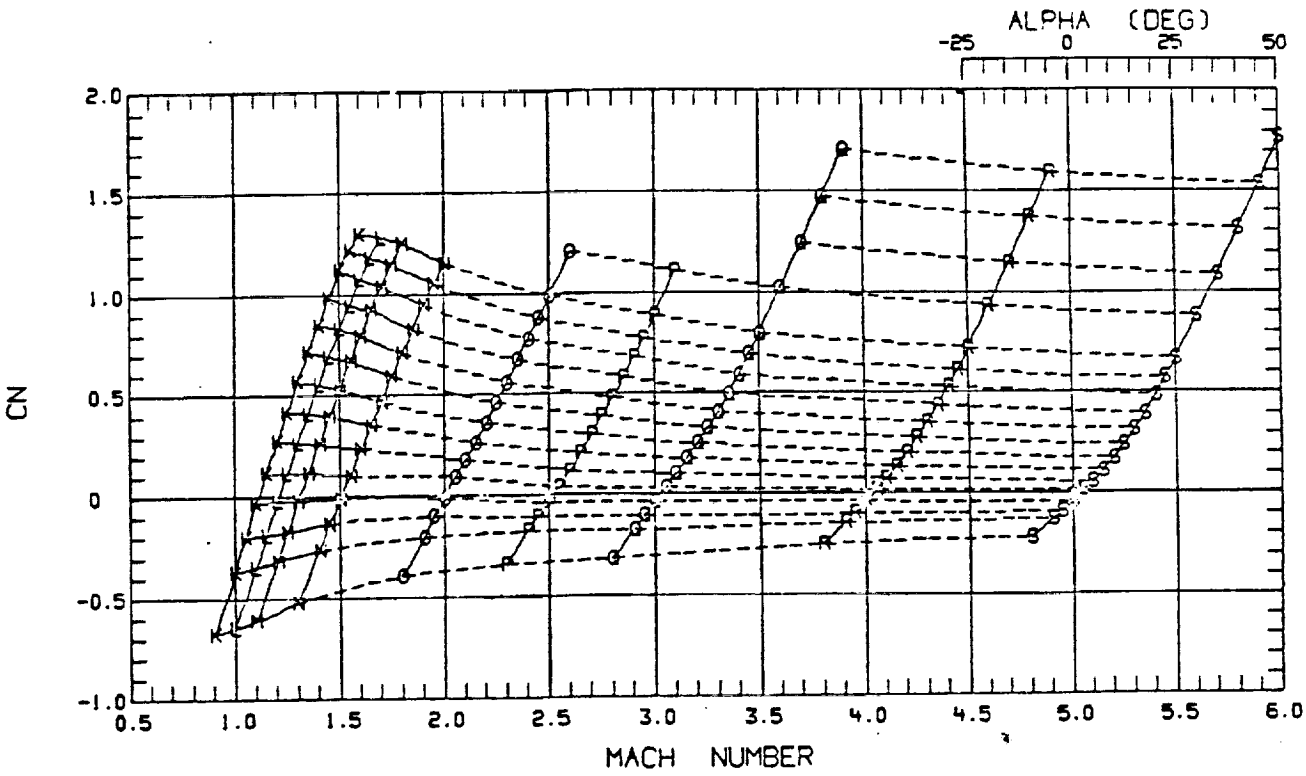
FIGURE 4.1.1.1 -2
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	1.100 K	1.200 L	1.300 M	1.500 N	2.000 O	2.500 P	3.000 Q	4.000 R	5.000 S
ALPHA (DEG)	NORMAL FORCE COEFFICIENT								
-10.000	-0.68000	-0.65000	-0.61500	-0.52500	-0.40000	-0.34310	-0.32000	-0.25260	-0.22130
-5.000	-0.37200	-0.35000	-0.32000	-0.26700	-0.21000	-0.17870	-0.18000	-0.14880	-0.13350
-2.500	-0.20000	-0.19000	-0.17500	-0.13700	-0.10500	-0.11000	-0.11000	-0.10500	-0.09500
0.0	-0.03600	-0.02500	-0.02300	-0.01500	-0.01700	-0.04290	-0.03700	-0.04430	-0.04724
2.500	0.11500	0.11170	0.11000	0.10000	0.09000	0.03500	0.02500	0.01500	0.01000
5.000	0.27000	0.26500	0.25500	0.23000	0.17300	0.11480	0.09500	0.06940	0.04990
7.500	0.41500	0.41000	0.39500	0.35000	0.26000	0.20480	0.17000	0.13060	0.10700
10.000	0.56500	0.55200	0.52500	0.46000	0.35700	0.29370	0.24500	0.19860	0.16700
12.500	0.71200	0.68700	0.66500	0.59000	0.45500	0.38280	0.32200	0.27040	0.23390
15.000	0.84500	0.82500	0.79000	0.70200	0.55500	0.47560	0.40200	0.35040	0.30690
17.500	0.98000	0.94300	0.91500	0.02000	0.66500	0.57440	0.49000	0.43460	0.38900
20.000	1.12000	1.07000	1.03500	0.93800	0.77000	0.67240	0.58500	0.52190	0.47500
22.500	1.21500	1.18000	1.14000	1.04500	0.87300	0.77000	0.69000	0.60500	0.56500
25.000	1.29500	1.28000	1.24500	1.15000	0.97700	0.88270	0.79000	0.71560	0.66000
30.000	.....	.....	.....	.....	1.20210	1.10420	1.01500	0.92770	0.87000
35.000	.....	.....	.....	.....	.....	.....	1.23500	1.14130	1.07900
40.000	.....	.....	.....	.....	.....	.....	1.46500	1.36490	1.30900
45.000	.....	.....	.....	.....	.....	.....	1.70000	1.58950	1.52900
50.000	.....	.....	.....	.....	.....	.....	.....	.....	1.7E303

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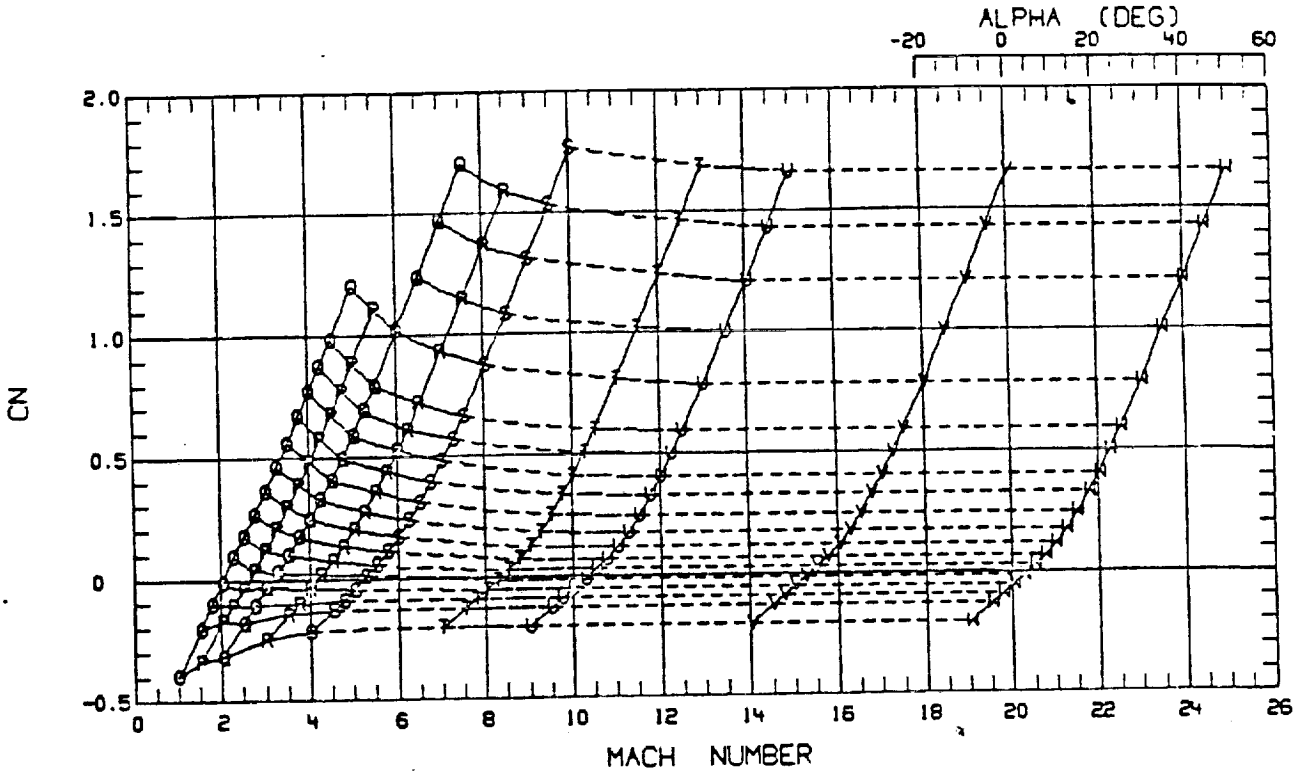
FIGURE 4.1.1.1 -3
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

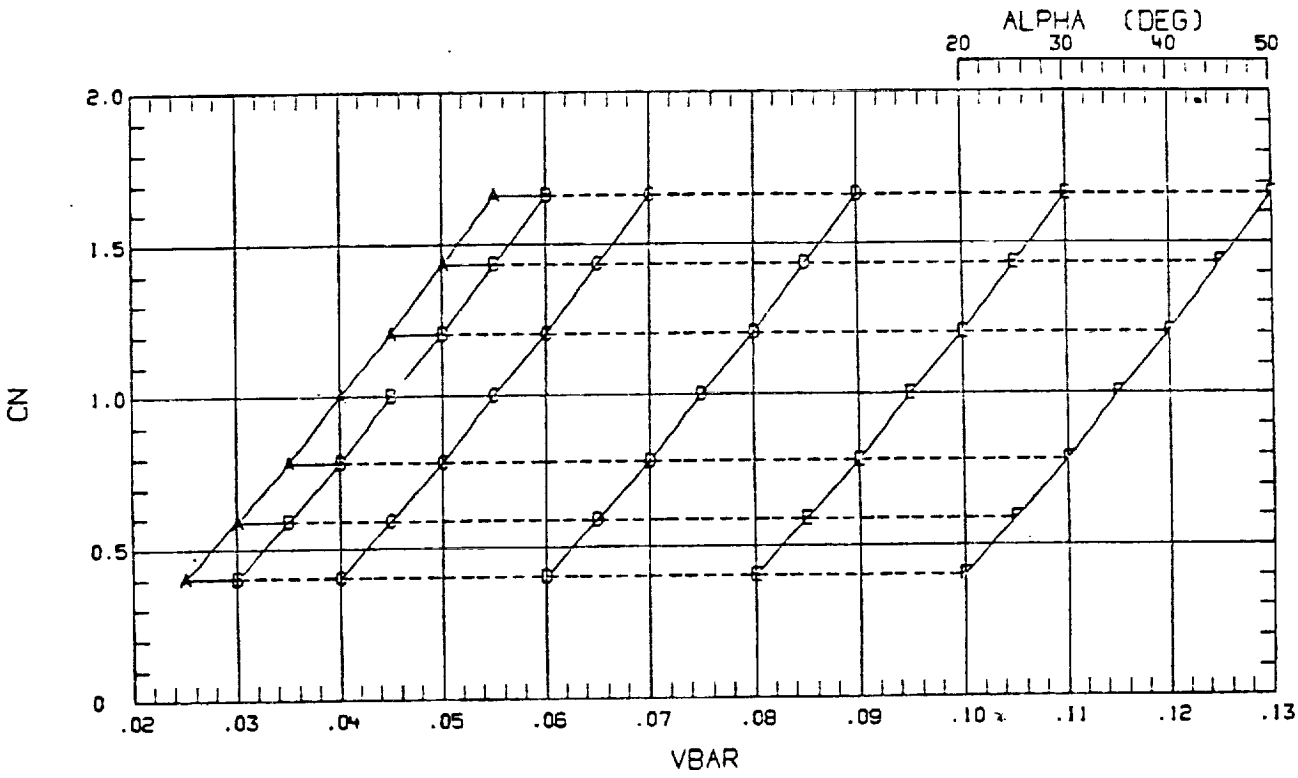
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

ALPHA (DEG)	MACH NUMBER 2.000 O	2.500 P	3.000 Q	4.000 R	5.000 S	8.000 T	10.000 U	15.000 V	20.000 W
	NORMAL FORCE COEFFICIENT								
-10.000	-0.40000	-0.34310	-0.32000	-0.25260	-0.22130	-0.20810	-0.20810	-0.20810	-0.20810
-5.000	-0.21000	-0.17870	-0.18000	-0.14880	-0.13350	-0.13270	-0.13270	-0.13270	-0.13270
-2.500	-0.10500	-0.11000	-0.11000	-0.10500	-0.09500	-0.09300	-0.09300	-0.09300	-0.09300
0.0	-0.01700	-0.04290	-0.03700	-0.04430	-0.04724	-0.05540	-0.05540	-0.05540	-0.05540
2.500	0.09000	0.03500	0.02500	0.01500	0.01000	-0.01700	-0.01700	-0.01700	-0.01700
5.000	0.17300	0.11480	0.09500	0.06940	0.04990	0.02390	0.02370	0.02370	0.02370
7.500	0.26000	0.20480	0.17000	0.13060	0.10700	0.06880	0.06470	0.06470	0.06470
10.000	0.35700	0.29370	0.24500	0.19860	0.16700	0.11870	0.11250	0.11250	0.11250
12.500	0.45500	0.38280	0.32200	0.27040	0.23390	0.17850	0.17030	0.17030	0.17030
15.000	0.55500	0.47560	0.40200	0.35040	0.30690	0.25030	0.24080	0.24080	0.24080
17.500	0.66500	0.57440	0.49000	0.43460	0.38900	0.33330	0.32300	0.32300	0.32300
20.000	0.77000	0.67240	0.58500	0.52190	0.47500	0.41000	0.40000	0.40000	0.40000
22.500	0.87300	0.77000	0.69000	0.60500	0.56500	0.50500	0.49500	0.49500	0.49500
25.000	0.97700	0.88270	0.79000	0.71560	0.66000	0.60000	0.59000	0.59000	0.59000
30.000	1.20210	1.10420	1.01500	0.92770	0.87000	0.80800	0.78000	0.78000	0.78000
35.000	.....	.....	1.23500	1.14130	1.07900	1.01900	1.00000	1.00000	1.00000
40.000	.....	.....	1.46500	1.36490	1.30900	1.24000	1.20500	1.20500	1.20500
45.000	.....	.....	1.70000	1.58950	1.52900	1.45800	1.43000	1.43000	1.43000
50.000	.....	.....	.....	.....	1.76303	1.68500	1.66000	1.66000	1.66000

ENGINEER [illegible]
DATE 10-4-78

FIGURE 4.1.1.1 -4
BASIC NORMAL FORCE COEFFICIENT

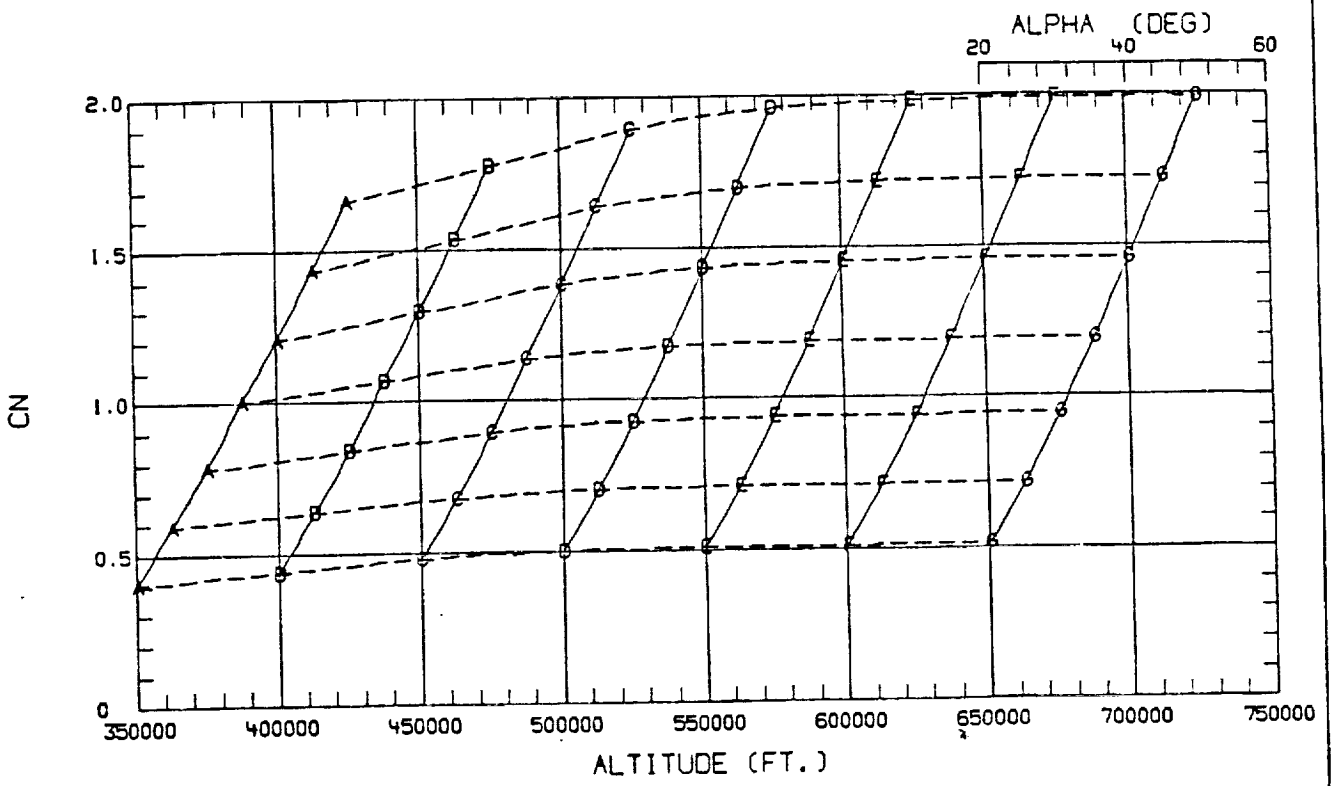


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005 A	0.010 B	0.020 C	0.040 D	0.060 E	0.080 F
ALPHA (DEG)	VISCOUS NORMAL FORCE COEFFICIENT					
20.000	0.40000	0.40000	0.40000	0.40000	0.40000	0.40000
25.000	0.59000	0.59000	0.59000	0.59000	0.59000	0.59000
30.000	0.78000	0.78000	0.78000	0.78000	0.78000	0.78000
35.000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
40.000	1.20500	1.20500	1.20500	1.20500	1.20500	1.20500
45.000	1.43000	1.43000	1.43000	1.43000	1.43000	1.43000
50.000	1.66000	1.66000	1.66000	1.66000	1.66000	1.66000

ENGINEER NASA
DATE

FIGURE 4.1.1.1-5
BASIC NORMAL FORCE COEFFICIENT

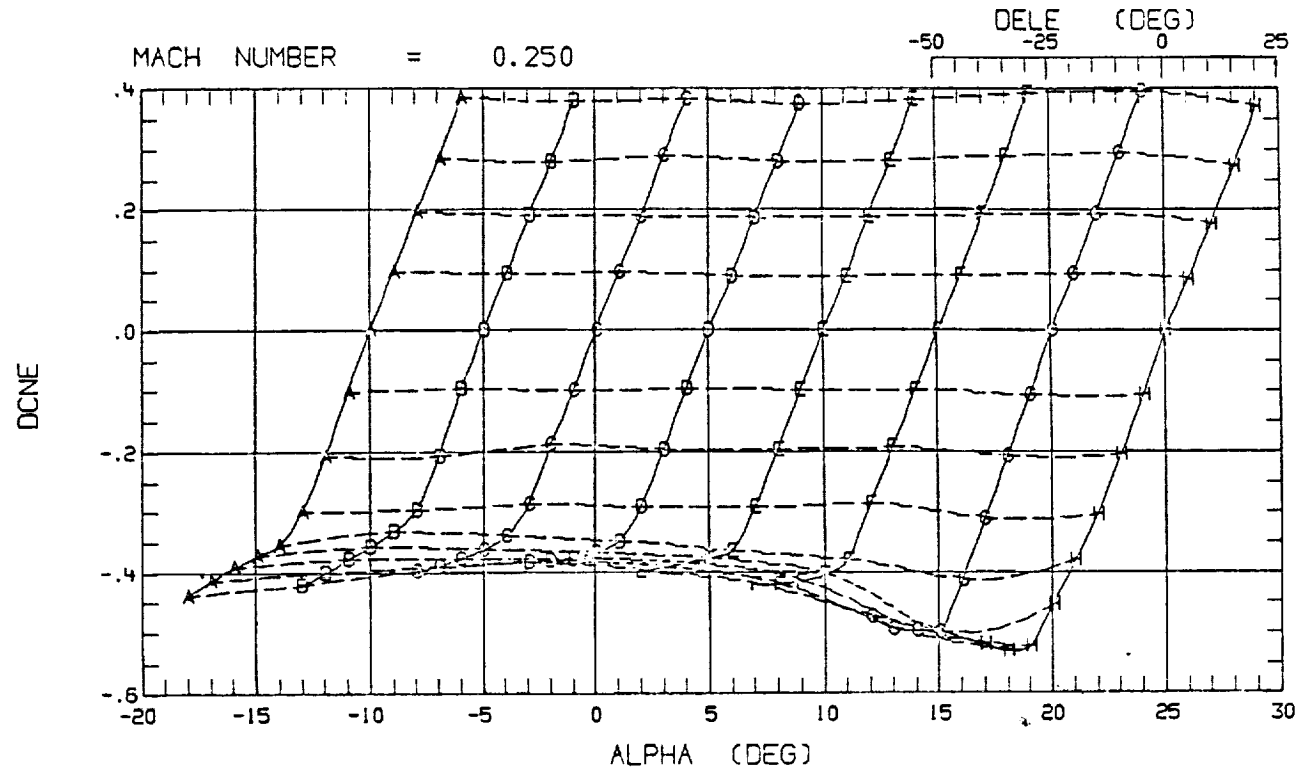


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE NORMAL FORCE						
20.000	0.40000	0.43820	0.47800	0.49930	0.50740	0.50990	0.51030
25.000	0.59000	0.63290	0.67730	0.70120	0.71020	0.71310	0.71350
30.000	0.78000	0.83600	0.89440	0.92570	0.93750	0.94120	0.94180
35.000	1.00000	1.06630	1.13530	1.17230	1.18630	1.19070	1.19140
40.000	1.20500	1.29210	1.38300	1.43160	1.45000	1.45580	1.45670
45.000	1.43000	1.53190	1.63820	1.69500	1.71650	1.72330	1.72440
50.000	1.66000	1.77500	1.89490	1.95900	1.98330	1.99090	1.99210

ENGINEER NASA
DATE

FIGURE 4.1.1.1-6
BASIC NORMAL FORCE COEFFICIENT



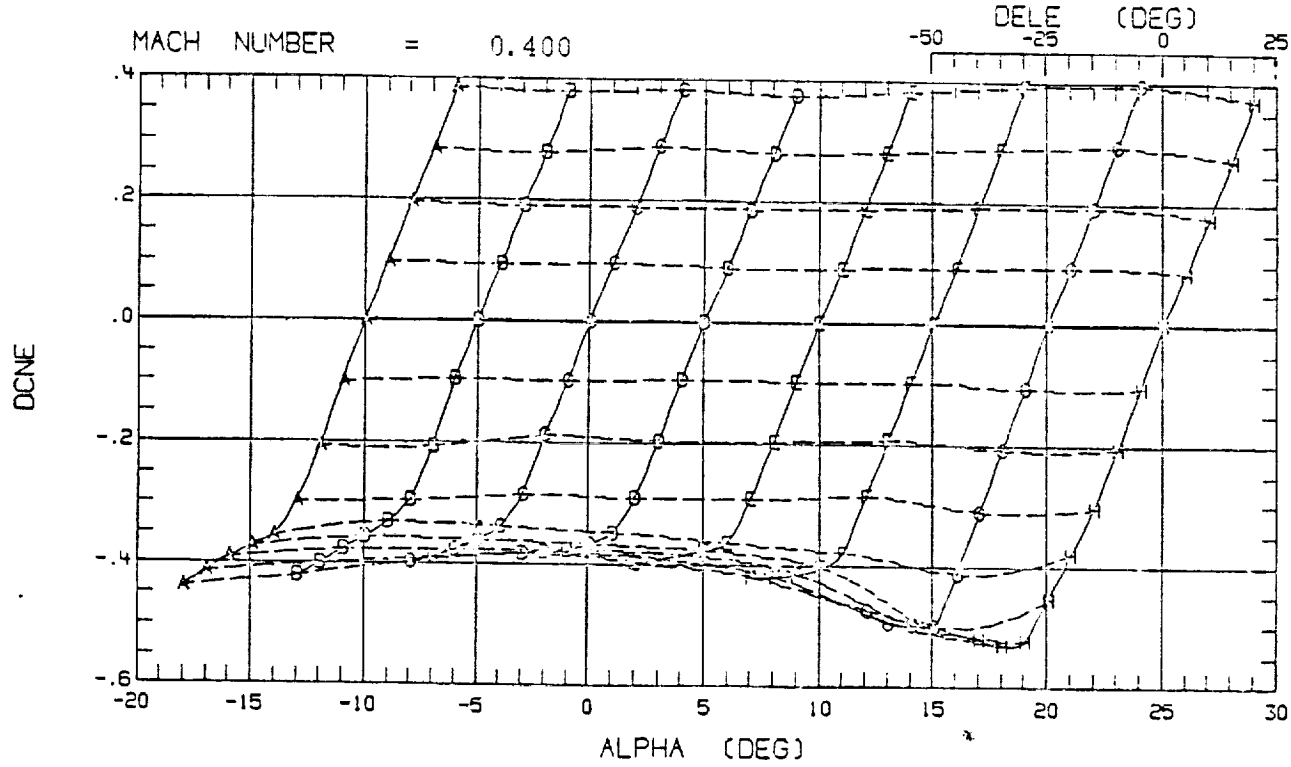
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43913	-0.42131	-0.39900	-0.38317	-0.39973	-0.42213	-0.47498	-0.52100
-35.000	-0.41452	-0.40204	-0.39100	-0.38213	-0.39352	-0.42144	-0.49616	-0.53170
-30.000	-0.39287	-0.37981	-0.37800	-0.37910	-0.38639	-0.41668	-0.49859	-0.52393
-25.000	-0.37464	-0.35849	-0.36300	-0.36910	-0.37909	-0.40568	-0.50218	-0.45592
-20.000	-0.35740	-0.33401	-0.34100	-0.35122	-0.36669	-0.38282	-0.41565	-0.38199
-15.000	-0.30036	-0.29684	-0.28800	-0.29323	-0.29272	-0.28816	-0.31274	-0.30470
-10.000	-0.20985	-0.20886	-0.19000	-0.19803	-0.19817	-0.19503	-0.20988	-0.20728
-5.000	-0.10148	-0.09832	-0.10000	-0.09824	-0.09894	-0.09932	-0.10844	-0.10851
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.09619	0.09299	0.09500	0.08845	0.08892	0.09018	0.09345	0.08313
10.000	0.19437	0.18846	0.18800	0.18530	0.18746	0.19093	0.19224	0.17445
15.000	0.28316	0.27659	0.29800	0.27761	0.28194	0.28892	0.29242	0.27060
20.000	0.38399	0.37924	0.38200	0.37370	0.38180	0.39292	0.39415	0.36894

ENGINEER DCO
DATE 10/4/78

FIGURE 4.1.1.1- 7
EFFECT OF ELEVON



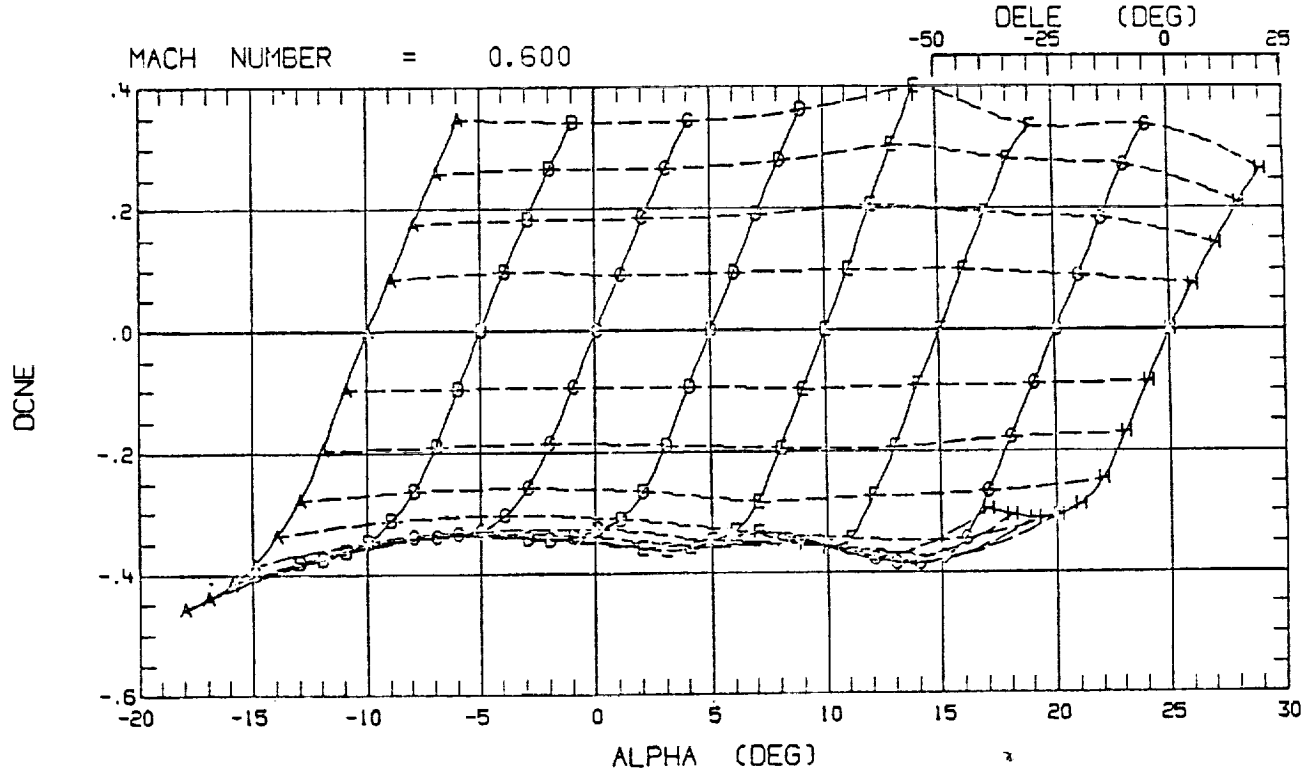
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43913	-0.42131	-0.39900	-0.38317	-0.39973	-0.42213	-0.47498	-0.52100
-35.000	-0.41452	-0.40204	-0.39100	-0.38213	-0.39352	-0.42144	-0.49616	-0.53170
-30.000	-0.39287	-0.37981	-0.37800	-0.37910	-0.38639	-0.41663	-0.49853	-0.52393
-25.000	-0.37464	-0.35849	-0.36300	-0.36910	-0.37909	-0.40558	-0.50219	-0.45592
-20.000	-0.35740	-0.33401	-0.34100	-0.35122	-0.36669	-0.38282	-0.41535	-0.38199
-15.000	-0.30036	-0.29684	-0.28800	-0.29323	-0.29272	-0.28816	-0.31274	-0.30470
-10.000	-0.20985	-0.20886	-0.19000	-0.19803	-0.19317	-0.19503	-0.20988	-0.20728
-5.000	-0.10148	-0.09832	-0.10000	-0.09824	-0.09894	-0.09932	-0.10844	-0.10851
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.09619	0.09299	0.09500	0.08845	0.08892	0.09018	0.09345	0.08313
10.000	0.19437	0.18846	0.18800	0.18530	0.18746	0.19093	0.19224	0.17445
15.000	0.29316	0.27859	0.28800	0.27761	0.28194	0.28892	0.29242	0.27060
20.000	0.38399	0.37924	0.38200	0.37370	0.38180	0.39292	0.39415	0.36894

ENGINEER DCQ
DATE 10-9-78

FIGURE 4.1.1.1-8
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

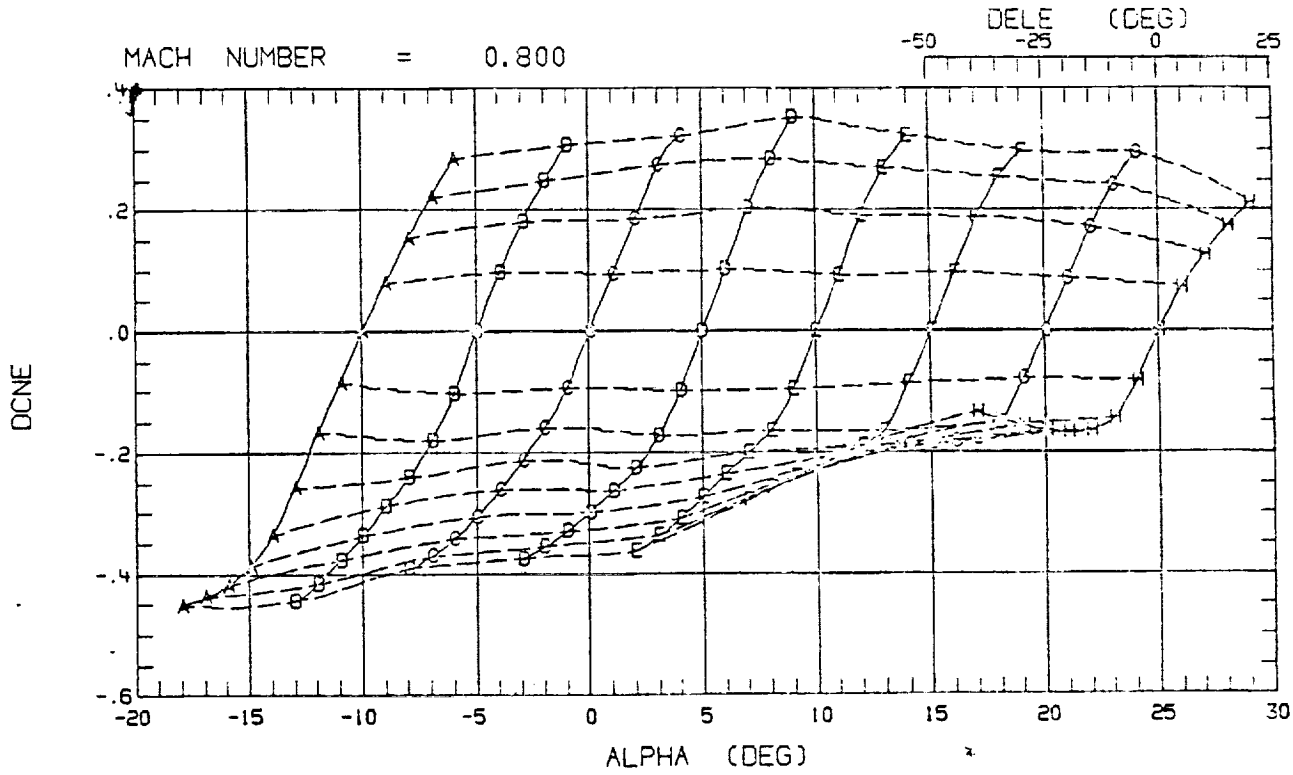
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.45821	-0.38280	-0.34200	-0.34335	-0.36044	-0.33661	-0.37852	-0.29746
-35.000	-0.44113	-0.37589	-0.34000	-0.34639	-0.36467	-0.34859	-0.38564	-0.30750
-30.000	-0.41817	-0.36301	-0.33600	-0.34055	-0.36004	-0.35454	-0.38804	-0.31301
-25.000	-0.38637	-0.34758	-0.33000	-0.32960	-0.34940	-0.36029	-0.37779	-0.30756
-20.000	-0.33882	-0.31422	-0.30600	-0.31258	-0.33229	-0.34625	-0.34609	-0.28920
-15.000	-0.28113	-0.26566	-0.26100	-0.26864	-0.28495	-0.27580	-0.26869	-0.24799
-10.000	-0.19673	-0.19137	-0.18600	-0.19062	-0.19551	-0.19427	-0.17839	-0.17164
-5.000	-0.09645	-0.09651	-0.09500	-0.09408	-0.09877	-0.09263	-0.09107	-0.08673
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.08309	0.09499	0.09000	0.09360	0.09801	0.09882	0.08660	0.07322
10.000	0.17434	0.18148	0.18300	0.18873	0.20495	0.19069	0.18121	0.13917
15.000	0.25839	0.26546	0.26500	0.27827	0.30470	0.28063	0.27033	0.20593
20.000	0.34613	0.34229	0.34400	0.36092	0.39895	0.33484	0.33740	0.26382

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-9
EFFECT OF ELEVON



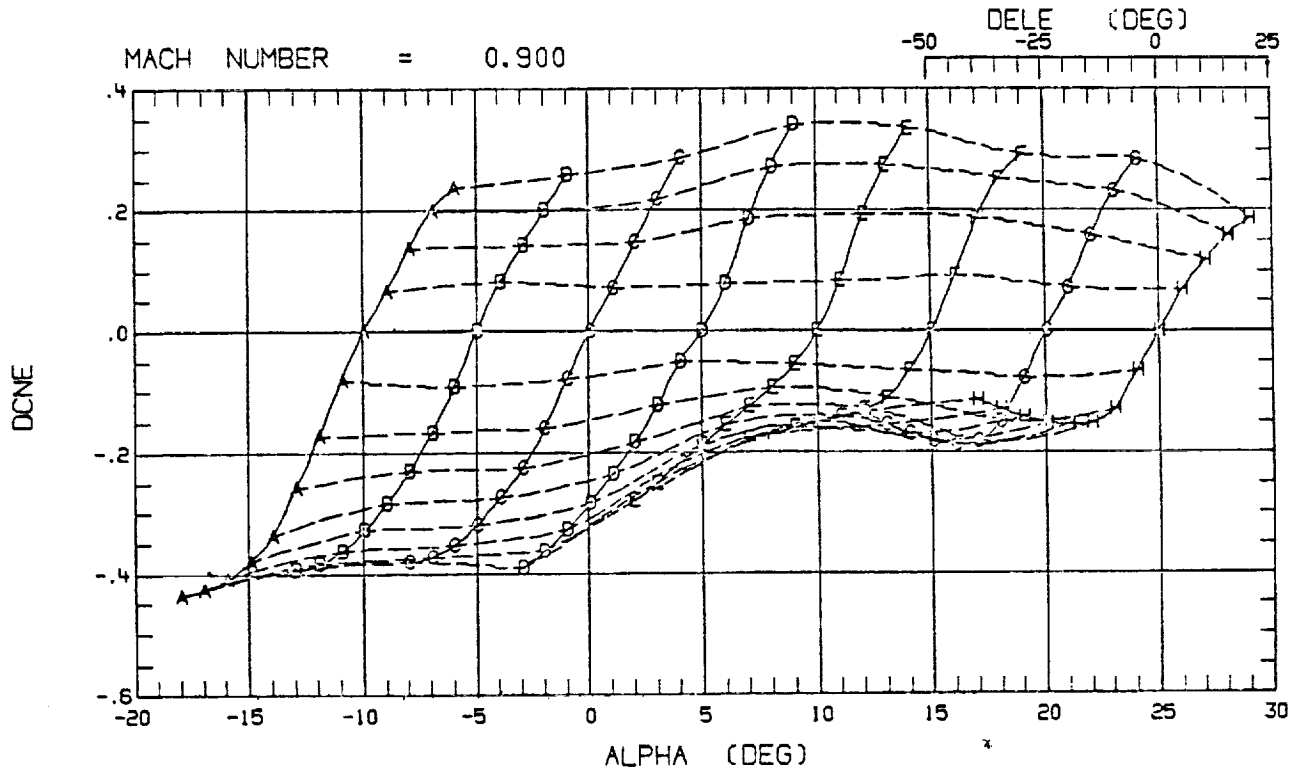
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.45183	-0.44512	-0.39300	-0.37583	-0.36465	-0.27929	-0.19060	-0.13676
-35.000	-0.43827	-0.41726	-0.37200	-0.35635	-0.33977	-0.26113	-0.18962	-0.14959
-30.000	-0.41892	-0.37835	-0.34400	-0.33197	-0.30952	-0.24209	-0.18648	-0.15861
-25.000	-0.38876	-0.33958	-0.30700	-0.30023	-0.27385	-0.22393	-0.18734	-0.16591
-20.000	-0.33795	-0.29984	-0.26300	-0.26424	-0.23641	-0.20526	-0.18449	-0.16867
-15.000	-0.25971	-0.24331	-0.21300	-0.22734	-0.20191	-0.19014	-0.17762	-0.16530
-10.000	-0.16762	-0.18193	-0.16000	-0.17433	-0.16527	-0.16515	-0.15448	-0.14549
-5.000	-0.08761	-0.10465	-0.09500	-0.10105	-0.09706	-0.09780	-0.08091	-0.08450
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.07767	0.09507	0.09400	0.09967	0.08996	0.09522	0.06552	0.07006
10.000	0.15165	0.17966	0.18400	0.20185	0.19035	0.18638	0.16801	0.12454
15.000	0.21979	0.24666	0.27400	0.28264	0.26728	0.25172	0.23959	0.17228
20.000	0.28258	0.30725	0.32200	0.35291	0.32011	0.29626	0.29235	0.20558

ENGINEER DCO
DATE 10-7-28

FIGURE 4.1.1.1-10
EFFECT OF ELEVON



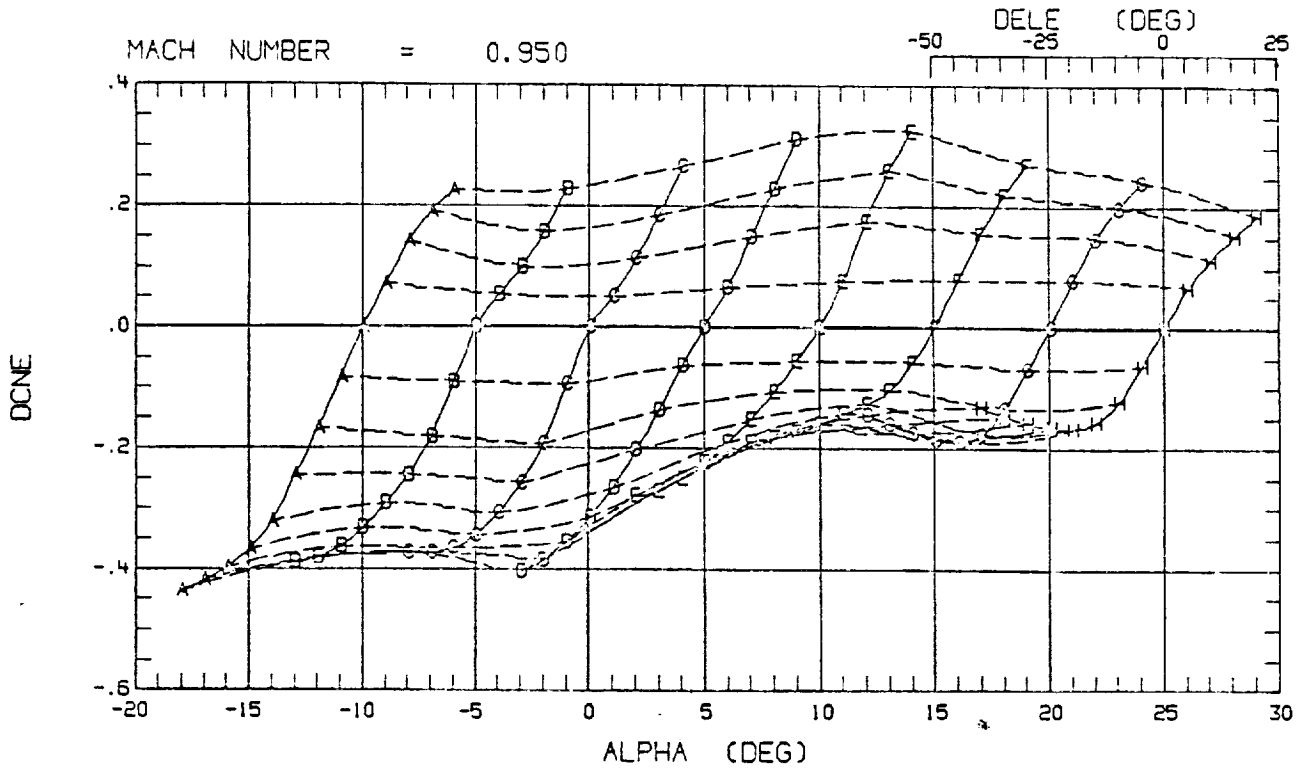
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43671	-0.39521	-0.38200	-0.39159	-0.28104	-0.17952	-0.13469	-0.11600
-35.000	-0.42634	-0.38535	-0.37300	-0.36341	-0.25133	-0.16993	-0.15595	-0.13046
-30.000	-0.41008	-0.36355	-0.35300	-0.32898	-0.21880	-0.16034	-0.17139	-0.14332
-25.000	-0.38201	-0.32962	-0.32000	-0.28619	-0.18798	-0.15198	-0.18368	-0.15256
-20.000	-0.33795	-0.28589	-0.27600	-0.23734	-0.15621	-0.14310	-0.18884	-0.15610
-15.000	-0.26066	-0.23188	-0.22800	-0.18425	-0.12652	-0.13074	-0.18284	-0.15271
-10.000	-0.17467	-0.16729	-0.16200	-0.12409	-0.09399	-0.11162	-0.15158	-0.12974
-5.000	-0.08182	-0.09187	-0.08000	-0.05275	-0.05674	-0.06737	-0.07892	-0.06703
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.06386	0.08002	0.07000	0.07741	0.08156	0.09109	0.07122	0.06704
10.000	0.13675	0.14046	0.14500	0.18366	0.19215	0.18470	0.15550	0.11514
15.000	0.19762	0.19936	0.21700	0.27138	0.27255	0.25146	0.22983	0.15719
20.000	0.23479	0.25666	0.28500	0.34096	0.33459	0.29020	0.28290	0.18452

ENGINEER DCO
DATE 10-4-72

FIGURE 4.1.1.1-11
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

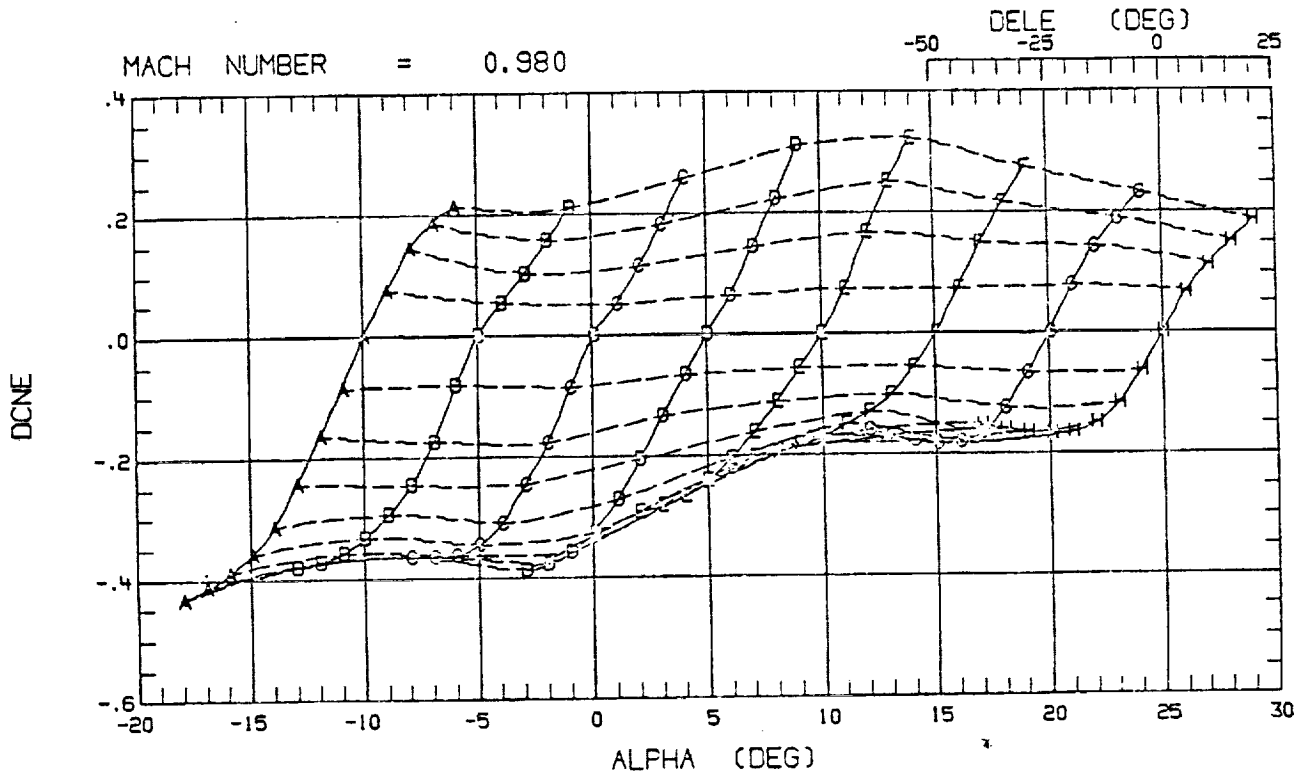
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43785	-0.38986	-0.37300	-0.40455	-0.28111	-0.19174	-0.14469	-0.13322
-35.000	-0.42016	-0.38209	-0.37500	-0.38567	-0.27193	-0.18301	-0.16150	-0.14711
-30.000	-0.39915	-0.36441	-0.36700	-0.35579	-0.25156	-0.17342	-0.17643	-0.15786
-25.000	-0.36890	-0.33365	-0.34500	-0.31697	-0.22541	-0.16067	-0.18667	-0.16633
-20.000	-0.32363	-0.29388	-0.30900	-0.26706	-0.19065	-0.14419	-0.19106	-0.16805
-15.000	-0.24834	-0.24605	-0.26000	-0.20517	-0.15235	-0.12880	-0.17874	-0.15780
-10.000	-0.16788	-0.18423	-0.19300	-0.13821	-0.10813	-0.10396	-0.13524	-0.12364
-5.000	-0.08576	-0.09166	-0.09500	-0.06475	-0.05744	-0.05894	-0.07052	-0.06459
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.06963	0.05180	0.05000	0.06450	0.07467	0.07724	0.07694	0.06539
10.000	0.14152	0.09737	0.11300	0.14871	0.17373	0.15507	0.14731	0.11187
15.000	0.18891	0.15731	0.18400	0.22850	0.25691	0.21674	0.19797	0.15089
20.000	0.22555	0.22686	0.26500	0.31116	0.32306	0.26759	0.24104	0.18328

ENGINEER DCO
DATE 12-4-78

FIGURE 4.1.1.1-12
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

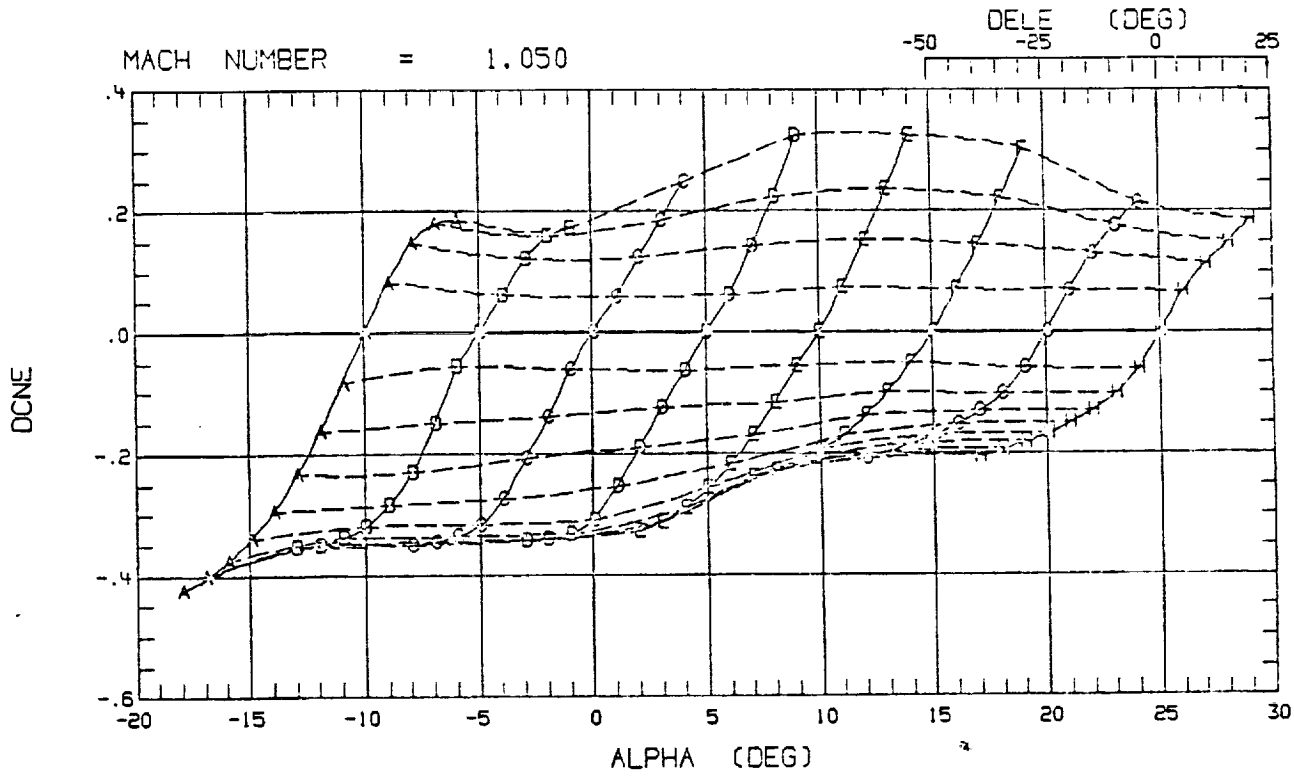
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43505	-0.38084	-0.36669	-0.38965	-0.29178	-0.20475	-0.16043	-0.15337
-35.000	-0.41536	-0.37411	-0.36699	-0.37964	-0.28401	-0.19546	-0.17064	-0.16057
-30.000	-0.39249	-0.35826	-0.36370	-0.35961	-0.26759	-0.18437	-0.17888	-0.16495
-25.000	-0.36054	-0.33272	-0.34625	-0.32530	-0.24218	-0.16958	-0.18469	-0.16801
-20.000	-0.31512	-0.29506	-0.30991	-0.27232	-0.20542	-0.15082	-0.18037	-0.16625
-15.000	-0.24371	-0.24835	-0.24602	-0.20621	-0.16304	-0.13086	-0.16606	-0.15159
-10.000	-0.16610	-0.17735	-0.17902	-0.13513	-0.11385	-0.10235	-0.12568	-0.11835
-5.000	-0.08633	-0.08299	-0.08718	-0.06766	-0.05714	-0.05611	-0.06716	-0.06353
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.07312	0.05191	0.05050	0.06311	0.07347	0.07384	0.07674	0.06498
10.000	0.14396	0.10003	0.11294	0.14466	0.16588	0.14987	0.14194	0.11108
15.000	0.18514	0.15588	0.18128	0.22281	0.24909	0.21367	0.18710	0.14882
20.000	0.21324	0.20940	0.25848	0.31041	0.32234	0.27230	0.22926	0.18364

ENGINEER DCG
DATE 10-4-78

FIGURE 4.1.1.1-13
EFFECT OF ELEVON



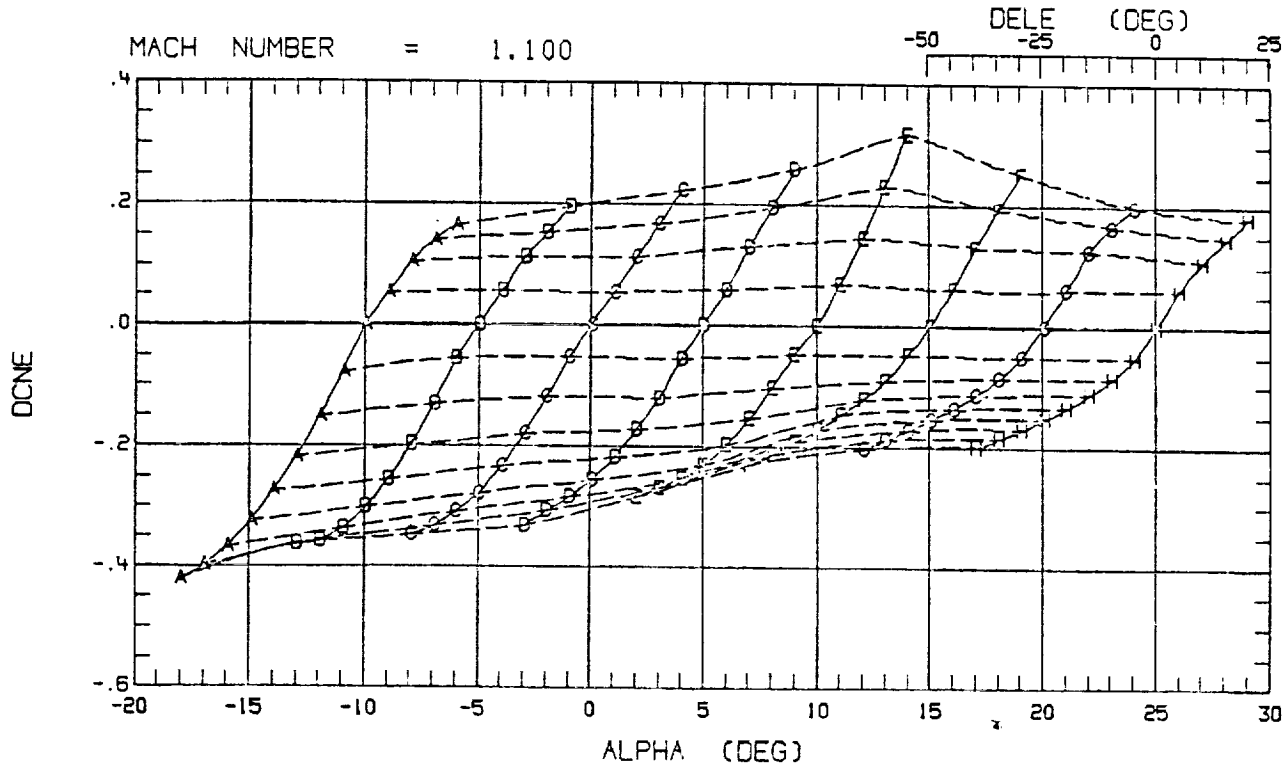
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0	IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0	IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.42587	-0.35449	-0.35100	-0.34386	-0.32737	-0.24037	-0.20900	-0.20615
-35.000	-0.40264	-0.35013	-0.34600	-0.34209	-0.31219	-0.22918	-0.19964	-0.19614
-30.000	-0.37657	-0.33938	-0.33700	-0.33340	-0.28925	-0.21335	-0.18557	-0.18340
-25.000	-0.34059	-0.32044	-0.31800	-0.30952	-0.25820	-0.19436	-0.17138	-0.16913
-20.000	-0.29526	-0.28413	-0.27600	-0.25367	-0.21822	-0.17226	-0.15339	-0.15171
-15.000	-0.23551	-0.23309	-0.20900	-0.19074	-0.17110	-0.13834	-0.13164	-0.12982
-10.000	-0.16399	-0.15143	-0.14000	-0.12573	-0.11690	-0.09958	-0.10356	-0.10166
-5.000	-0.08386	-0.05648	-0.06200	-0.06475	-0.05581	-0.05192	-0.06054	-0.06155
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.08136	0.05960	0.05700	0.06099	0.07276	0.06881	0.06871	0.06476
10.000	0.14645	0.11984	0.12300	0.14226	0.15194	0.14309	0.12643	0.11021
15.000	0.17799	0.15774	0.18500	0.22231	0.23455	0.21907	0.17350	0.14631
20.000	0.19485	0.17153	0.24800	0.32481	0.32445	0.29976	0.21263	0.18626

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-14
EFFECT OF ELEVON



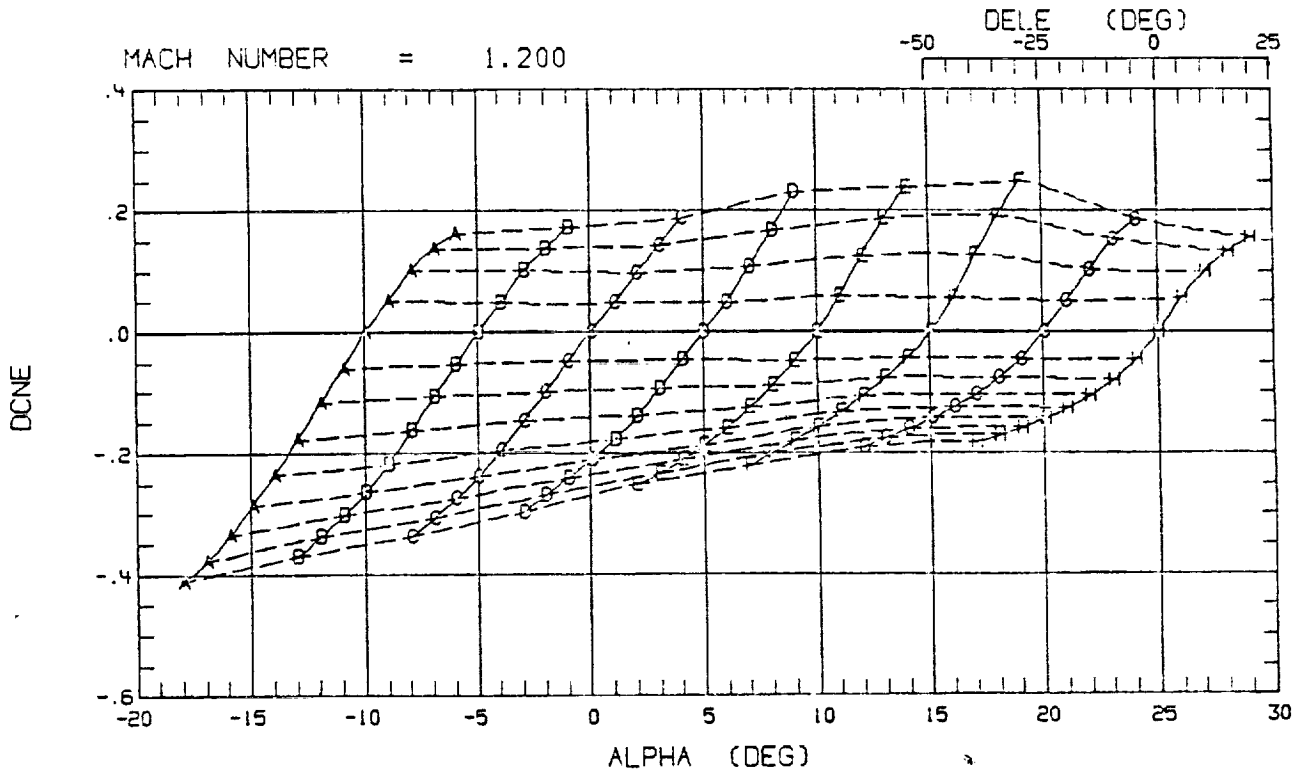
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.42245	-0.36322	-0.35000	-0.33269	-0.28531	-0.23194	-0.20365	-0.20179
-35.000	-0.39998	-0.35871	-0.33400	-0.30896	-0.27031	-0.21488	-0.18973	-0.18584
-30.000	-0.36836	-0.33799	-0.31000	-0.28619	-0.25423	-0.19417	-0.17295	-0.17147
-25.000	-0.32670	-0.30312	-0.27900	-0.25830	-0.23108	-0.17304	-0.15583	-0.15431
-20.000	-0.27544	-0.25719	-0.23400	-0.22041	-0.19890	-0.14896	-0.13703	-0.13487
-15.000	-0.21885	-0.20018	-0.18200	-0.17331	-0.15670	-0.12353	-0.11505	-0.11344
-10.000	-0.15302	-0.13251	-0.12000	-0.12214	-0.10537	-0.09262	-0.08781	-0.08772
-5.000	-0.07987	-0.05610	-0.05500	-0.05678	-0.04959	-0.04947	-0.05171	-0.05318
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.05295	0.05406	0.05300	0.05792	0.06685	0.05908	0.05870	0.06031
10.000	0.10311	0.11092	0.11100	0.12904	0.14291	0.12963	0.12432	0.10603
15.000	0.13943	0.15232	0.16700	0.19325	0.22956	0.19105	0.16433	0.14334
20.000	0.16284	0.19558	0.22300	0.25715	0.31697	0.24926	0.19755	0.17840

ENGINEER DCO
DATE 12-4-78

FIGURE 4.1.1.1-15
EFFECT OF ELEVON



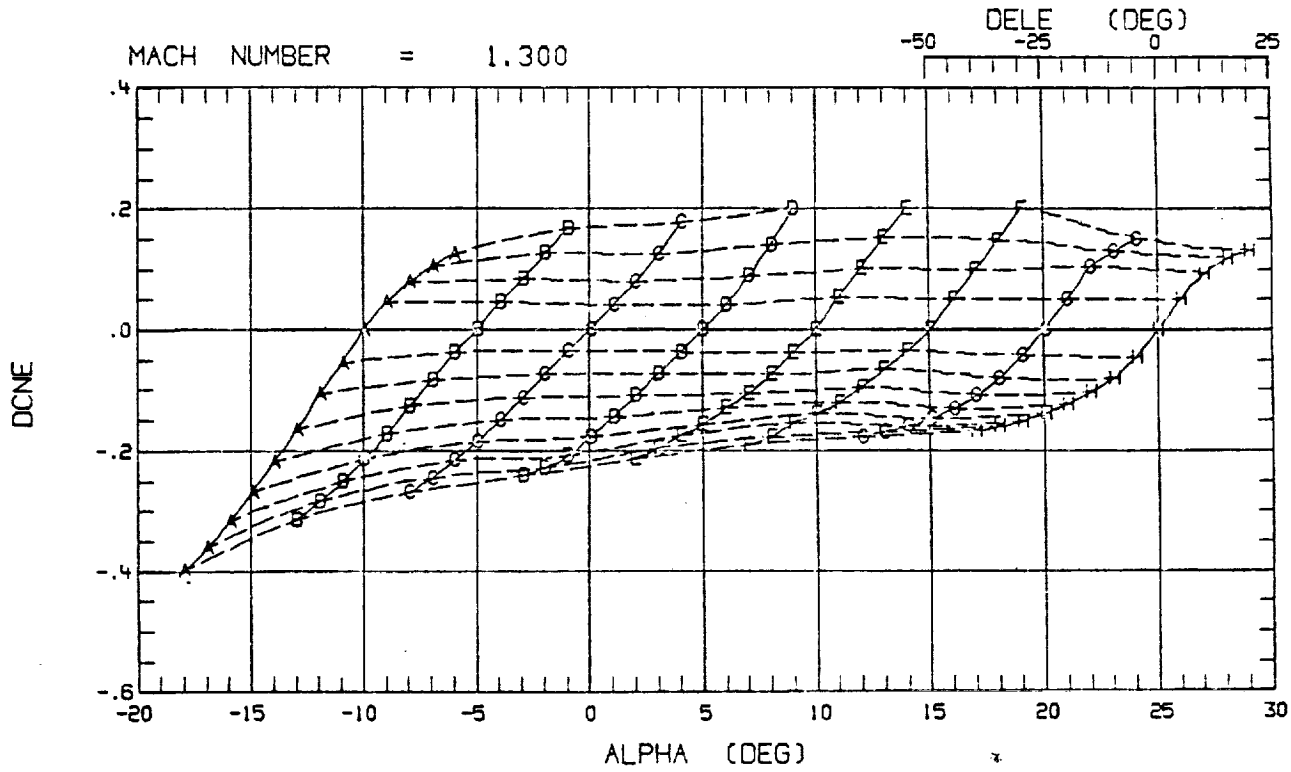
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.41251	-0.37195	-0.33900	-0.29683	-0.25232	-0.22303	-0.19215	-0.18306
-35.000	-0.37869	-0.33885	-0.30700	-0.27007	-0.23445	-0.20214	-0.17659	-0.17302
-30.000	-0.33655	-0.30376	-0.27500	-0.24123	-0.21255	-0.18025	-0.16189	-0.16025
-25.000	-0.28878	-0.26525	-0.23900	-0.21239	-0.18833	-0.15740	-0.14404	-0.14523
-20.000	-0.23736	-0.21876	-0.19700	-0.17857	-0.16000	-0.13332	-0.12618	-0.12820
-15.000	-0.17842	-0.16405	-0.14800	-0.13950	-0.12658	-0.10705	-0.10423	-0.10754
-10.000	-0.11846	-0.10851	-0.10000	-0.09429	-0.09066	-0.07640	-0.07715	-0.08122
-5.000	-0.06082	-0.05447	-0.04900	-0.04778	-0.04831	-0.04393	-0.04552	-0.04766
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.04980	0.04617	0.04600	0.04782	0.05810	0.05399	0.04990	0.05431
10.000	0.10004	0.09971	0.09500	0.10678	0.12460	0.12507	0.10075	0.09913
15.000	0.13689	0.13695	0.14200	0.16674	0.18624	0.18994	0.15072	0.13198
20.000	0.16147	0.17207	0.18700	0.23020	0.23854	0.24833	0.19474	0.15492

ENGINEER DCO
DATE 12-4-78

FIGURE 4.1.1.1-16
EFFECT OF ELEVON



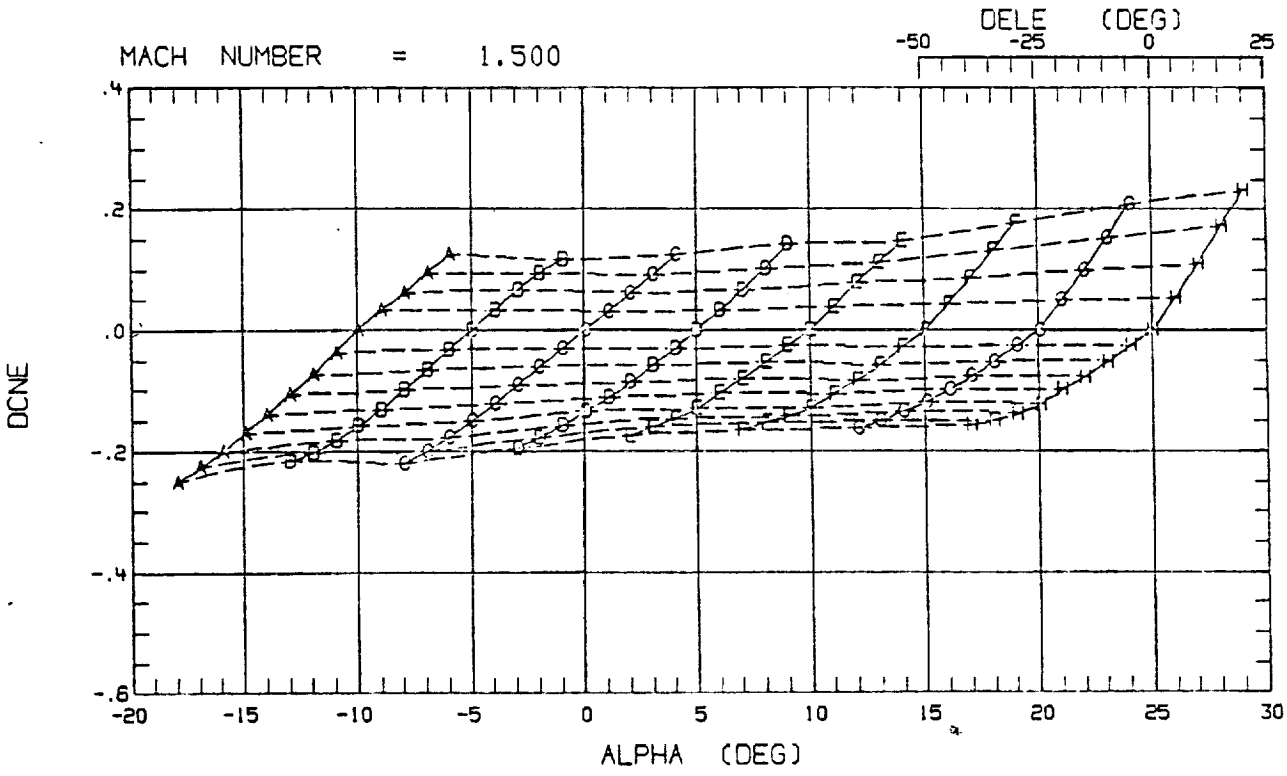
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.40065	-0.31526	-0.27000	-0.24328	-0.21464	-0.19086	-0.17821	-0.16914
-35.000	-0.36130	-0.28554	-0.24600	-0.22923	-0.19665	-0.17769	-0.17033	-0.16204
-30.000	-0.31818	-0.25278	-0.21700	-0.21017	-0.17692	-0.15507	-0.16138	-0.15219
-25.000	-0.26987	-0.21518	-0.18600	-0.17921	-0.15775	-0.14065	-0.14829	-0.13941
-20.000	-0.21940	-0.17458	-0.15100	-0.14533	-0.13153	-0.12166	-0.13222	-0.12461
-15.000	-0.16724	-0.12814	-0.11400	-0.11122	-0.10752	-0.09693	-0.11089	-0.10507
-10.000	-0.10825	-0.08486	-0.07500	-0.07415	-0.07554	-0.06628	-0.08338	-0.08190
-5.000	-0.05573	-0.03873	-0.03600	-0.03786	-0.03846	-0.03704	-0.04424	-0.04551
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.04403	0.04407	0.04000	0.04070	0.05233	0.04883	0.04995	0.05034
10.000	0.07644	0.08151	0.07800	0.08659	0.09943	0.09690	0.10254	0.08962
15.000	0.10316	0.12474	0.12300	0.13914	0.15081	0.14716	0.12755	0.11669
20.000	0.12451	0.16563	0.17600	0.19992	0.19961	0.19878	0.14851	0.12863

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-17
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

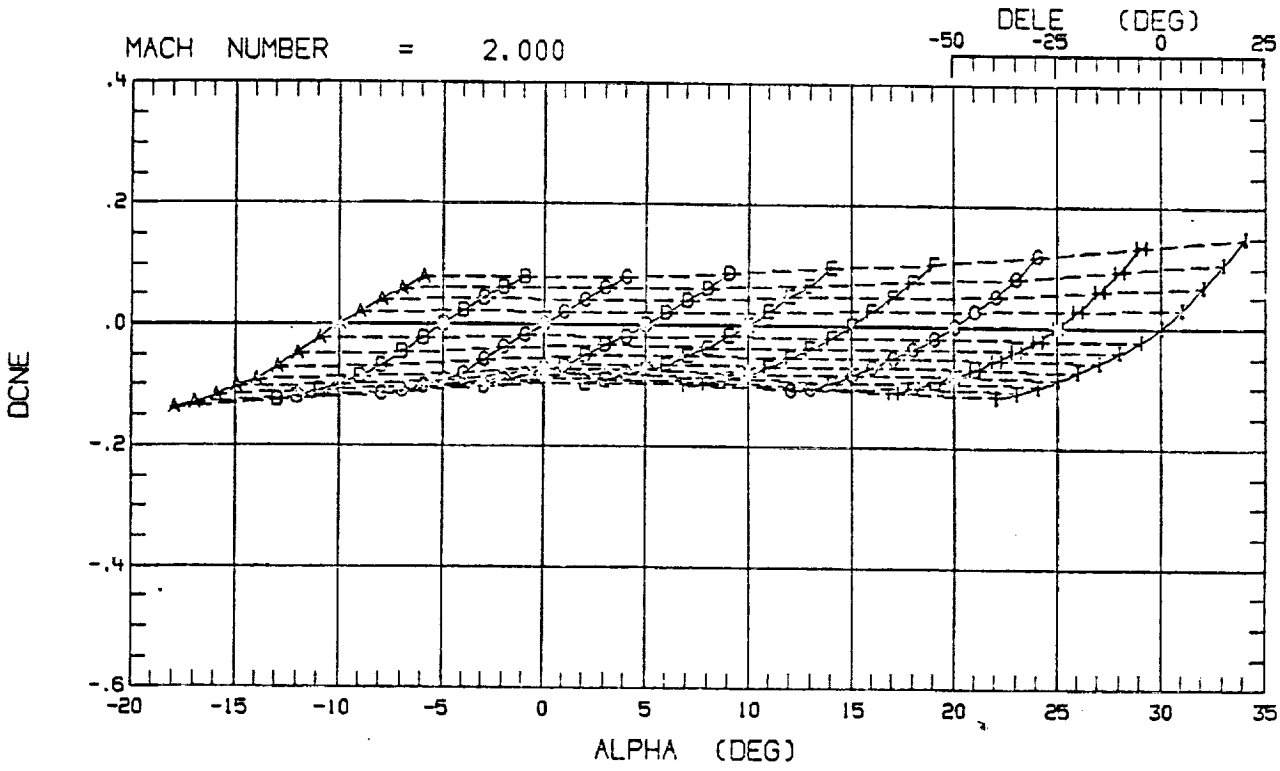
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.25126	-0.21725	-0.22071	-0.19612	-0.17532	-0.16669	-0.16336	-0.15770
-35.000	-0.22801	-0.20330	-0.20103	-0.17790	-0.16070	-0.15405	-0.15087	-0.15055
-30.000	-0.20137	-0.18340	-0.17821	-0.15874	-0.14707	-0.14440	-0.13551	-0.13992
-25.000	-0.17106	-0.15959	-0.15060	-0.13548	-0.13110	-0.12940	-0.12074	-0.12480
-20.000	-0.14064	-0.13187	-0.12363	-0.11373	-0.10488	-0.10660	-0.09949	-0.10050
-15.000	-0.10753	-0.10041	-0.09235	-0.08807	-0.08121	-0.08550	-0.07835	-0.07918
-10.000	-0.07579	-0.06755	-0.06076	-0.05955	-0.05491	-0.05890	-0.05308	-0.05379
-5.000	-0.03813	-0.03301	-0.03029	-0.03216	-0.02719	-0.02947	-0.02701	-0.02738
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.03125	0.03211	0.03005	0.03169	0.03760	0.04289	0.04853	0.05294
10.000	0.05952	0.06557	0.06064	0.06568	0.07686	0.08589	0.09753	0.10801
15.000	0.09217	0.09323	0.08980	0.10167	0.11125	0.13012	0.15163	0.17033
20.000	0.12451	0.11589	0.12316	0.14178	0.14498	0.17747	0.20761	0.23068

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1- 18
EFFECT OF ELEVON



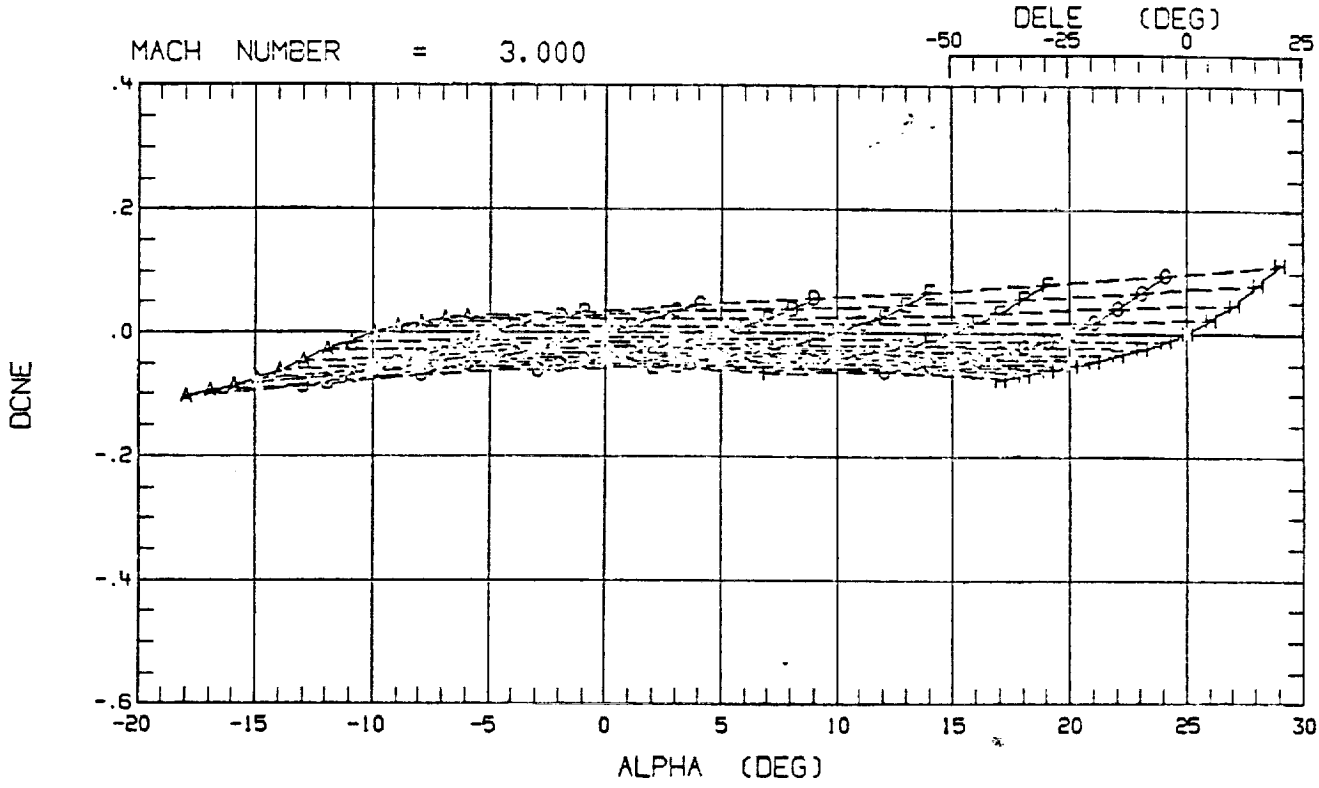
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT								
-40.000	-0.13682	-0.12580	-0.11500	-0.10225	-0.09640	-0.09982	-0.10653	-0.11097	-0.11843
-35.000	-0.13130	-0.11970	-0.11000	-0.09285	-0.09127	-0.09673	-0.10500	-0.10378	-0.10987
-30.000	-0.11887	-0.10961	-0.10300	-0.08545	-0.08336	-0.08952	-0.09560	-0.09301	-0.09958
-25.000	-0.10365	-0.09959	-0.09300	-0.07564	-0.07502	-0.08354	-0.08244	-0.08301	-0.08842
-20.000	-0.09137	-0.08668	-0.08100	-0.06921	-0.06668	-0.06957	-0.06895	-0.07249	-0.07429
-15.000	-0.07182	-0.06914	-0.06000	-0.05275	-0.05260	-0.05437	-0.05417	-0.05630	-0.05930
-10.000	-0.04835	-0.04752	-0.04000	-0.03504	-0.03800	-0.03936	-0.03905	-0.04081	-0.04281
-5.000	-0.02442	-0.02417	-0.02000	-0.02019	-0.01993	-0.02165	-0.02162	-0.02314	-0.02395
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01908	0.02096	0.01900	0.01936	0.02091	0.02410	0.02546	0.02755	0.03005
10.000	0.03875	0.04174	0.03900	0.03998	0.04628	0.04678	0.05101	0.05950	0.06670
15.000	0.05817	0.06023	0.05900	0.06078	0.06580	0.07340	0.08006	0.09399	0.10535
20.000	0.07678	0.07666	0.07800	0.06491	0.09471	0.10376	0.11808	0.13289	0.14810

ENGINEER DCQ
DATE 12-4-78

FIGURE 4.1.1.1-19
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.10457	-0.08652	-0.07000	-0.06137	-0.05735	-0.05620	-0.06508	-0.07636
-35.000	-0.09576	-0.08283	-0.06000	-0.05374	-0.05312	-0.05873	-0.05861	-0.06933
-30.000	-0.08796	-0.06919	-0.05200	-0.04708	-0.04692	-0.05030	-0.05425	-0.06186
-25.000	-0.07651	-0.06069	-0.04500	-0.04132	-0.03939	-0.04283	-0.04955	-0.05440
-20.000	-0.06210	-0.05120	-0.03700	-0.03461	-0.03482	-0.03439	-0.04297	-0.04652
-15.000	-0.04606	-0.04081	-0.02700	-0.02482	-0.02711	-0.02982	-0.03511	-0.03661
-10.000	-0.02803	-0.02742	-0.01700	-0.01694	-0.02039	-0.02210	-0.02409	-0.02579
-5.000	-0.01548	-0.01421	-0.01000	-0.01005	-0.01118	-0.01289	-0.01427	-0.01462
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00916	0.00905	0.00900	0.01018	0.01448	0.01604	0.01752	0.02265
10.000	0.01535	0.01992	0.02200	0.02253	0.02439	0.03215	0.04076	0.04567
15.000	0.02215	0.02464	0.03400	0.03708	0.04501	0.05561	0.06605	0.07860
20.000	0.02502	0.03153	0.04500	0.05372	0.06534	0.07862	0.09339	0.11012

ENGINEER Dco
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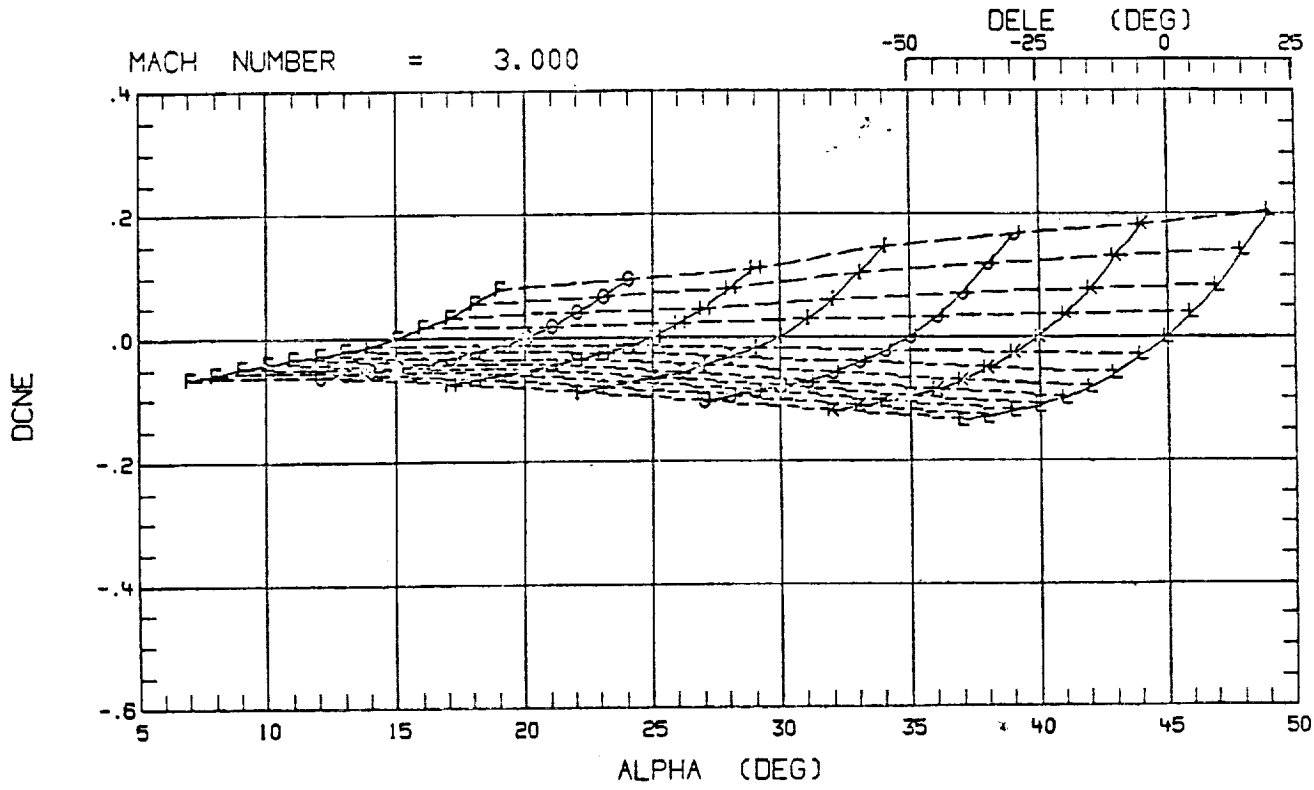
FIGURE 4.1.1.1-20
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.06620	-0.06508	-0.07636	-0.09046	-0.10530	-0.12130	-0.13672
-35.000	-0.05873	-0.05861	-0.06933	-0.08255	-0.09748	-0.11363	-0.12952
-30.000	-0.05030	-0.05425	-0.06186	-0.07427	-0.08953	-0.10595	-0.12126
-25.000	-0.04283	-0.04955	-0.05440	-0.06696	-0.08202	-0.09783	-0.11160
-20.000	-0.03439	-0.04297	-0.04652	-0.05903	-0.07339	-0.08713	-0.09934
-15.000	-0.02982	-0.03511	-0.03661	-0.04677	-0.05958	-0.07266	-0.08335
-10.000	-0.02210	-0.02409	-0.02579	-0.03352	-0.04233	-0.05148	-0.05992
-5.000	-0.01289	-0.01427	-0.01462	-0.01876	-0.02270	-0.02652	-0.03019
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01604	0.01752	0.02265	0.02819	0.03306	0.03736	0.03912
10.000	0.03215	0.04076	0.04567	0.05937	0.06961	0.07775	0.08338
15.000	0.05561	0.06605	0.07860	0.10290	0.11832	0.12998	0.14021
20.000	0.07862	0.09339	0.11012	0.14630	0.16599	0.18291	0.20343

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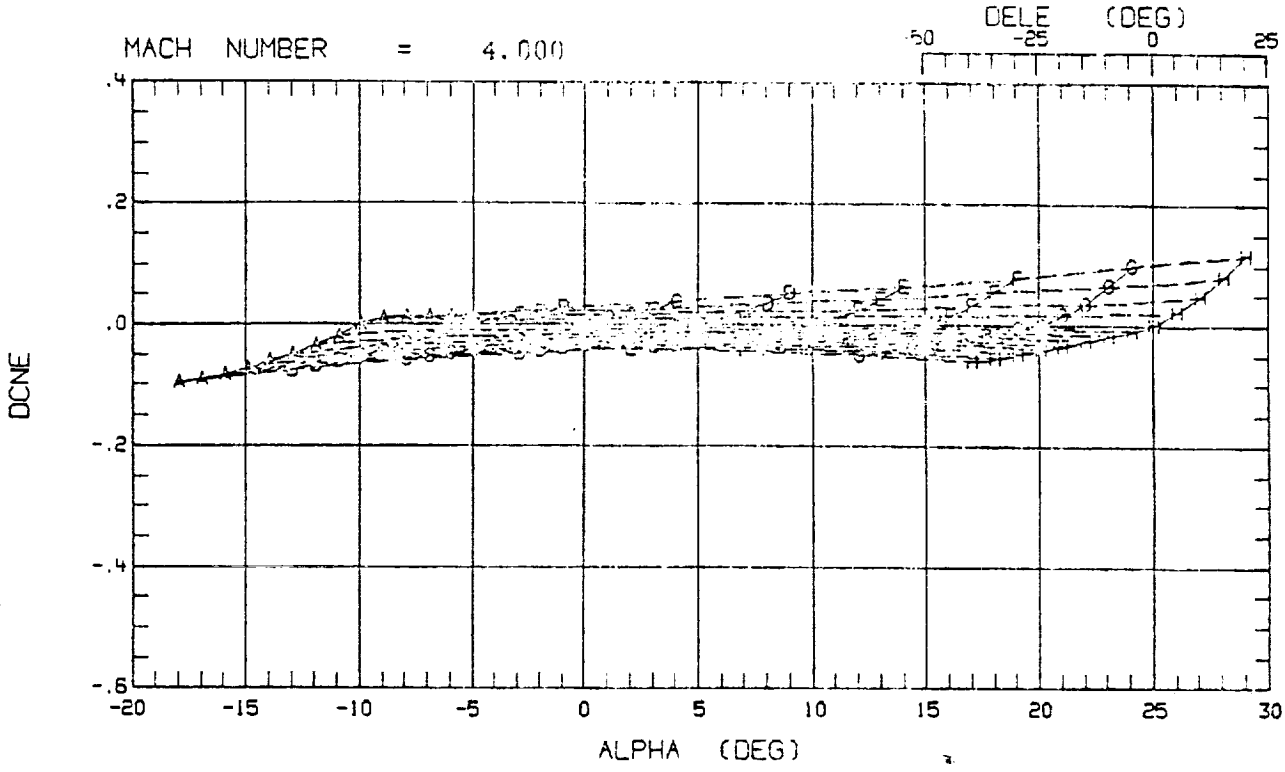
FIGURE 4.1.1.1-21
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.09746	-0.07621	-0.05000	-0.04912	-0.04059	-0.04540	-0.05107	-0.06317
-35.000	-0.09178	-0.06849	-0.05500	-0.04370	-0.03766	-0.04064	-0.04673	-0.05733
-30.000	-0.08414	-0.06091	-0.05000	-0.03915	-0.03328	-0.03549	-0.03851	-0.04957
-25.000	-0.07385	-0.05346	-0.04300	-0.03339	-0.02870	-0.03003	-0.03204	-0.04268
-20.000	-0.06258	-0.04605	-0.03600	-0.02863	-0.02595	-0.02429	-0.02700	-0.03579
-15.000	-0.05077	-0.03464	-0.02900	-0.02074	-0.02013	-0.01797	-0.01957	-0.02761
-10.000	-0.03601	-0.02335	-0.02000	-0.01395	-0.01521	-0.01289	-0.01307	-0.01930
-5.000	-0.02048	-0.01113	-0.01200	-0.00697	-0.00823	-0.00657	-0.00607	-0.01072
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00843	0.00715	0.00800	0.01014	0.01243	0.01508	0.01589	0.02271
10.000	0.01160	0.01412	0.01500	0.02146	0.02323	0.03174	0.03558	0.04775
15.000	0.01170	0.01992	0.02400	0.03578	0.04126	0.05464	0.06391	0.08029
20.000	0.01072	0.02577	0.03800	0.05111	0.06211	0.07826	0.09812	0.11629

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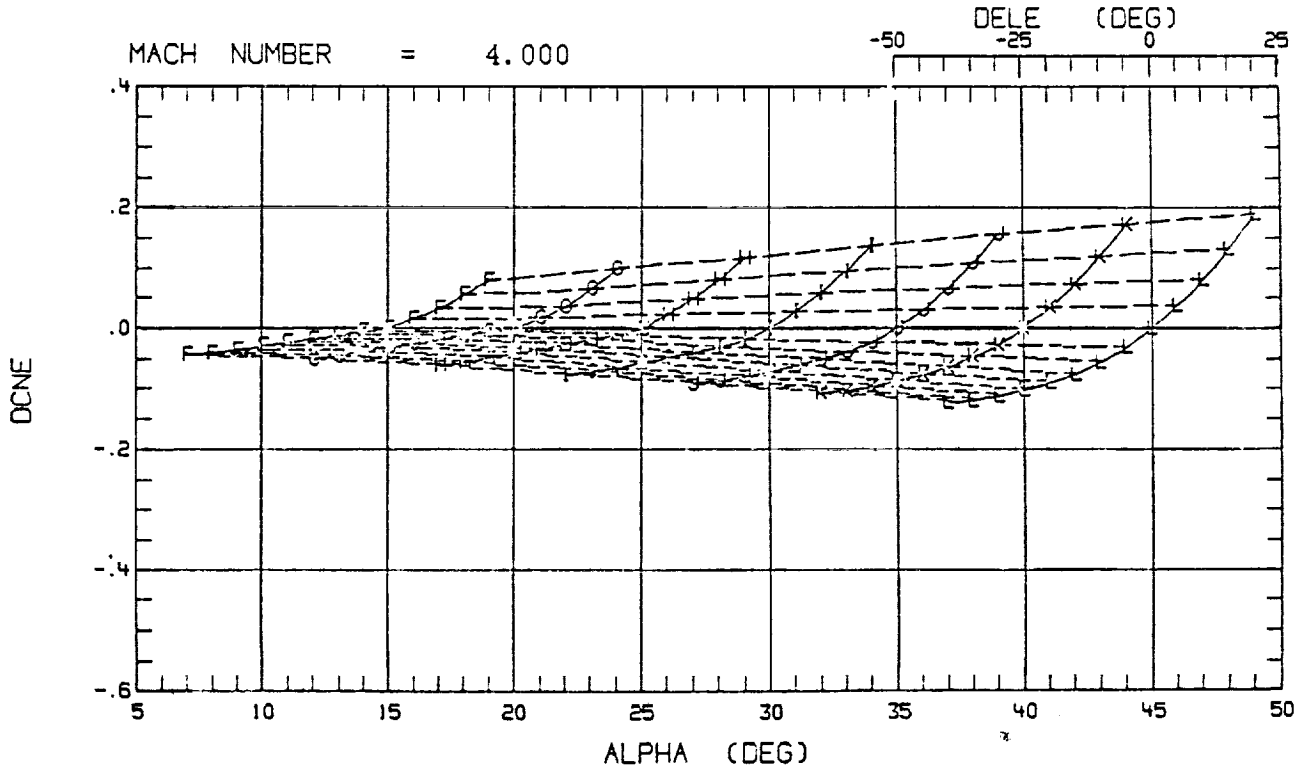
FIGURE 4.1.1.1-22
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.04540	-0.05107	-0.06317	-0.07737	-0.09172	-0.10703	-0.12263
-35.000	-0.04064	-0.04673	-0.05733	-0.07194	-0.08756	-0.10415	-0.12009
-30.000	-0.03549	-0.03851	-0.04957	-0.06585	-0.08086	-0.09686	-0.11230
-25.000	-0.03003	-0.03204	-0.04268	-0.05752	-0.07235	-0.08816	-0.10330
-20.000	-0.02429	-0.02700	-0.03579	-0.04944	-0.06290	-0.07715	-0.09098
-15.000	-0.01797	-0.01957	-0.02761	-0.04116	-0.05259	-0.06481	-0.07692
-10.000	-0.01289	-0.01307	-0.01930	-0.03242	-0.03976	-0.04765	-0.05681
-5.000	-0.00657	-0.00607	-0.01072	-0.01949	-0.02371	-0.02825	-0.03226
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01508	0.01589	0.02271	0.02595	0.02975	0.03384	0.03641
10.000	0.03174	0.03558	0.04775	0.05731	0.06568	0.07319	0.07997
15.000	0.05464	0.06391	0.08028	0.09416	0.10734	0.11934	0.13002
20.000	0.07826	0.09812	0.11629	0.13642	0.15528	0.17249	0.18656

ENGINEER DCO
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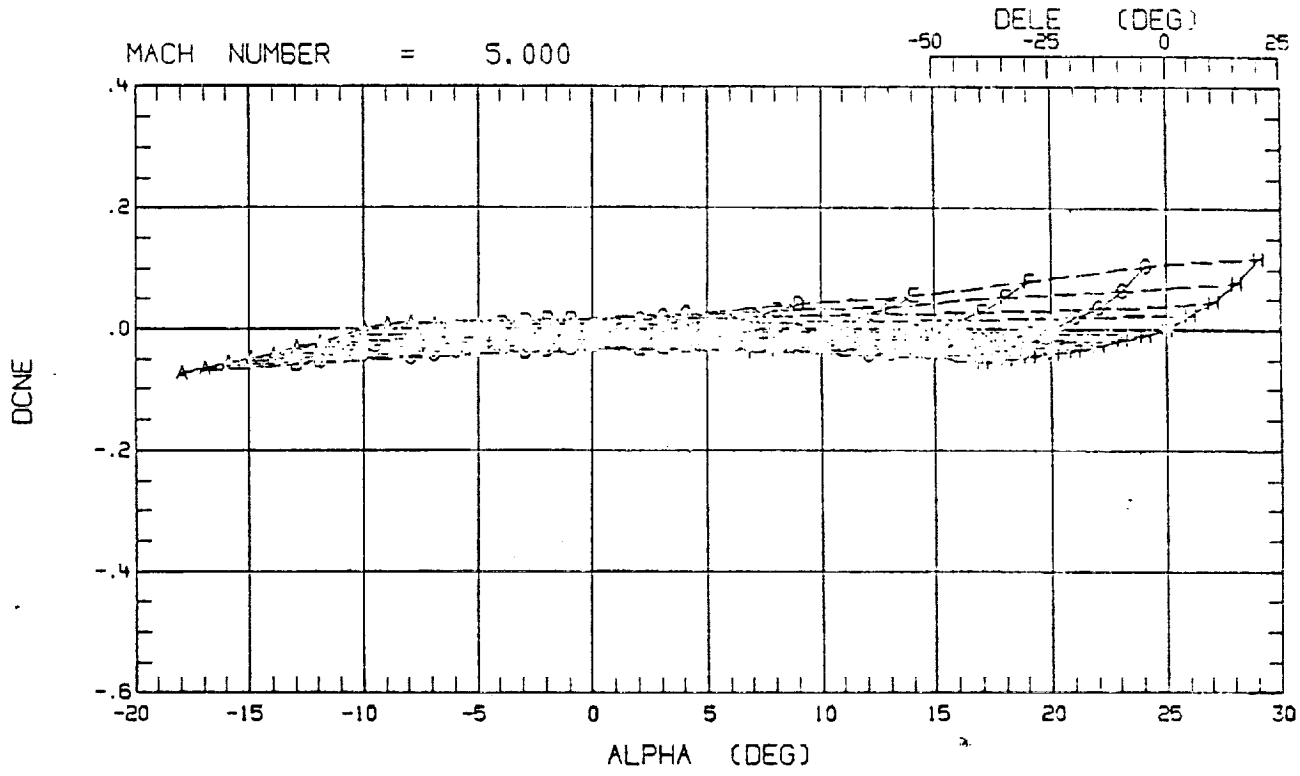
FIGURE 4.1.1.1-23
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07367	-0.06043	-0.04800	-0.04022	-0.03398	-0.03874	-0.04492	-0.05733
-35.000	-0.06599	-0.05370	-0.04500	-0.03677	-0.03260	-0.03529	-0.04053	-0.05176
-30.000	-0.05734	-0.04714	-0.03800	-0.03310	-0.02826	-0.03184	-0.03614	-0.04706
-25.000	-0.05015	-0.04162	-0.03300	-0.02845	-0.02562	-0.02826	-0.03154	-0.04137
-20.000	-0.04295	-0.03510	-0.02800	-0.02471	-0.02198	-0.02468	-0.02695	-0.03663
-15.000	-0.03204	-0.02671	-0.02100	-0.01893	-0.01726	-0.01889	-0.02107	-0.02870
-10.000	-0.02506	-0.01733	-0.01400	-0.01304	-0.01630	-0.01309	-0.01895	-0.01995
-5.000	-0.01336	-0.00905	-0.00700	-0.00602	-0.00626	-0.00655	-0.00769	-0.01105
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00553	0.00615	0.00700	0.00915	0.01144	0.01372	0.01871	0.02296
10.000	0.00964	0.01213	0.01400	0.01830	0.02316	0.02764	0.03325	0.04357
15.000	0.00759	0.01295	0.01900	0.02972	0.03510	0.05283	0.06263	0.07587
20.000	0.00265	0.01377	0.02400	0.04014	0.05415	0.07786	0.10323	0.11511

ENGINEER DCO
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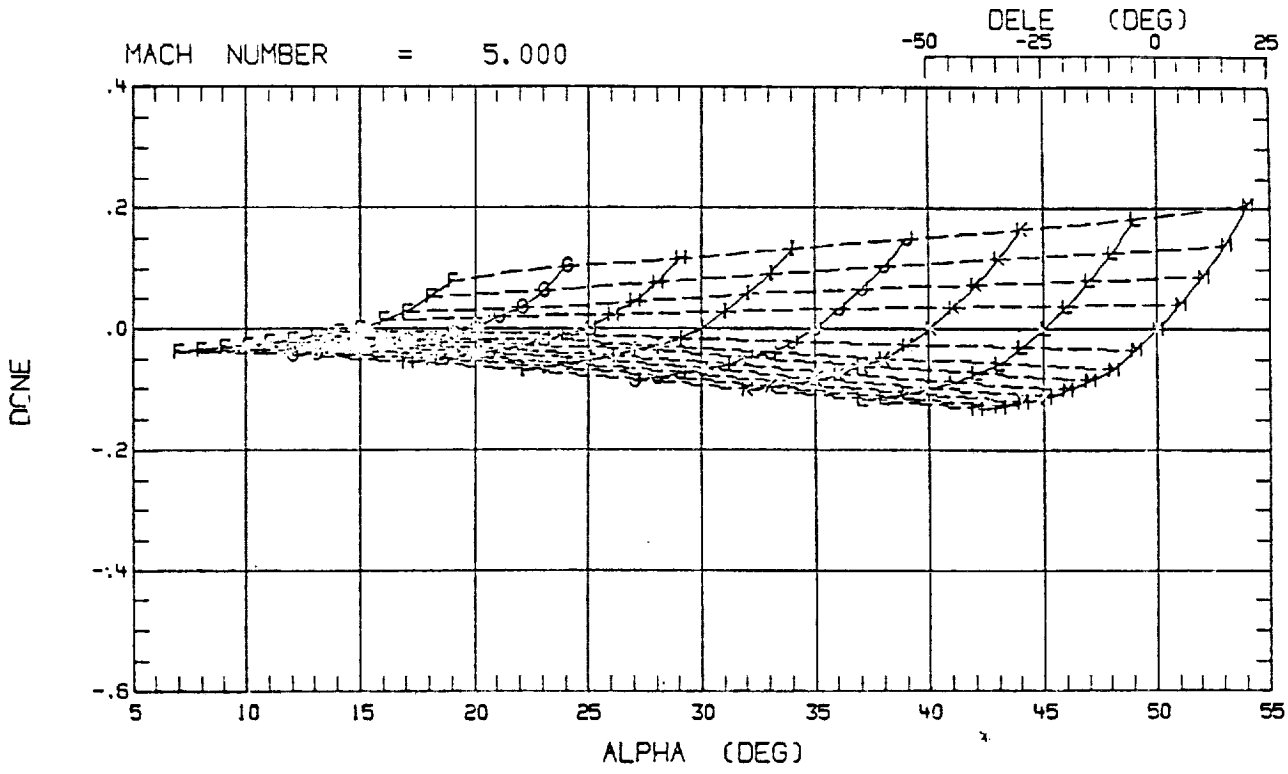
FIGURE 4.1.1.1-24
EFFECT OF ELEVON



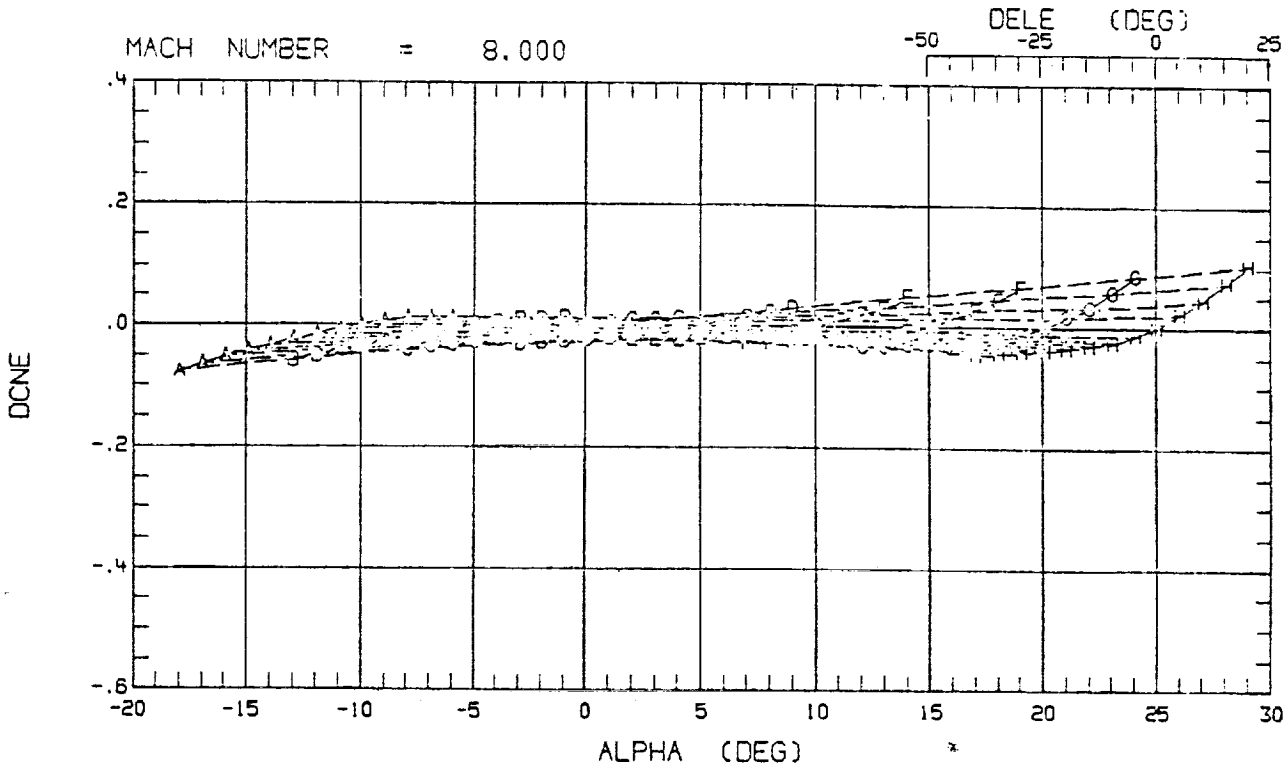
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.03874	-0.04492	-0.05733	-0.07044	-0.08667	-0.10349	-0.11889	-0.13330
-35.000	-0.03529	-0.04053	-0.05176	-0.06510	-0.08151	-0.09832	-0.11442	-0.12963
-30.000	-0.03184	-0.03614	-0.04706	-0.05975	-0.07577	-0.09244	-0.10814	-0.12298
-25.000	-0.02826	-0.03154	-0.04137	-0.05299	-0.06907	-0.08579	-0.10087	-0.11462
-20.000	-0.02468	-0.02695	-0.03663	-0.04709	-0.06161	-0.07670	-0.09047	-0.10321
-15.000	-0.01869	-0.02107	-0.02870	-0.03703	-0.04984	-0.06327	-0.07574	-0.08707
-10.000	-0.01309	-0.01895	-0.01995	-0.03038	-0.04074	-0.05066	-0.06013	-0.06901
-5.000	-0.00655	-0.00769	-0.01105	-0.01761	-0.02312	-0.02793	-0.03233	-0.03647
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01372	0.01871	0.02296	0.02805	0.03192	0.03517	0.03809	0.04068
10.000	0.02764	0.03325	0.04357	0.05638	0.06512	0.07257	0.07954	0.08570
15.000	0.05283	0.06263	0.07587	0.08969	0.10261	0.11499	0.12630	0.13746
20.000	0.07786	0.10323	0.11511	0.13209	0.14776	0.16355	0.18226	0.20429

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-25
EFFECT OF ELEVON



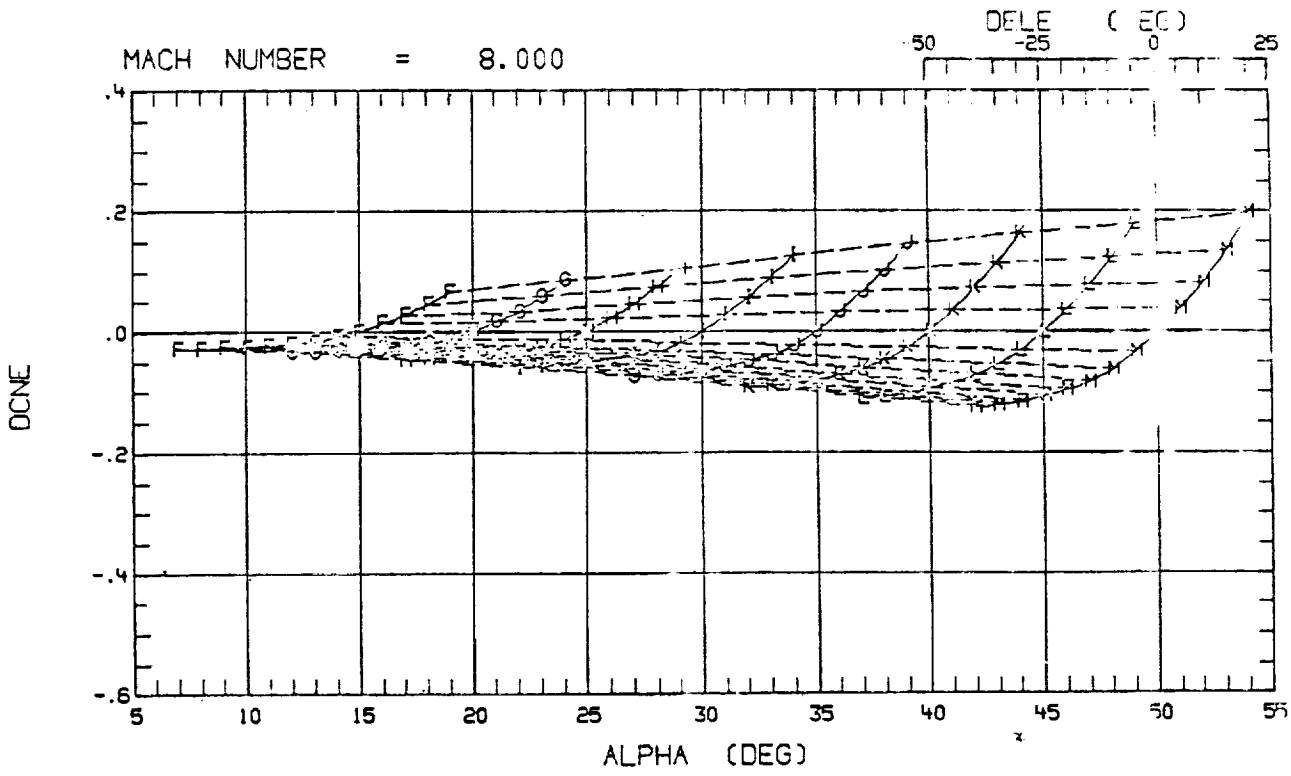
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07722	-0.05815	-0.04200	-0.03172	-0.02413	-0.02957	-0.03445	-0.04694
-35.000	-0.06486	-0.05058	-0.03700	-0.03000	-0.02339	-0.02798	-0.03298	-0.04512
-30.000	-0.05250	-0.04202	-0.03300	-0.02729	-0.02365	-0.02735	-0.03245	-0.04245
-25.000	-0.04323	-0.03454	-0.02800	-0.02448	-0.02179	-0.02552	-0.02970	-0.03947
-20.000	-0.03395	-0.02807	-0.02300	-0.02167	-0.01994	-0.02369	-0.02674	-0.03654
-15.000	-0.02487	-0.02170	-0.01900	-0.01778	-0.01797	-0.02066	-0.02338	-0.03142
-10.000	-0.01580	-0.01432	-0.01200	-0.01488	-0.01502	-0.01764	-0.01962	-0.02630
-5.000	-0.00740	-0.00717	-0.00700	-0.00695	-0.00997	-0.00832	-0.01299	-0.01362
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00557	0.00509	0.00500	0.00715	0.00939	0.01327	0.01555	0.02166
10.000	0.01077	0.01017	0.01000	0.01429	0.01803	0.02655	0.03267	0.04427
15.000	0.01084	0.01011	0.01000	0.02264	0.02975	0.04555	0.05776	0.07362
20.000	0.01224	0.01105	0.01100	0.02999	0.04662	0.06549	0.08403	0.10297

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-26
EFFECT OF ELEVON

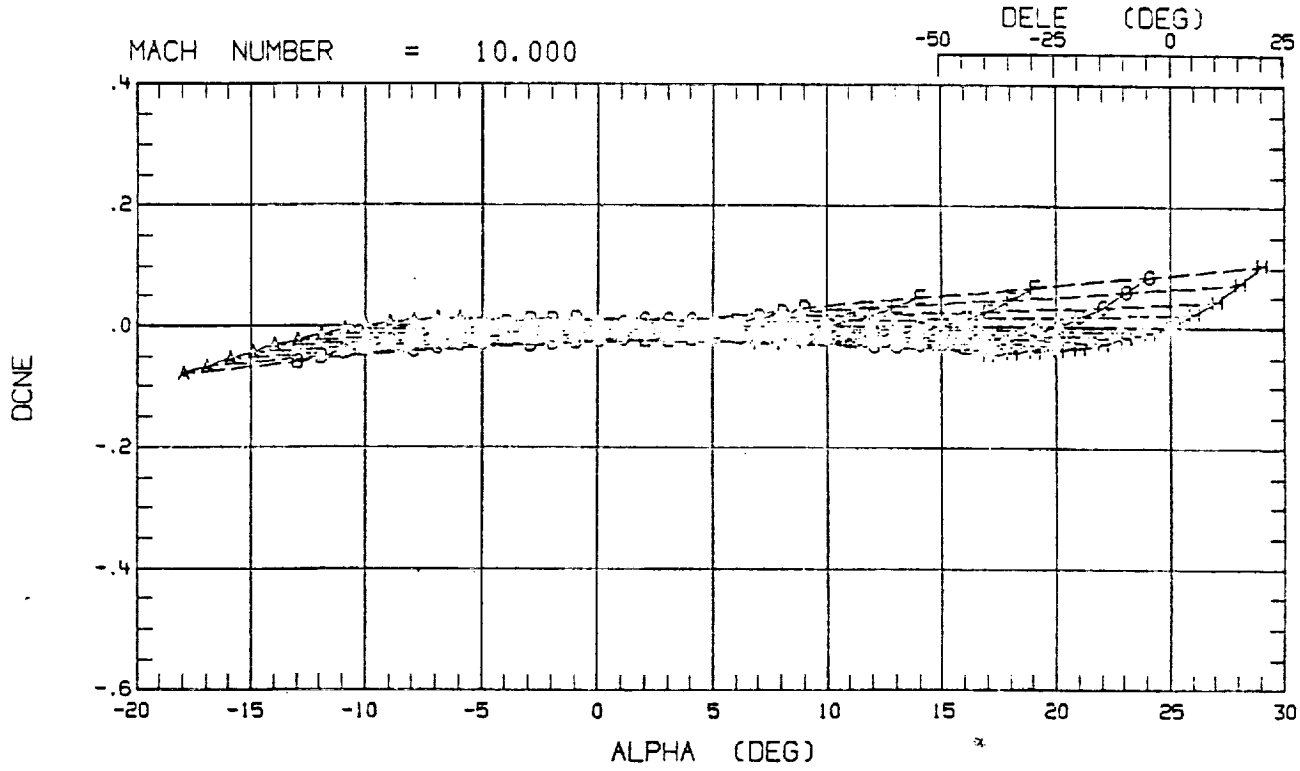


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.02957	-0.03445	-0.04694	-0.05977	-0.07577	-0.09287	-0.10962	-0.12641
-35.000	-0.02798	-0.03298	-0.04512	-0.05667	-0.07331	-0.09063	-0.10677	-0.12220
-30.000	-0.02735	-0.03245	-0.04245	-0.05357	-0.07030	-0.08743	-0.10272	-0.11672
-25.000	-0.02552	-0.02970	-0.03947	-0.04941	-0.06485	-0.08085	-0.09472	-0.10695
-20.000	-0.02369	-0.02674	-0.03654	-0.04524	-0.05879	-0.07292	-0.08583	-0.09775
-15.000	-0.02066	-0.02338	-0.03142	-0.03924	-0.05002	-0.06147	-0.07282	-0.08375
-10.000	-0.01764	-0.01962	-0.02630	-0.03325	-0.04013	-0.04765	-0.05543	-0.06322
-5.000	-0.00832	-0.01299	-0.01362	-0.02047	-0.02380	-0.02761	-0.03116	-0.03443
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01327	0.01555	0.02166	0.02669	0.03080	0.03396	0.03602	0.03708
10.000	0.02655	0.03267	0.04427	0.05586	0.06499	0.07197	0.07662	0.07965
15.000	0.04555	0.05776	0.07362	0.08796	0.10108	0.11281	0.12304	0.13345
20.000	0.06549	0.08403	0.10297	0.12472	0.14500	0.16285	0.17929	0.19712

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-27
EFFECT OF ELEVON



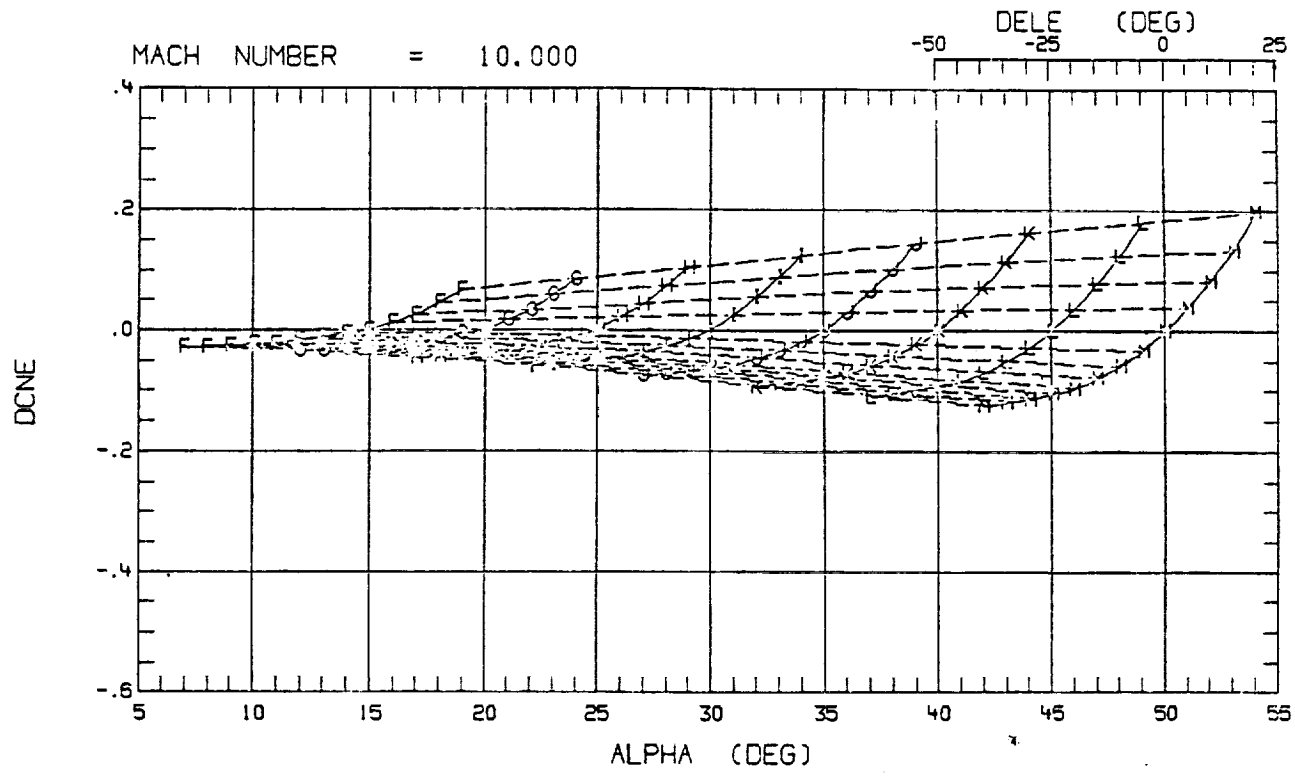
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07889	-0.05933	-0.04200	-0.03170	-0.02408	-0.02950	-0.03441	-0.04694
-35.000	-0.06632	-0.05070	-0.03700	-0.02898	-0.02331	-0.02790	-0.03298	-0.04422
-30.000	-0.05472	-0.04308	-0.03200	-0.02625	-0.02154	-0.02630	-0.03158	-0.04150
-25.000	-0.04337	-0.03458	-0.02800	-0.02346	-0.01973	-0.02448	-0.02966	-0.03852
-20.000	-0.03203	-0.02708	-0.02300	-0.02066	-0.01792	-0.02265	-0.02778	-0.03650
-15.000	-0.02399	-0.01972	-0.01700	-0.01479	-0.01400	-0.01675	-0.02083	-0.02866
-10.000	-0.01499	-0.01336	-0.01100	-0.00991	-0.00909	-0.01179	-0.01485	-0.01991
-5.000	-0.00733	-0.00618	-0.00600	-0.00495	-0.00503	-0.00540	-0.00694	-0.00996
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00455	0.00409	0.00400	0.00712	0.00835	0.01226	0.01555	0.02166
10.000	0.00970	0.00917	0.00900	0.01325	0.01792	0.02454	0.03267	0.04328
15.000	0.01072	0.01010	0.01000	0.02062	0.03275	0.04450	0.05776	0.07259
20.000	0.01220	0.01103	0.01000	0.02899	0.04760	0.06447	0.08393	0.10280

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1- 28
EFFECT OF ELEVON



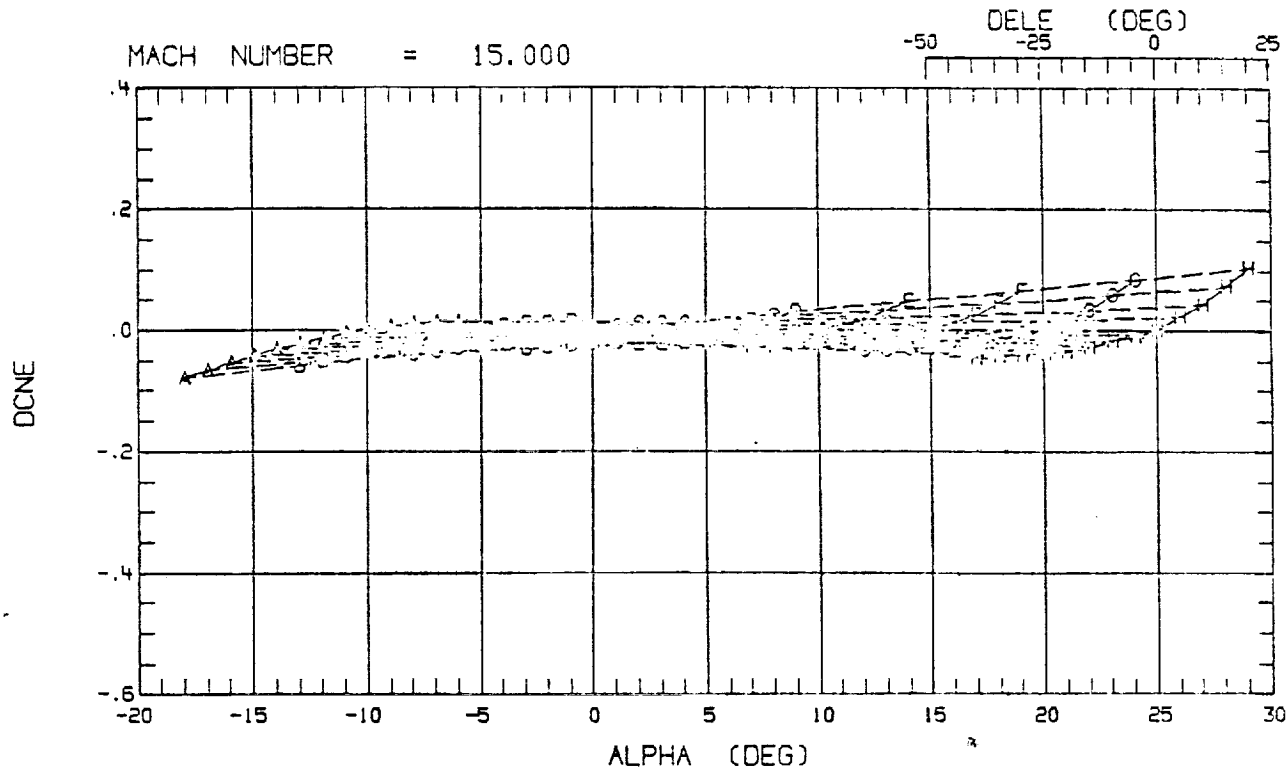
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.02950	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.02790	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.02630	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02448	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02265	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.01675	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01179	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00540	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01226	0.01555	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.02454	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.04450	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.06447	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-29
EFFECT OF ELEVON



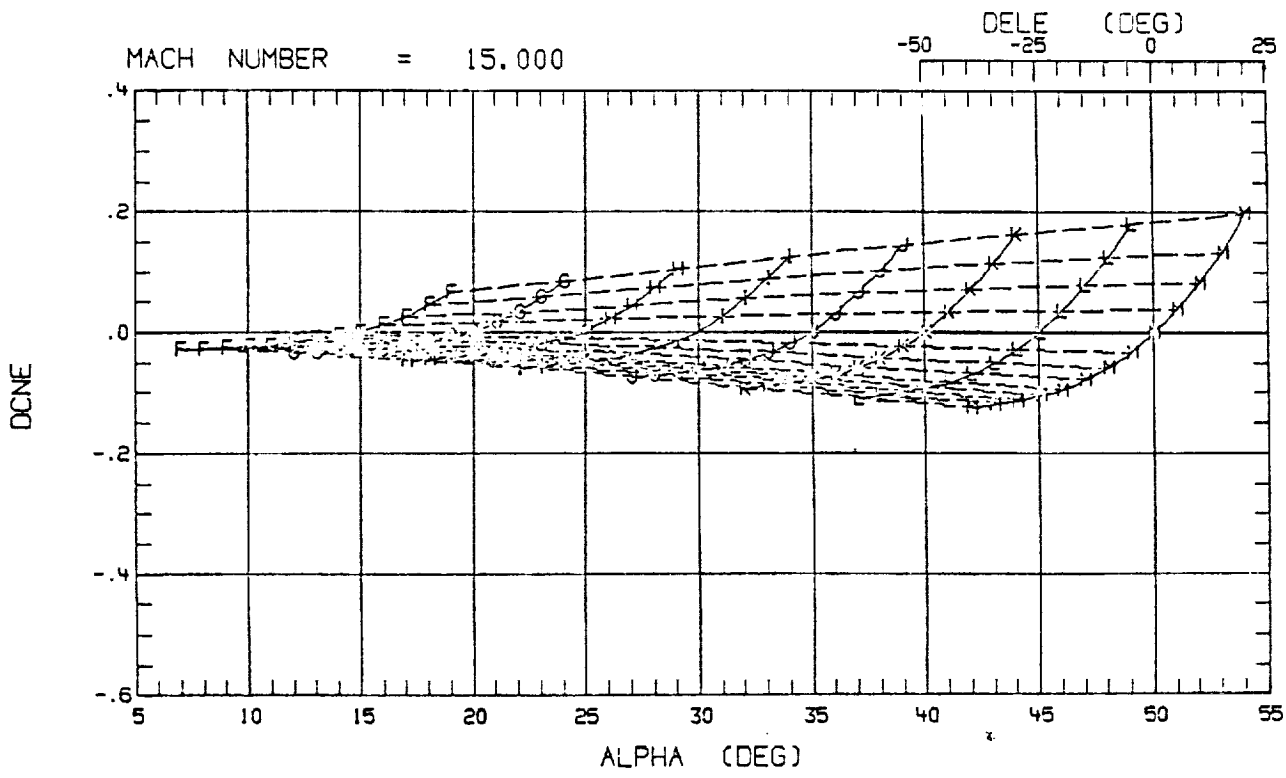
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07889	-0.05933	-0.04200	-0.03170	-0.02408	-0.02950	-0.03441	-0.04694
-35.000	-0.06632	-0.05070	-0.03700	-0.02898	-0.02331	-0.02790	-0.03298	-0.04422
-30.000	-0.05472	-0.04308	-0.03200	-0.02625	-0.02154	-0.02630	-0.03158	-0.04150
-25.000	-0.04337	-0.03458	-0.02800	-0.02346	-0.01973	-0.02448	-0.02966	-0.03852
-20.000	-0.03203	-0.02708	-0.02300	-0.02066	-0.01792	-0.02265	-0.02778	-0.03650
-15.000	-0.02399	-0.01972	-0.01700	-0.01479	-0.01400	-0.01675	-0.02083	-0.02666
-10.000	-0.01499	-0.01336	-0.01100	-0.00991	-0.00909	-0.01179	-0.01485	-0.01991
-5.000	-0.00733	-0.00618	-0.00600	-0.00495	-0.00503	-0.00540	-0.00694	-0.00996
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00455	0.00409	0.00400	0.00712	0.00835	0.01226	0.01555	0.02166
10.000	0.00970	0.00917	0.00900	0.01325	0.01792	0.02454	0.03267	0.04329
15.000	0.01072	0.01010	0.01000	0.02062	0.03275	0.04450	0.05776	0.07259
20.000	0.01220	0.01103	0.01000	0.02899	0.04760	0.06447	0.08393	0.10390

ENGINEER DSO
DATE 10-4-78

FIGURE 4.1.1.1-30
EFFECT OF ELEVON

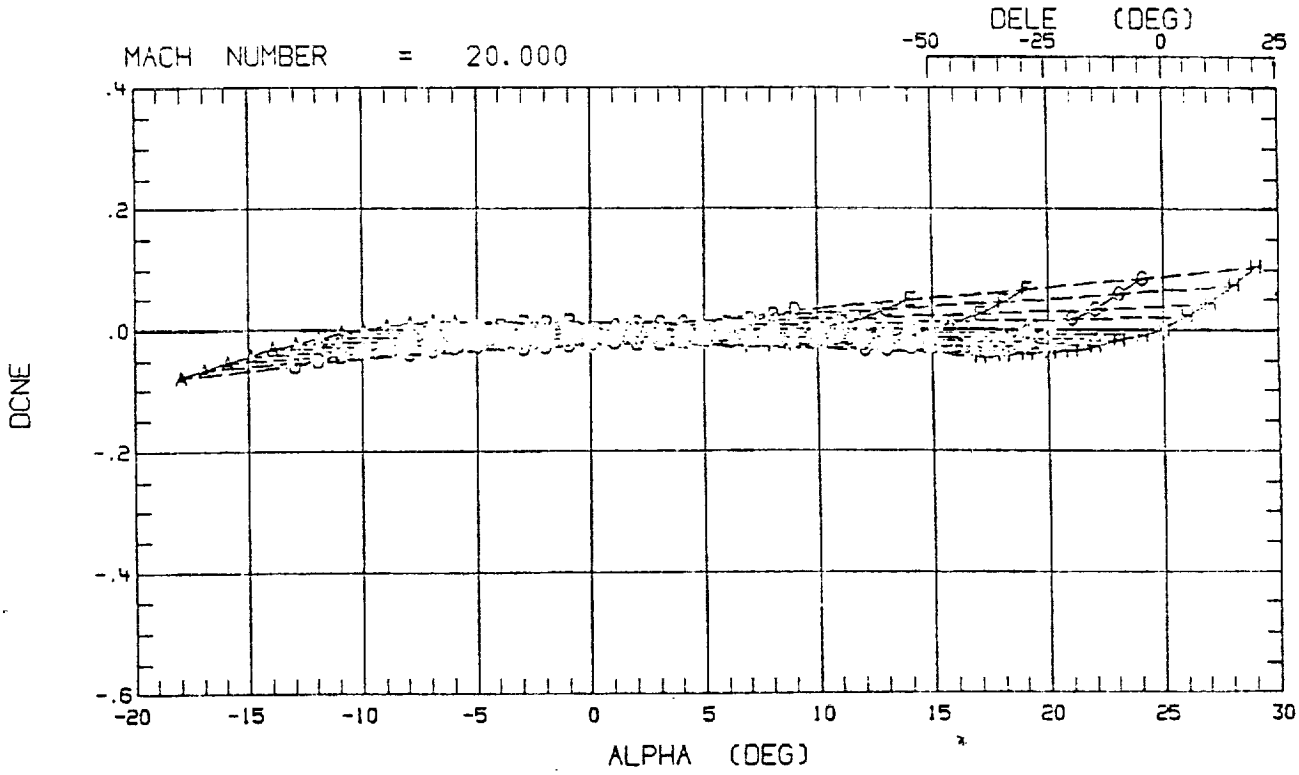


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.02950	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.02790	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.02630	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02448	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02265	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.01675	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01179	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00540	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01226	0.01555	0.02166	0.02507	0.02929	0.03268	0.03504	0.03658
10.000	0.02454	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.04450	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.06447	0.08393	0.10290	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-31
EFFECT OF ELEVON



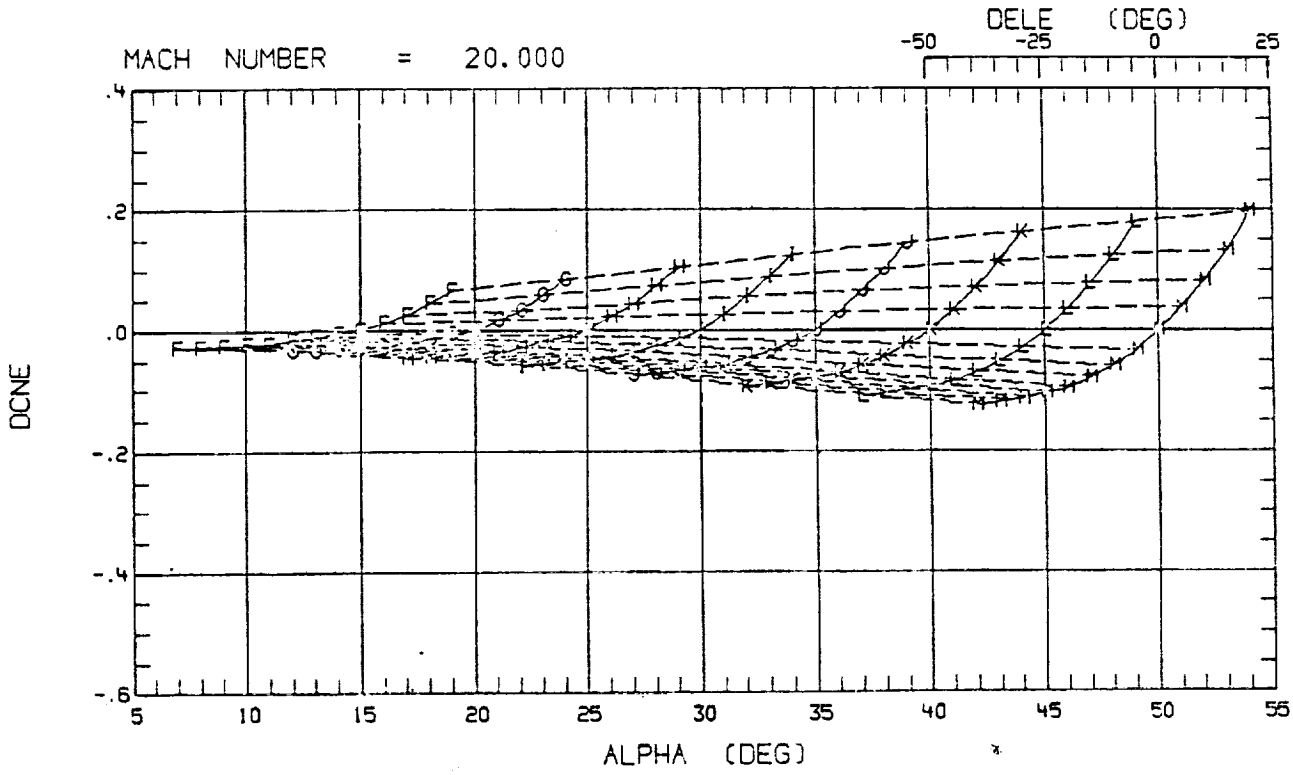
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07889	-0.05933	-0.04200	-0.03170	-0.02408	-0.02950	-0.03441	-0.04694
-35.000	-0.06632	-0.05070	-0.03700	-0.02898	-0.02331	-0.02790	-0.03298	-0.04422
-30.000	-0.05472	-0.04308	-0.03200	-0.02625	-0.02154	-0.02630	-0.03158	-0.04150
-25.000	-0.04337	-0.03458	-0.02800	-0.02346	-0.01973	-0.02448	-0.02966	-0.03852
-20.000	-0.03203	-0.02708	-0.02300	-0.02066	-0.01792	-0.02265	-0.02778	-0.03650
-15.000	-0.02399	-0.01972	-0.01700	-0.01479	-0.01400	-0.01675	-0.02083	-0.02866
-10.000	-0.01499	-0.01336	-0.01100	-0.00991	-0.00909	-0.01179	-0.01465	-0.01991
-5.000	-0.00733	-0.00618	-0.00600	-0.00495	-0.00503	-0.00540	-0.00694	-0.00996
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00455	0.00409	0.00400	0.00712	0.00835	0.01226	0.01555	0.02166
10.000	0.00970	0.00917	0.00900	0.01325	0.01792	0.02454	0.03267	0.04328
15.000	0.01072	0.01010	0.01000	0.02062	0.03275	0.04450	0.05776	0.07259
20.000	0.01220	0.01103	0.01000	0.02899	0.04760	0.06447	0.08393	0.10280

ENGINEER D.C.D.
DATE 10-4-78

FIGURE 4.1.1.1-32
EFFECT OF ELEVON



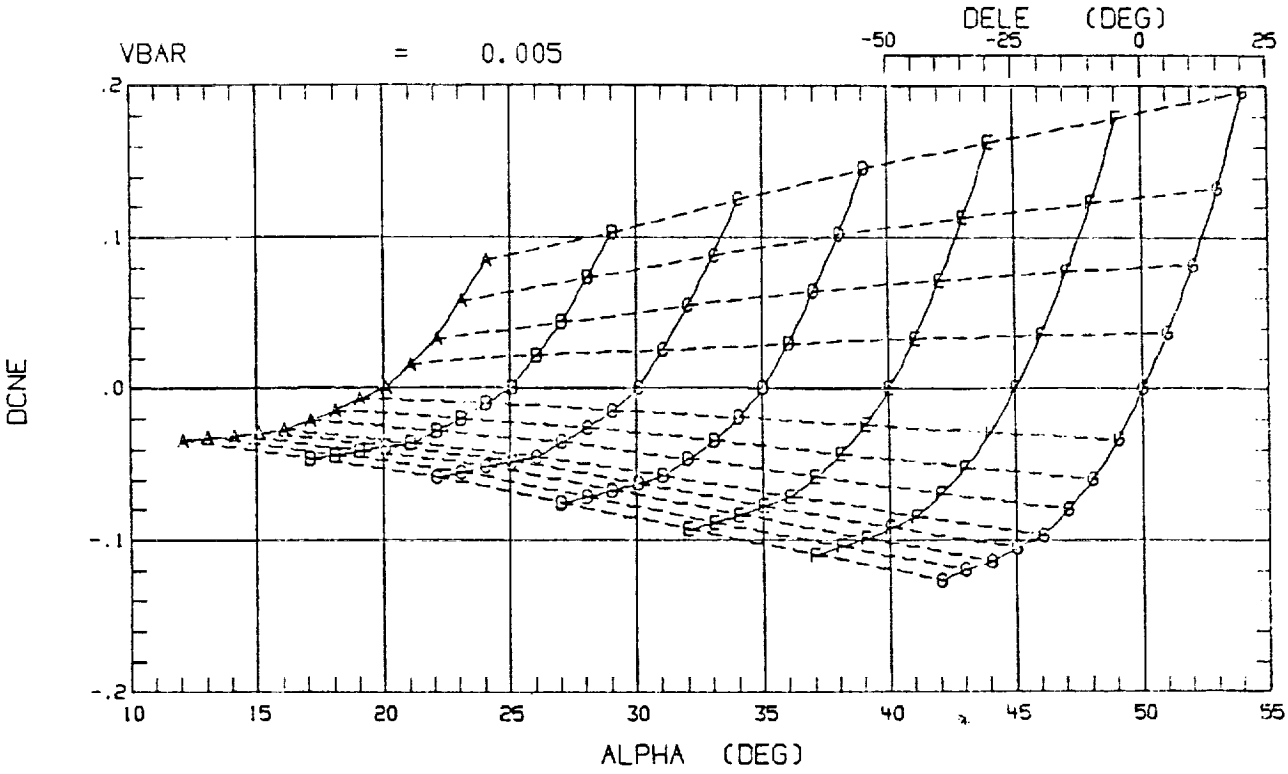
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.02950	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.02790	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.02630	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02448	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02265	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.01675	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01179	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00540	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01226	0.01555	0.02166	0.02507	0.02929	0.03268	0.03504	0.03658
10.000	0.02454	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.04450	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.06447	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1- 33
EFFECT OF ELEVON

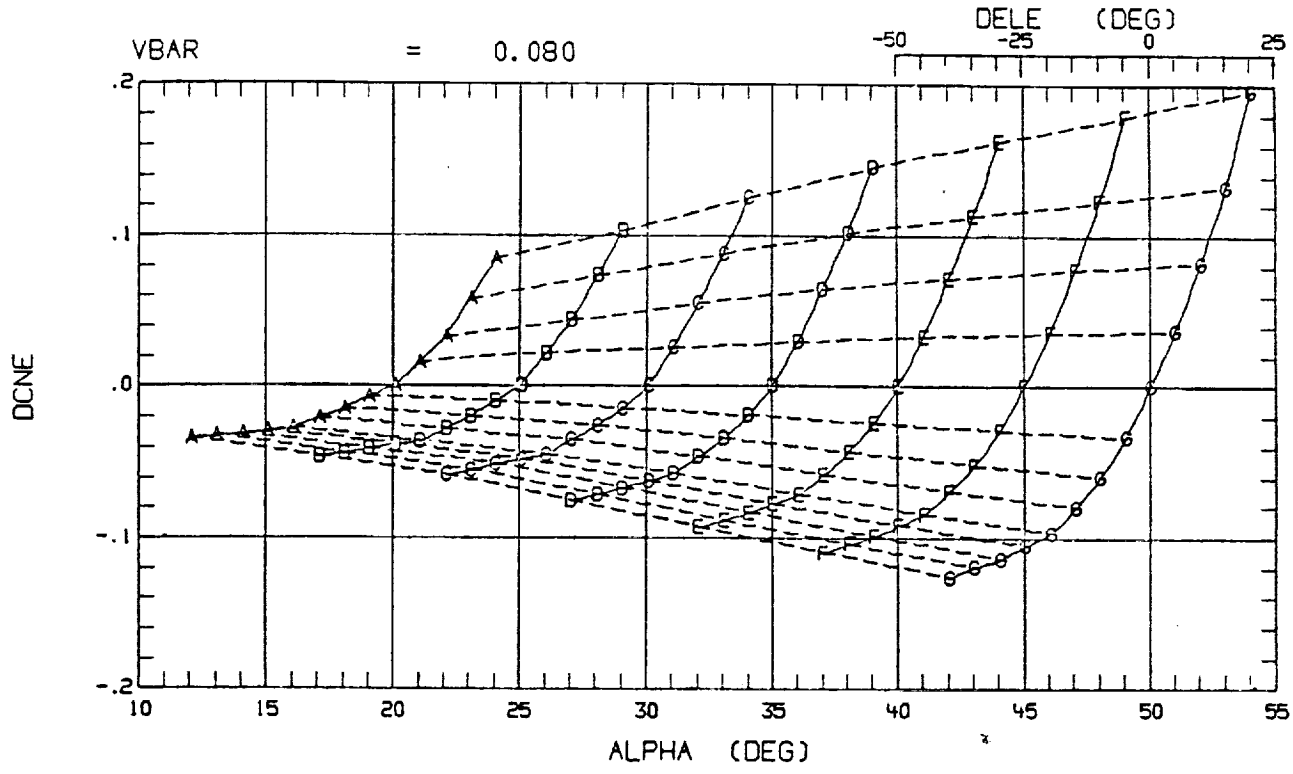


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01465	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01556	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER NASA
DATE

FIGURE 4.1.1.1-34
EFFECT OF ELEVON

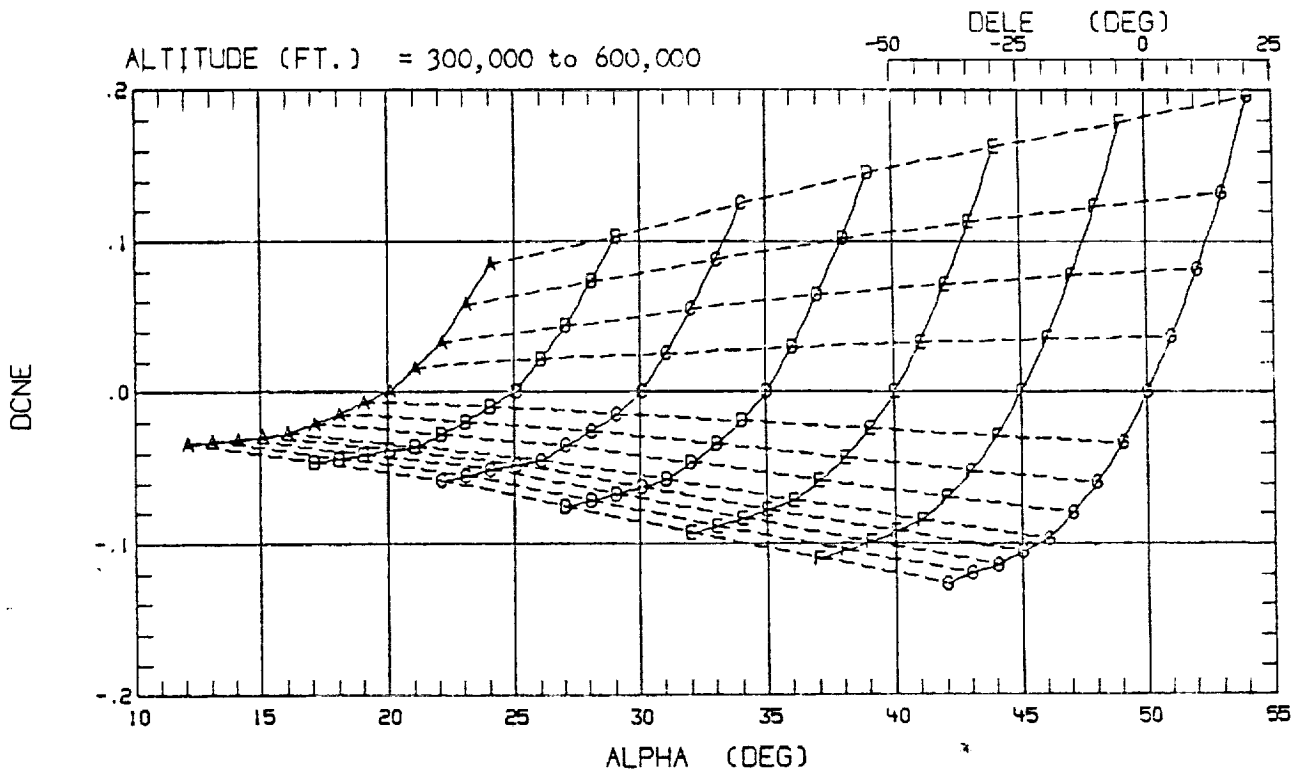


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.02083	-0.02966	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01555	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER NASA
DATE

FIGURE 4.1.1.1-35
EFFECT OF ELEVON

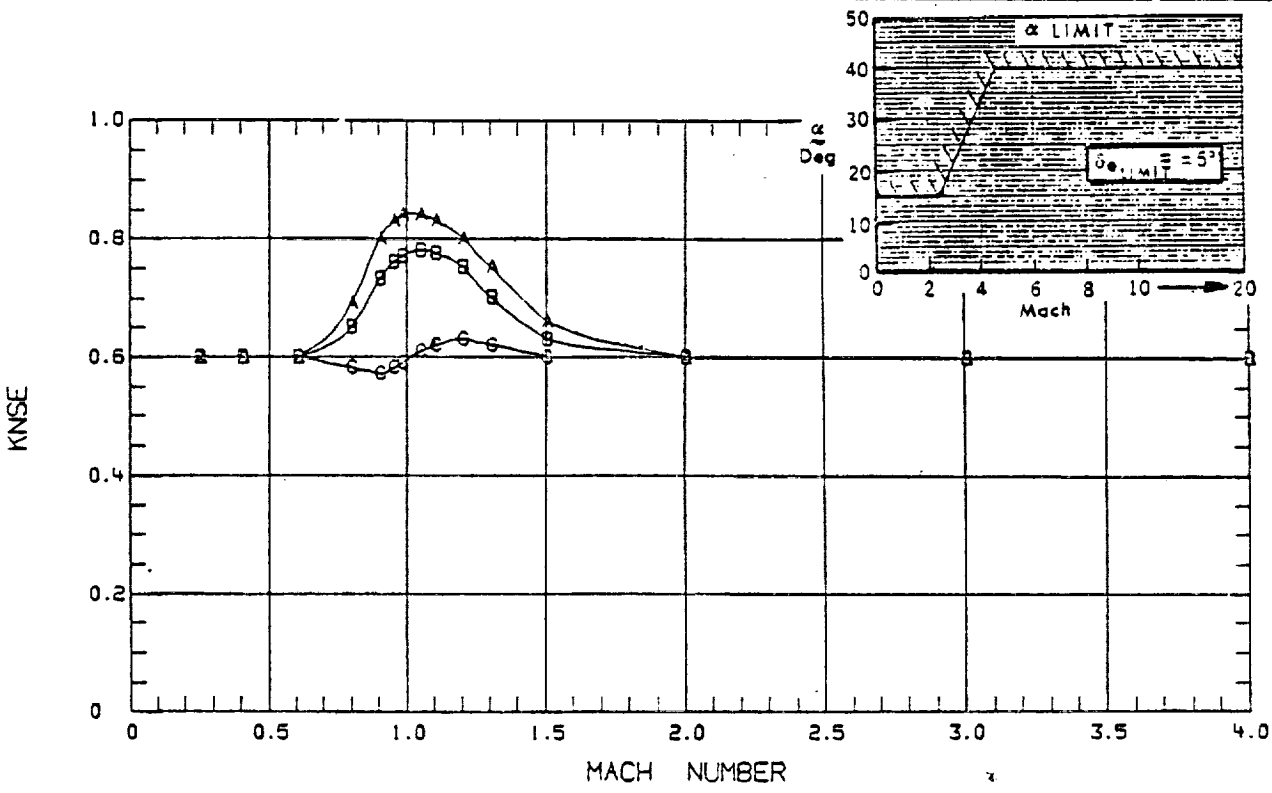


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.02083	-0.02666	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01555	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER NASA
DATE

FIGURE 4.1.1.1-36
EFFECT OF ELEVON



CONFIGURATION

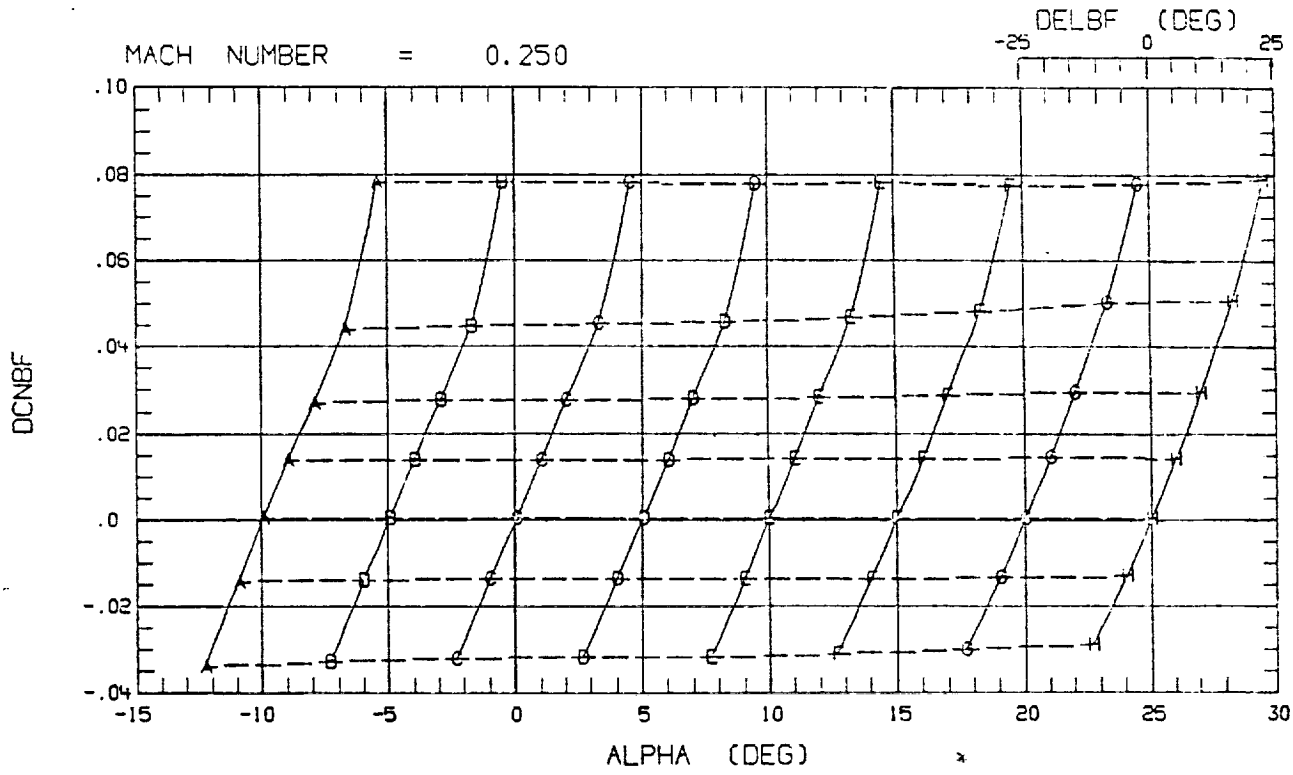
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	DELE (DEG)		
	-5.000 A	0.0 B	5.000 C
MACH NUMBER	NORMAL FORCE PARTIAL SPAN FACTOR		
0.250	0.60000	0.60000	0.60000
0.400	0.60000	0.60000	0.60000
0.600	0.60000	0.60000	0.60000
0.800	0.69000	0.65000	0.58000
0.900	0.80000	0.73000	0.57000
0.950	0.83000	0.76000	0.58000
0.980	0.84000	0.77000	0.59000
1.050	0.84000	0.78000	0.61000
1.100	0.83000	0.77500	0.62000
1.200	0.80000	0.75000	0.63000
1.300	0.75000	0.70000	0.62000
1.500	0.66000	0.63000	0.60000
2.000	0.60000	0.60000	0.60000
3.000	0.60000	0.60000	0.60000
4.000	0.60000	0.60000	0.60000
5.000	0.60000	0.60000	0.60000
8.000	0.60000	0.60000	0.60000
10.000	0.60000	0.60000	0.60000
15.000	0.60000	0.60000	0.60000
20.000	0.60000	0.60000	0.60000

NOTE: In the event partial span factors are required which exceed the given limits, the Aero Data Unit at Rockwell International should be contacted before extrapolation of the given data.

ENGINEER WMZ
DATE 10-4-78 Rev 1-26-79

FIGURE 4.1.1.1-37
ELEVON PARTIAL SPAN FACTOR



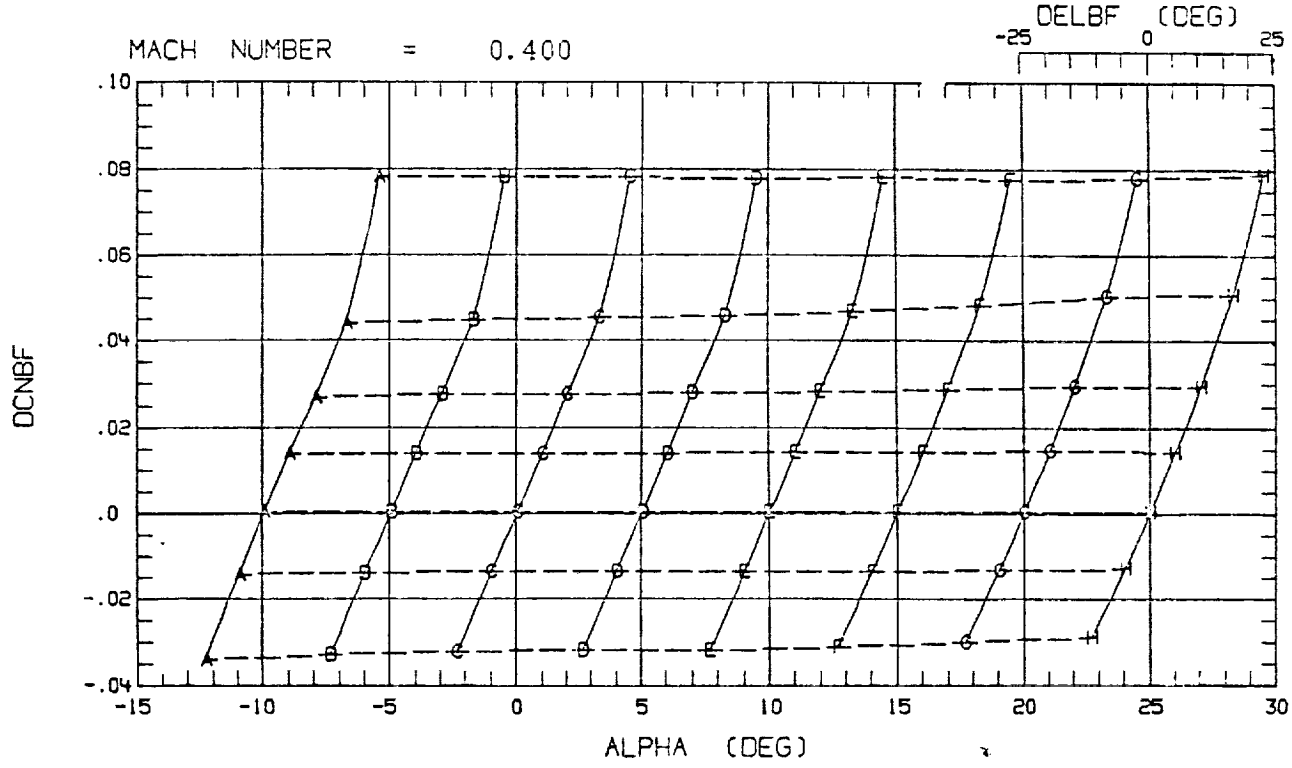
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.03407	-0.03291	-0.03220	-0.03187	-0.03180	-0.03109	-0.03005	-0.02693
-5.000	-0.01430	-0.01398	-0.01379	-0.01372	-0.01376	-0.01365	-0.01346	-0.01312
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01349	0.01382	0.01380	0.01382	0.01396	0.01409	0.01426	0.01411
10.000	0.02692	0.02752	0.02761	0.02774	0.02812	0.02866	0.02938	0.02927
16.300	0.04392	0.04474	0.04520	0.04567	0.04663	0.04815	0.05017	0.05047
22.500	0.07780	0.07801	0.07780	0.07770	0.07782	0.07719	0.07762	0.07861

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-38
EFFECT OF BODY FLAP

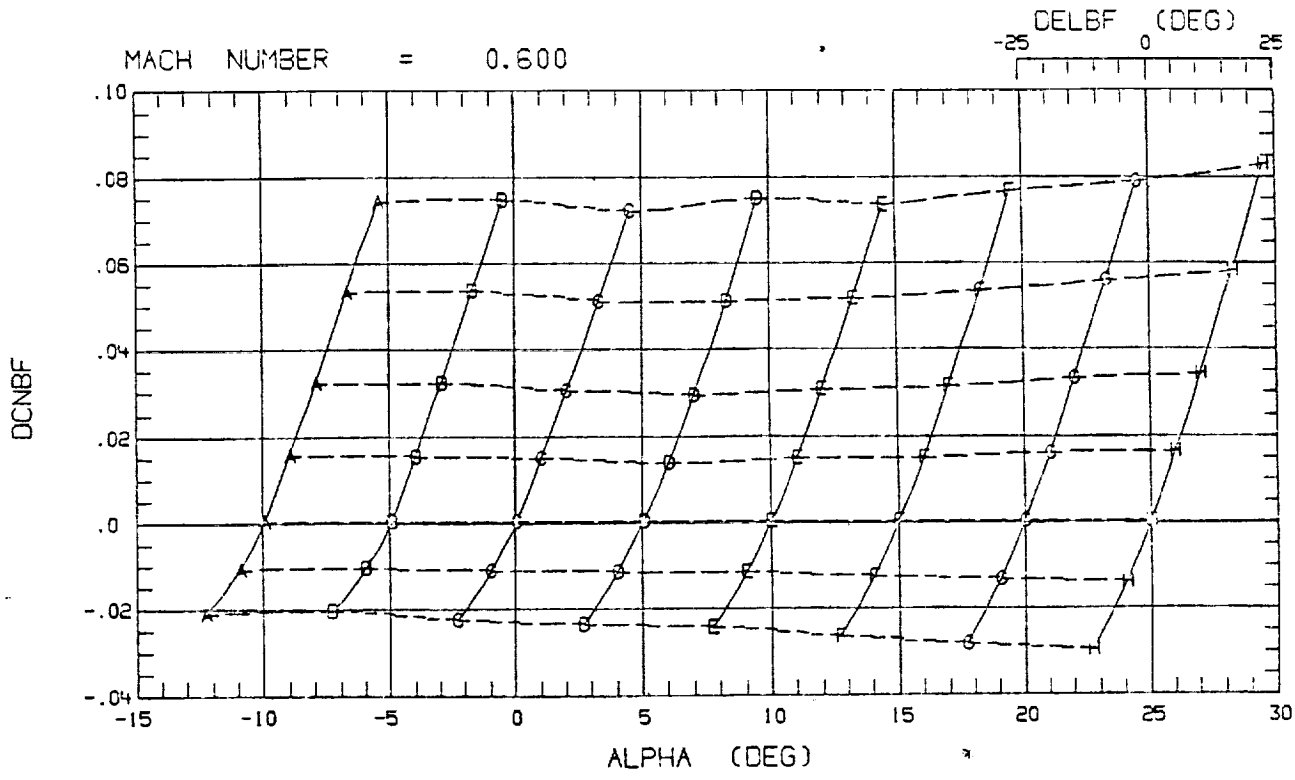


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.03407	-0.03291	-0.03220	-0.03187	-0.03180	-0.03109	-0.03005	-0.02893
-5.000	-0.01430	-0.01398	-0.01379	-0.01372	-0.01376	-0.01365	-0.01346	-0.01312
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01349	0.01382	0.01380	0.01382	0.01396	0.01409	0.01426	0.01411
10.000	0.02692	0.02752	0.02761	0.02774	0.02812	0.02866	0.02938	0.02927
16.300	0.04392	0.04474	0.04520	0.04567	0.04663	0.04815	0.05017	0.05047
22.500	0.07780	0.07801	0.07780	0.07770	0.07782	0.07719	0.07762	0.07861

ENGINEER wm2
DATE 9-21-78

FIGURE 4.1.1.1-39
EFFECT OF BODY FLAP



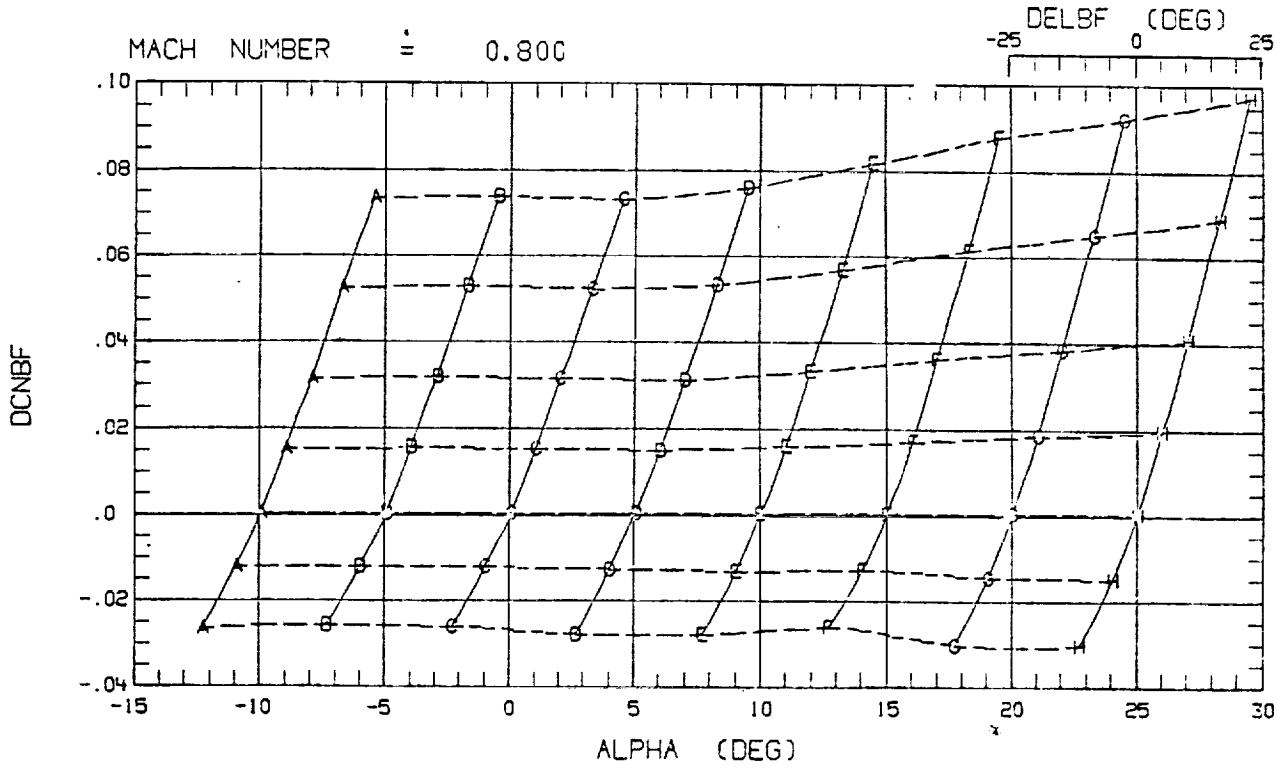
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02116	-0.02050	-0.02267	-0.02361	-0.02434	-0.02661	-0.02818	-0.02980
-5.000	-0.01078	-0.01058	-0.01112	-0.01142	-0.01171	-0.01258	-0.01326	-0.01395
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01550	0.01525	0.01455	0.01363	0.01458	0.01481	0.01589	0.01629
10.000	0.03210	0.03201	0.03053	0.02925	0.03068	0.03133	0.03316	0.03426
16.300	0.05318	0.05332	0.05111	0.05112	0.05181	0.05347	0.05578	0.05809
22.500	0.07416	0.07446	0.07182	0.07484	0.07345	0.07651	0.07884	0.08251

ENGINEER Lum2
DATE 9-30-78

FIGURE 4.1.1.1-40
EFFECT OF BODY FLAP



CONFIGURATION

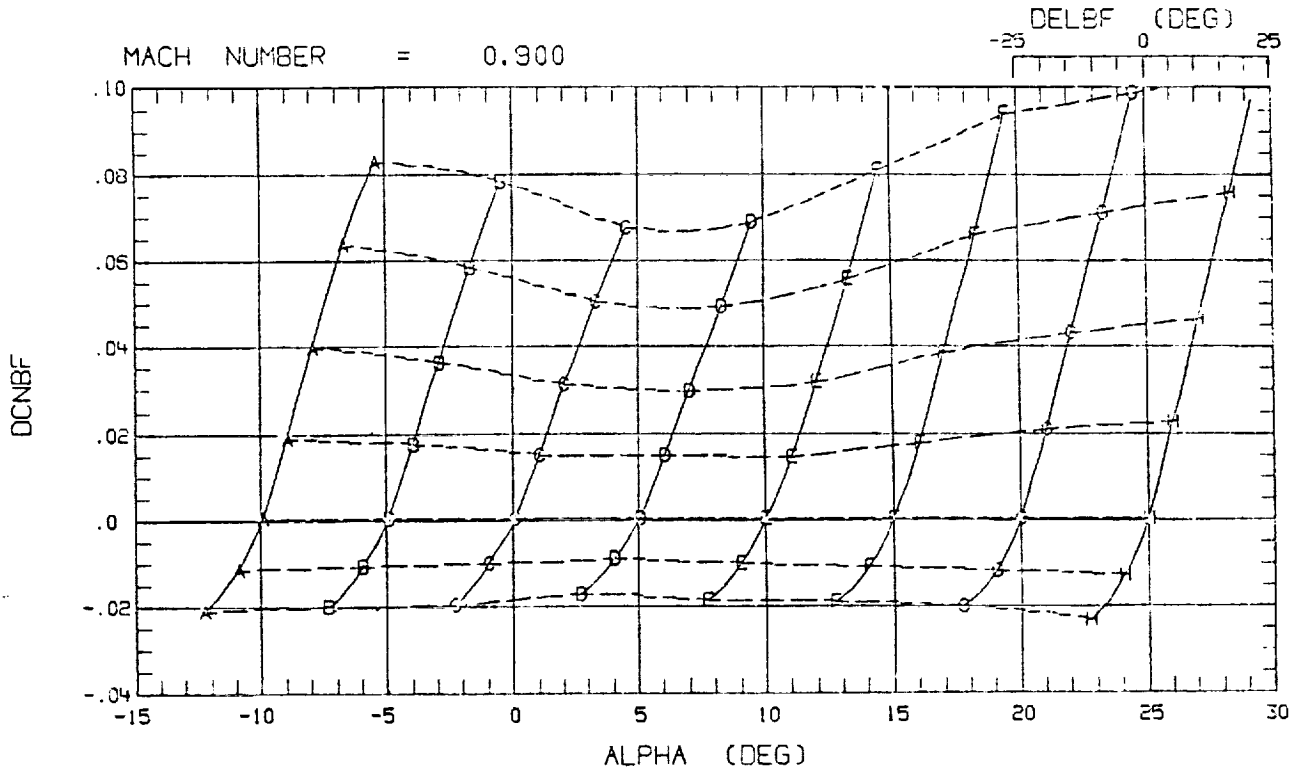
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02634	-0.02561	-0.02630	-0.02784	-0.02783	-0.02622	-0.03033	-0.03051
-5.000	-0.01240	-0.01220	-0.01238	-0.01294	-0.01321	-0.01302	-0.01462	-0.01495
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01502	0.01528	0.01515	0.01481	0.01562	0.01687	0.01817	0.01917
10.000	0.03135	0.03176	0.03139	0.03116	0.03313	0.03596	0.03835	0.04059
16.300	0.05231	0.05273	0.05215	0.05308	0.05672	0.06128	0.06485	0.06856
22.500	0.07336	0.07358	0.07291	0.07592	0.08142	0.08743	0.09193	0.09702

ENGINEER [illegible]
DATE 5-11-78

FIGURE 4.1.1.1-41
EFFECT OF BODY FLAP

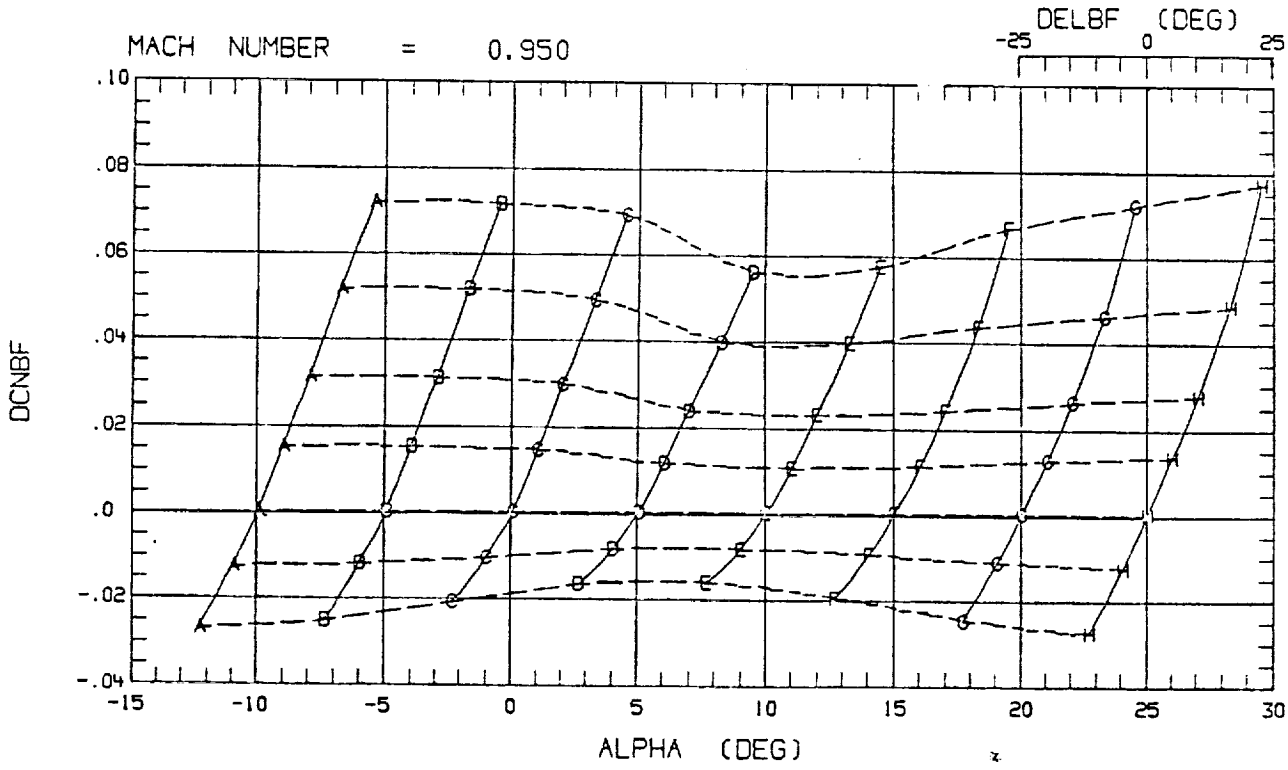


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02099	-0.02027	-0.01973	-0.01710	-0.01863	-0.01898	-0.02016	-0.02332
-5.000	-0.01147	-0.01096	-0.01009	-0.00917	-0.01013	-0.01100	-0.01176	-0.01313
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01851	0.01732	0.01478	0.01466	0.01440	0.01772	0.02093	0.02250
10.000	0.03970	0.03618	0.03100	0.02981	0.03172	0.03853	0.04301	0.04623
16.300	0.06337	0.05819	0.05010	0.04918	0.05552	0.06586	0.07092	0.07563
22.500	0.08272	0.07789	0.06731	0.06856	0.08085	0.09390	0.09860	0.10414

ENGINEER WM2
DATE 9-21-78

FIGURE 4.1.1.1-42
EFFECT OF BODY FLAP



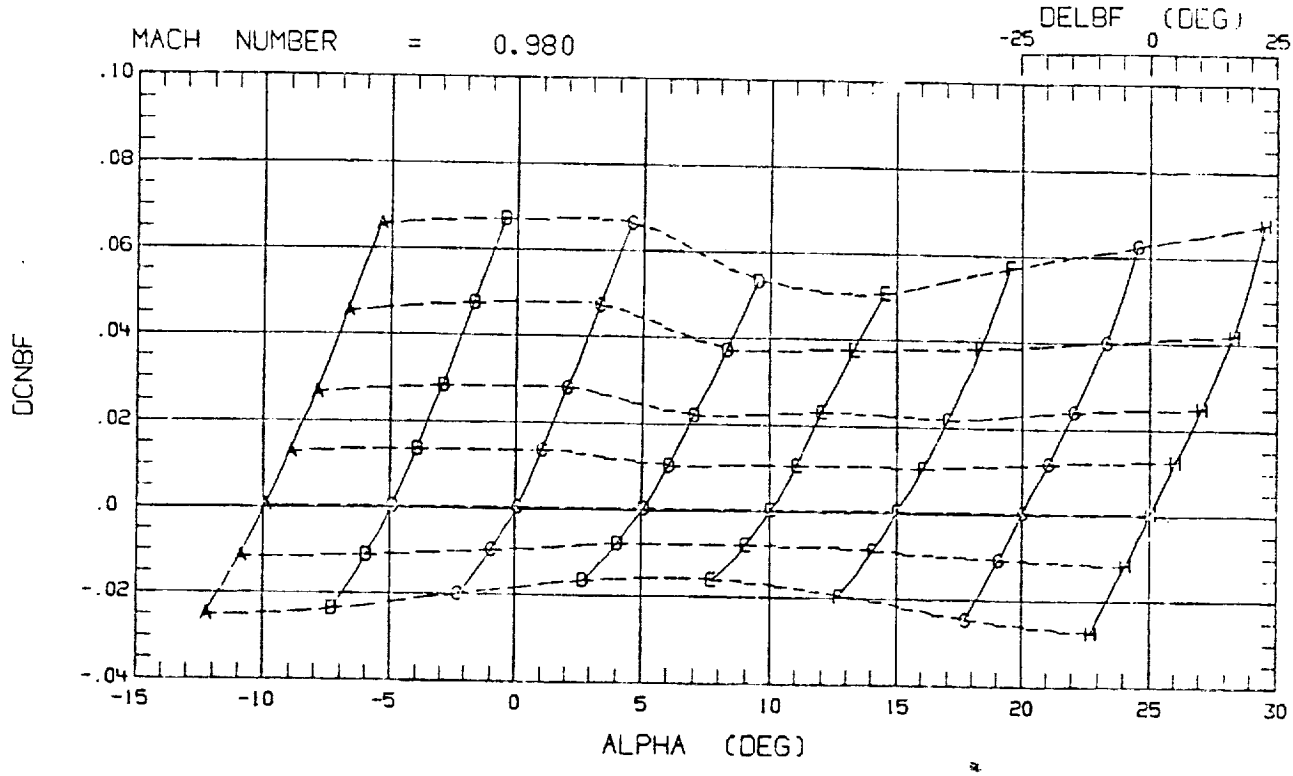
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02670	-0.02506	-0.02072	-0.01660	-0.01627	-0.01967	-0.02460	-0.02773
-5.000	-0.01247	-0.01193	-0.01036	-0.00831	-0.00820	-0.00959	-0.01139	-0.01257
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01512	0.01516	0.01420	0.01143	0.01059	0.01119	0.01245	0.01340
10.000	0.03129	0.03121	0.02963	0.02374	0.02284	0.02406	0.02598	0.02761
16.300	0.05173	0.05154	0.04934	0.03965	0.03961	0.04352	0.04614	0.04851
22.500	0.07169	0.07171	0.06906	0.05581	0.05748	0.06575	0.07194	0.07702

ENGINEER WWZ
DATE 9-14-78

FIGURE 4.1.1.1-43
EFFECT OF BODY FLAP

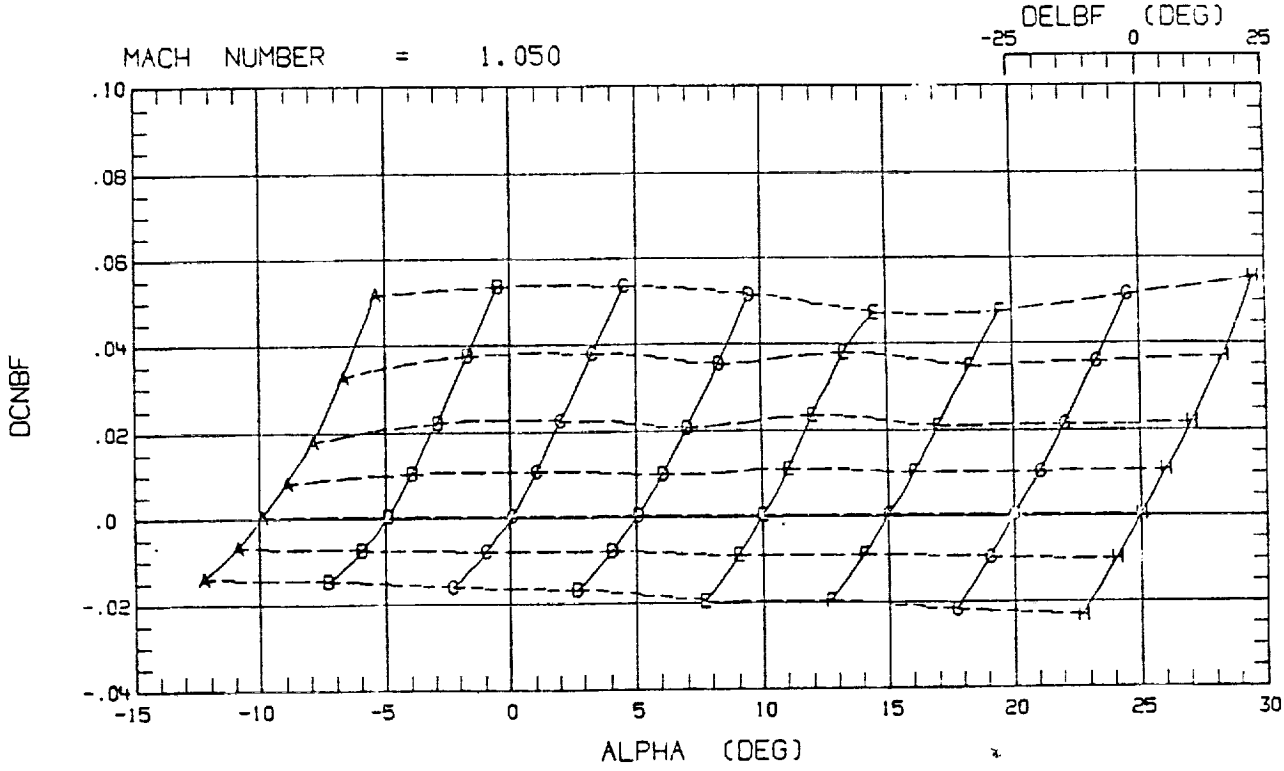


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB	= 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02508	-0.02377	-0.01998	-0.01654	-0.01625	-0.01975	-0.02488	-0.02754
-5.000	-0.01149	-0.01122	-0.00994	-0.00810	-0.00803	-0.00921	-0.01103	-0.01202
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01264	0.01341	0.01316	0.01015	0.01058	0.01025	0.01155	0.01222
10.000	0.02643	0.02816	0.02787	0.02167	0.02278	0.02159	0.02366	0.02459
16.300	0.04535	0.04744	0.04698	0.03712	0.03750	0.03806	0.03999	0.04179
22.500	0.06561	0.06705	0.06635	0.05324	0.05051	0.05715	0.06229	0.06754

ENGINEER LUM 2
DATE 9-21-78

FIGURE 4.1.1.1-44
EFFECT OF BODY FLAP



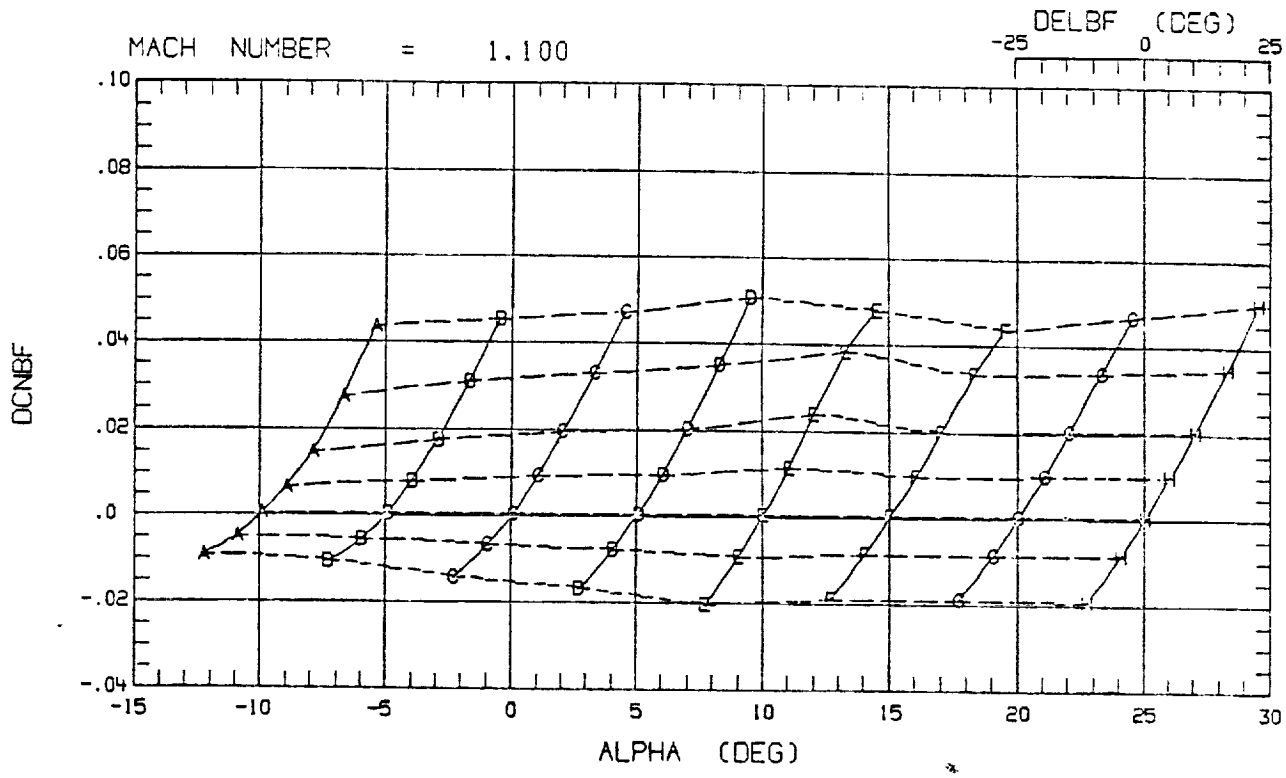
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.01422	-0.01476	-0.01613	-0.01704	-0.01975	-0.01971	-0.02194	-0.02337
-5.000	-0.00701	-0.00756	-0.00802	-0.00814	-0.00920	-0.00896	-0.00977	-0.01031
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00810	0.01021	0.01054	0.00960	0.01093	0.00993	0.01023	0.01052
10.000	0.01752	0.02199	0.02236	0.02047	0.02328	0.02075	0.02115	0.02137
16.300	0.03256	0.03753	0.03776	0.03545	0.03793	0.03478	0.03565	0.03690
22.500	0.05150	0.05348	0.05340	0.05145	0.04717	0.04752	0.05125	0.05513

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-45
EFFECT OF BODY FLAP



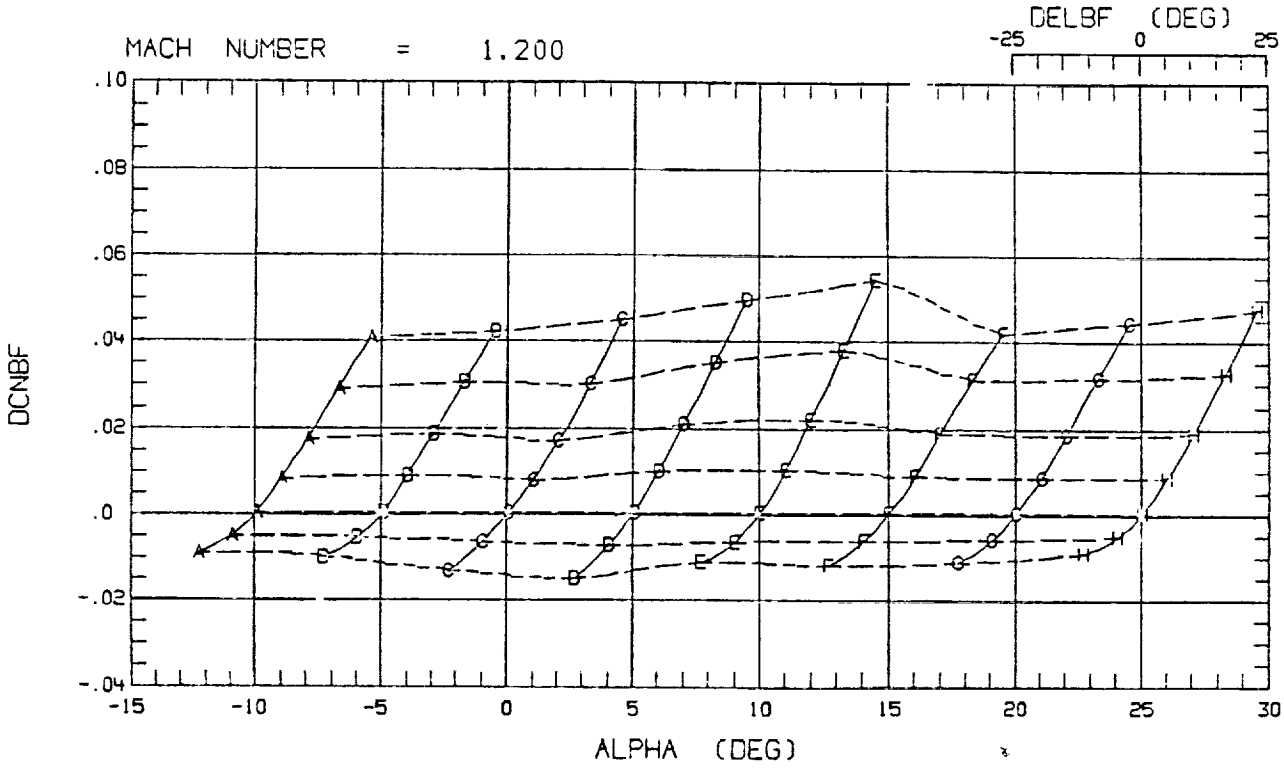
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00935	-0.01070	-0.01427	-0.01705	-0.02040	-0.01908	-0.01901	-0.01936
-5.000	-0.00504	-0.00573	-0.00705	-0.00810	-0.00943	-0.00863	-0.00865	-0.00882
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00634	0.00778	0.00894	0.00949	0.01120	0.00949	0.00957	0.00965
10.000	0.01425	0.01726	0.01918	0.02016	0.02349	0.01968	0.01998	0.02014
16.300	0.02723	0.03071	0.03286	0.03484	0.03809	0.03307	0.03367	0.03449
22.500	0.04362	0.04536	0.04705	0.05051	0.04764	0.04363	0.04666	0.04983

ENGINEER WMZ
DATE 5-21-78

FIGURE 4.1.1.1-46
EFFECT OF BODY FLAP

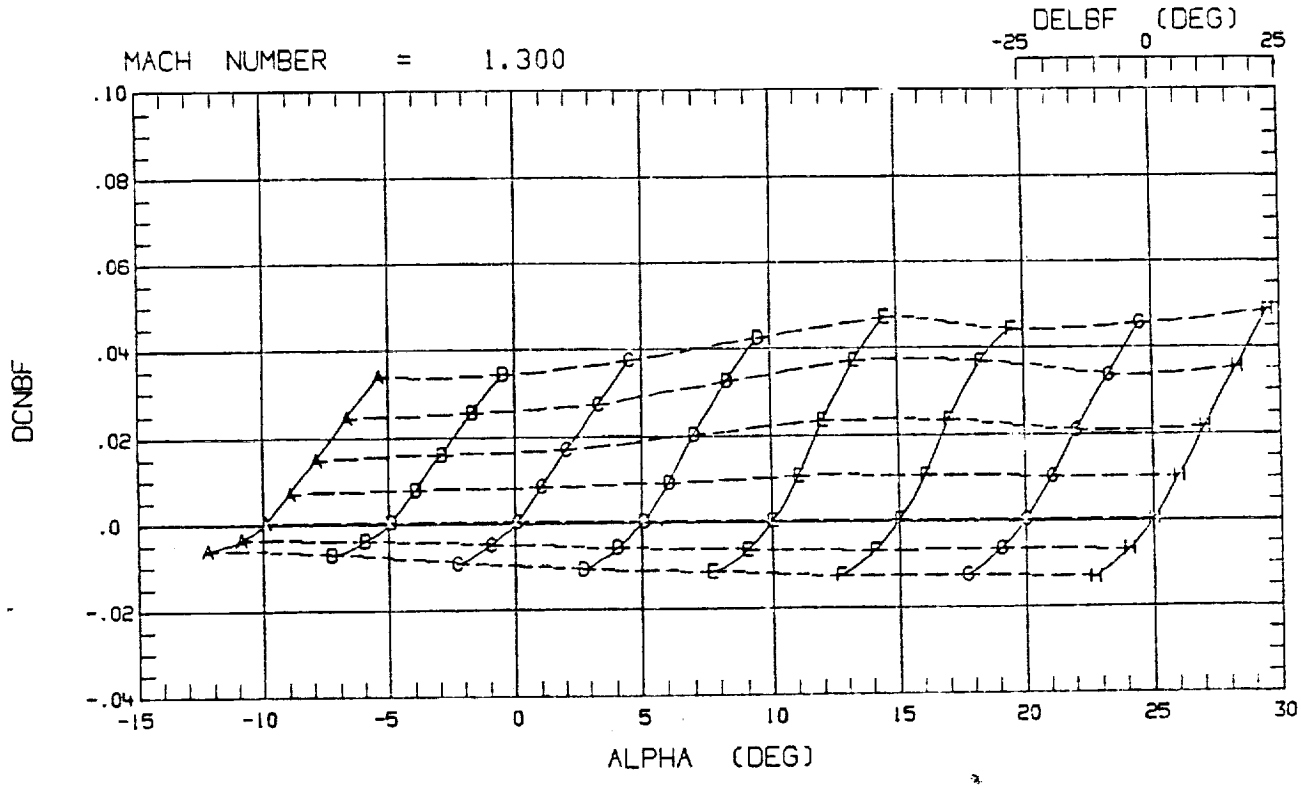


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00892	-0.01011	-0.01352	-0.01503	-0.01125	-0.01209	-0.01128	-0.00906
-5.000	-0.00503	-0.00550	-0.00659	-0.00745	-0.00643	-0.00622	-0.00598	-0.00533
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00790	0.00872	0.00775	0.00968	0.01006	0.00852	0.00834	0.00831
10.000	0.01716	0.01819	0.01669	0.02060	0.02199	0.01875	0.01834	0.01851
16.300	0.02902	0.03020	0.02986	0.03491	0.03780	0.03120	0.03140	0.03243
22.500	0.04078	0.04217	0.04500	0.04954	0.05409	0.04188	0.04435	0.04724

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-47
EFFECT OF BODY FLAP



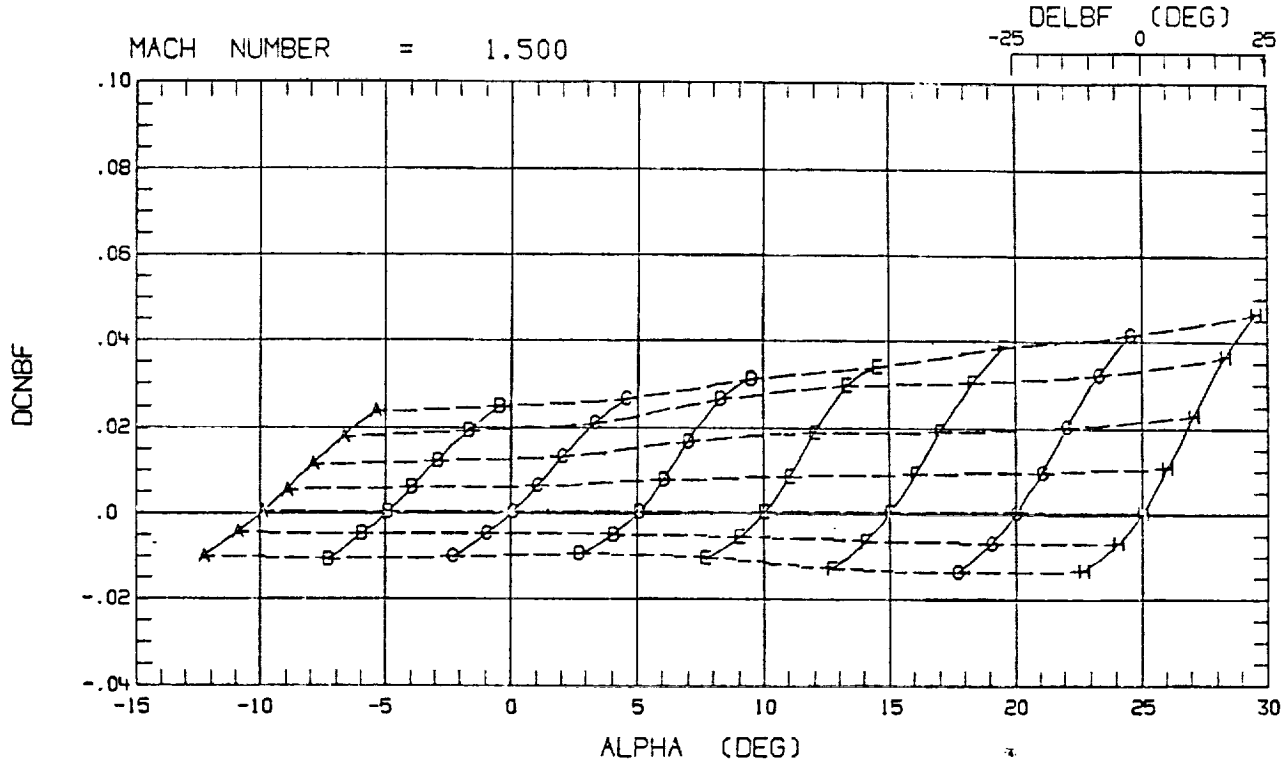
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00614	-0.00725	-0.00941	-0.01090	-0.01175	-0.01278	-0.01264	-0.01341
-5.000	-0.00378	-0.00423	-0.00505	-0.00593	-0.00654	-0.00686	-0.00658	-0.00696
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00708	0.00766	0.00828	0.00919	0.01056	0.01052	0.01004	0.01023
10.000	0.01469	0.01588	0.01669	0.02008	0.02312	0.02313	0.02079	0.02148
16.300	0.02427	0.02550	0.02718	0.03247	0.03699	0.03684	0.03367	0.03534
22.500	0.03377	0.03423	0.03740	0.04250	0.04701	0.04426	0.04554	0.04863

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-48
EFFECT OF BODY FLAP



CONFIGURATION

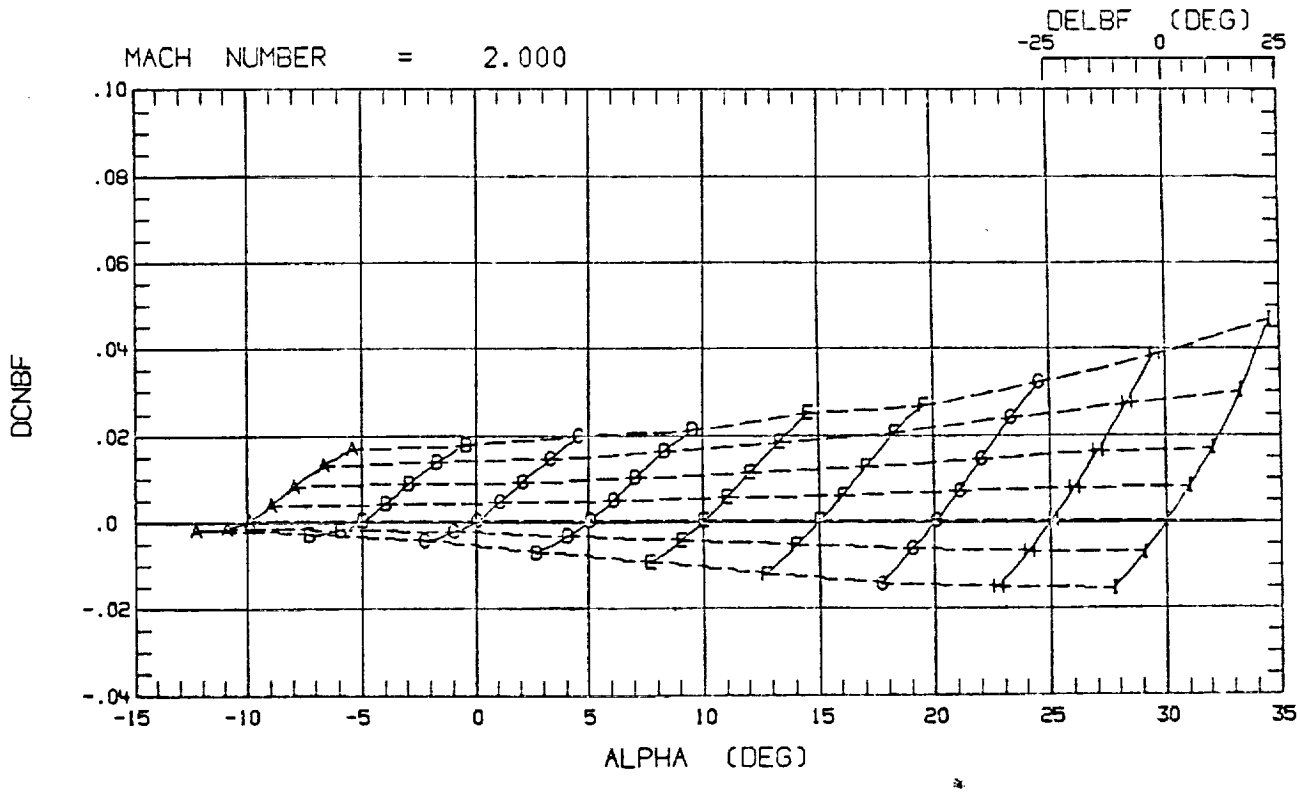
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.01002	-0.01069	-0.01019	-0.00956	-0.01057	-0.01300	-0.01383	-0.01330
-5.000	-0.00456	-0.00488	-0.00484	-0.00504	-0.00560	-0.00646	-0.00685	-0.00699
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00528	0.00568	0.00604	0.00744	0.00838	0.00893	0.00955	0.01055
10.000	0.01103	0.01192	0.01297	0.01657	0.01864	0.01889	0.01995	0.02257
16.300	0.01773	0.01904	0.02077	0.02628	0.02952	0.03033	0.03217	0.03625
22.500	0.02343	0.02452	0.02633	0.03106	0.03383	0.03838	0.04120	0.04632

ENGINEER WMZ
DATE 9-27-78

FIGURE 4.1.1.1-49
EFFECT OF BODY FLAP



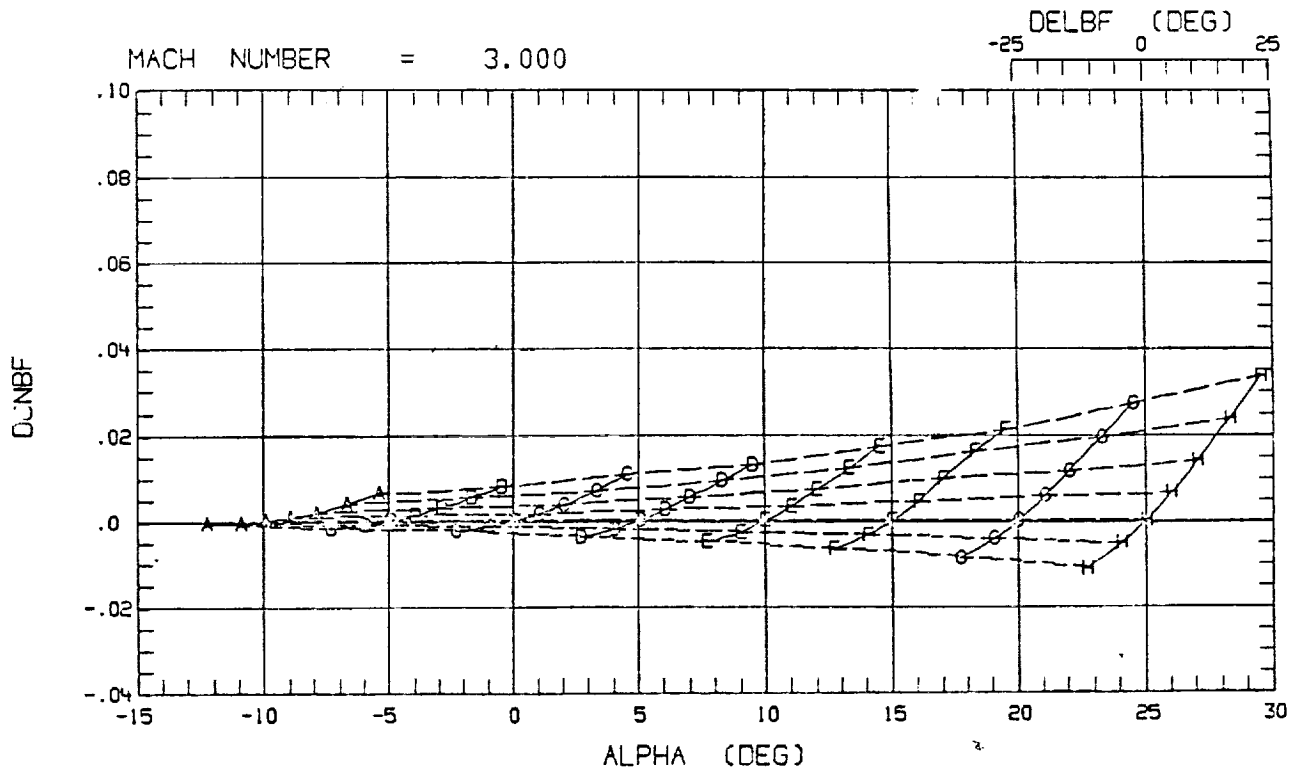
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT								
-11.700	-0.00197	-0.00299	-0.00439	-0.00722	-0.00960	-0.01213	-0.01427	-0.01495	-0.01541
-5.000	-0.00158	-0.00198	-0.00249	-0.00354	-0.00446	-0.00545	-0.00640	-0.00685	-0.00721
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00364	0.00391	0.00429	0.00464	0.00532	0.00598	0.00694	0.00765	0.00797
10.000	0.00799	0.00863	0.00891	0.00999	0.01107	0.01248	0.01444	0.01600	0.01675
16.300	0.01280	0.01377	0.01444	0.01613	0.01818	0.02051	0.02392	0.02706	0.03005
22.500	0.01674	0.01767	0.01958	0.02094	0.02491	0.02688	0.03204	0.03848	0.04671

ENGINEER [illegible]
DATE 9-21-78

FIGURE 4.1.1.1-50
EFFECT OF BODY FLAP



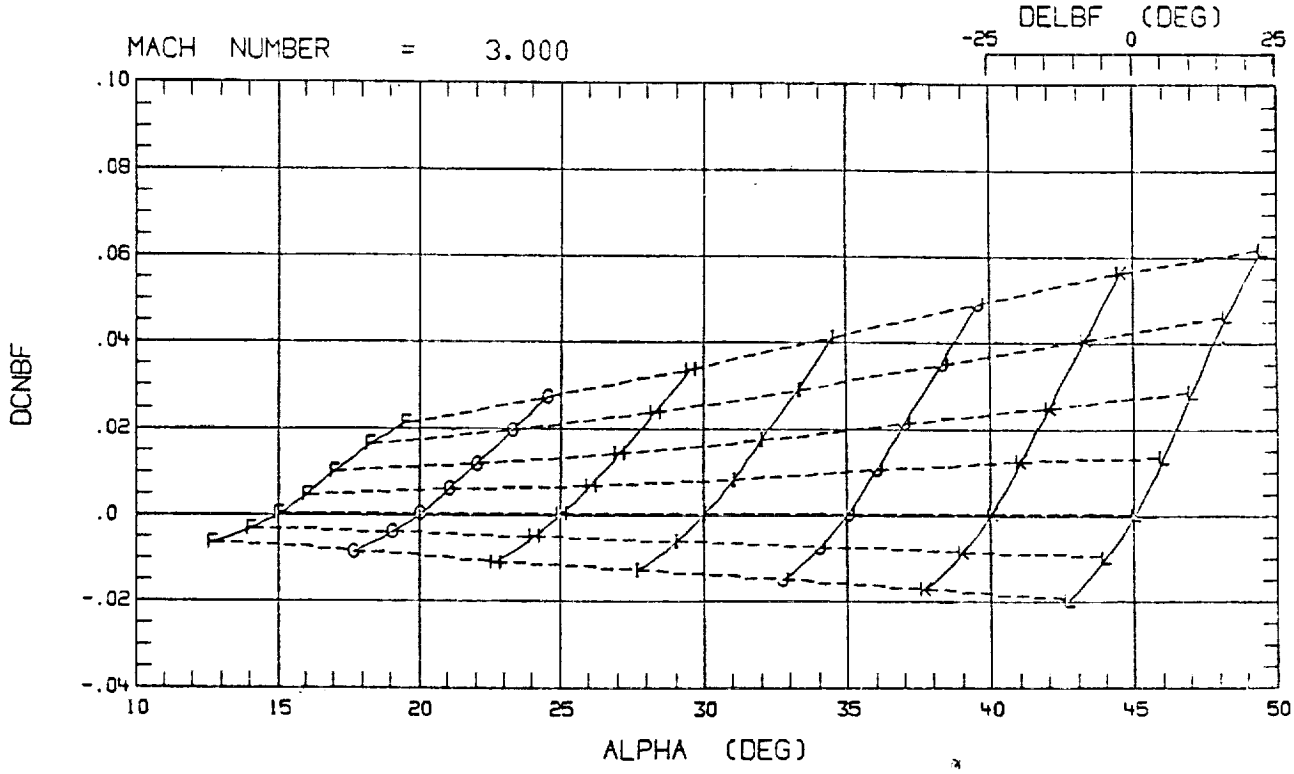
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00049	-0.00175	-0.00222	-0.00378	-0.00500	-0.00653	-0.00856	-0.01110
-5.000	-0.00045	-0.00097	-0.00124	-0.00191	-0.00252	-0.00330	-0.00421	-0.00534
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00081	0.00135	0.00169	0.00265	0.00344	0.00456	0.00567	0.00652
10.000	0.00198	0.00302	0.00381	0.00557	0.00727	0.00968	0.01168	0.01385
16.300	0.00394	0.00544	0.00707	0.00931	0.01223	0.01607	0.01942	0.02361
22.500	0.00640	0.00804	0.01089	0.01306	0.01725	0.02121	0.02719	0.03371

ENGINEER WMZ
DATE 4-21-78

FIGURE 4.1.1.1-51
EFFECT OF BODY FLAP



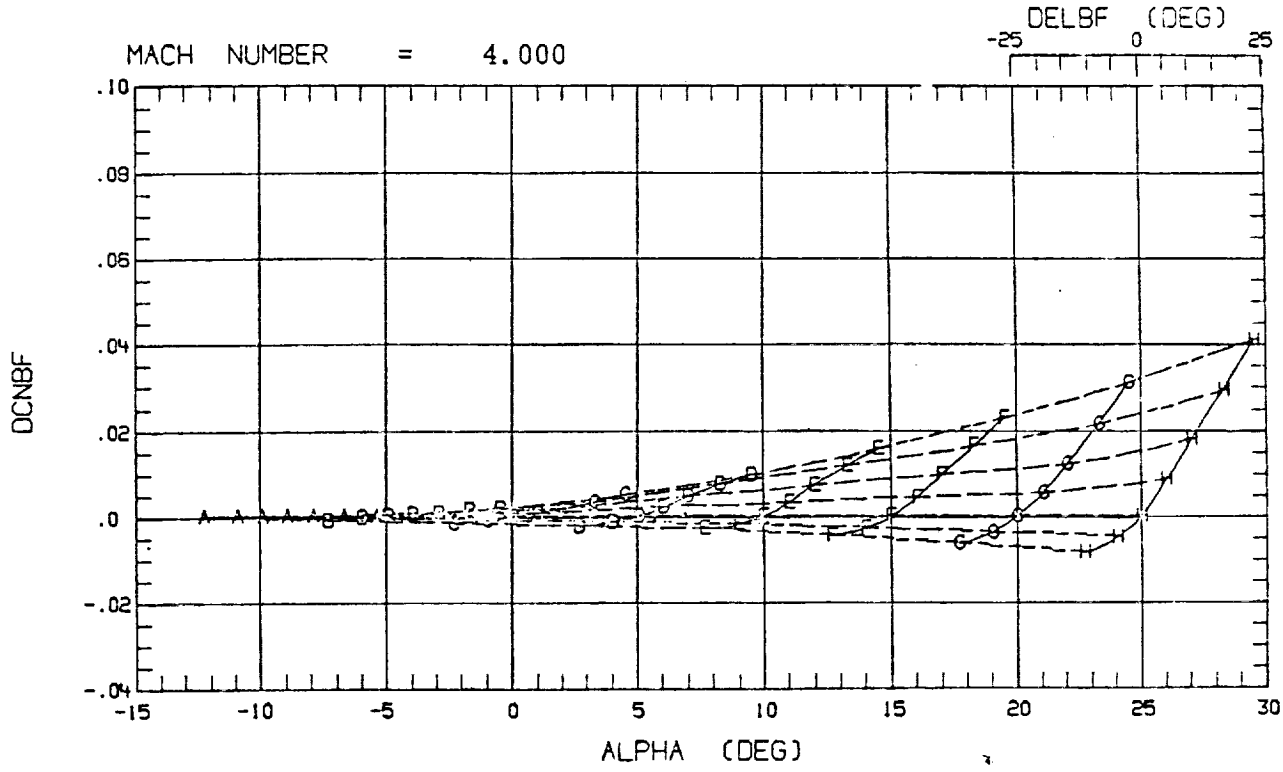
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT						
-11.700	-0.00653	-0.00856	-0.01110	-0.01299	-0.01528	-0.01741	-0.01980
-5.000	-0.00330	-0.00421	-0.00534	-0.00635	-0.00753	-0.00865	-0.00984
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00456	0.00567	0.00652	0.00806	0.01029	0.01213	0.01336
10.000	0.00988	0.01168	0.01385	0.01707	0.02113	0.02480	0.02856
16.300	0.01607	0.01942	0.02361	0.02895	0.03498	0.04070	0.04632
22.500	0.02121	0.02719	0.03371	0.04116	0.04983	0.05627	0.06152

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-52
EFFECT OF BODY FLAP



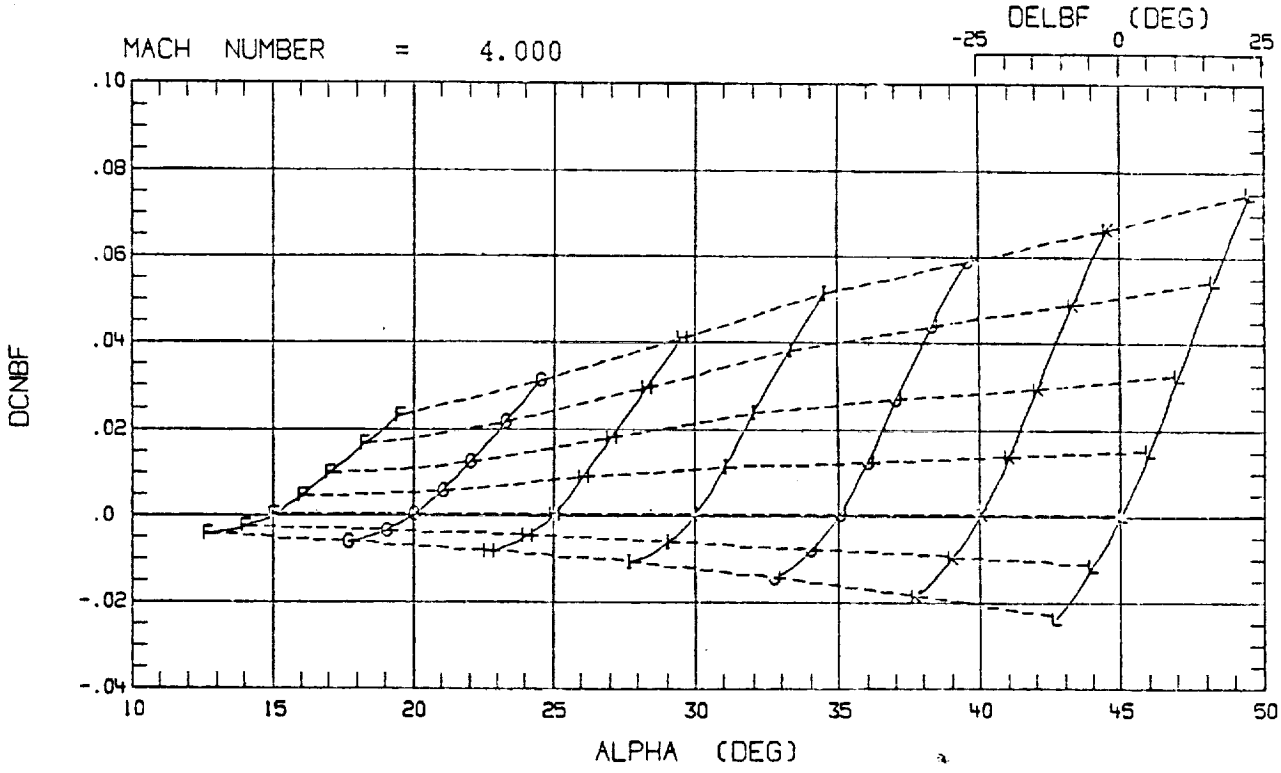
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00085	-0.00160	-0.00221	-0.00286	-0.00456	-0.00636	-0.00847
-5.000	-0.00002	-0.00038	-0.00078	-0.00127	-0.00180	-0.00268	-0.00364	-0.00492
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00007	0.00040	0.00094	0.00215	0.00344	0.00456	0.00549	0.00859
10.000	0.00020	0.00083	0.00201	0.00465	0.00735	0.00976	0.01221	0.01779
16.300	0.00030	0.00140	0.00350	0.00747	0.01184	0.01641	0.02141	0.02944
22.500	0.0	0.00200	0.00510	0.00979	0.01576	0.02305	0.03119	0.04103

ENGINEER WMZ
DATE 4-21-78

FIGURE 4.1.1.1-53
EFFECT OF BODY FLAP

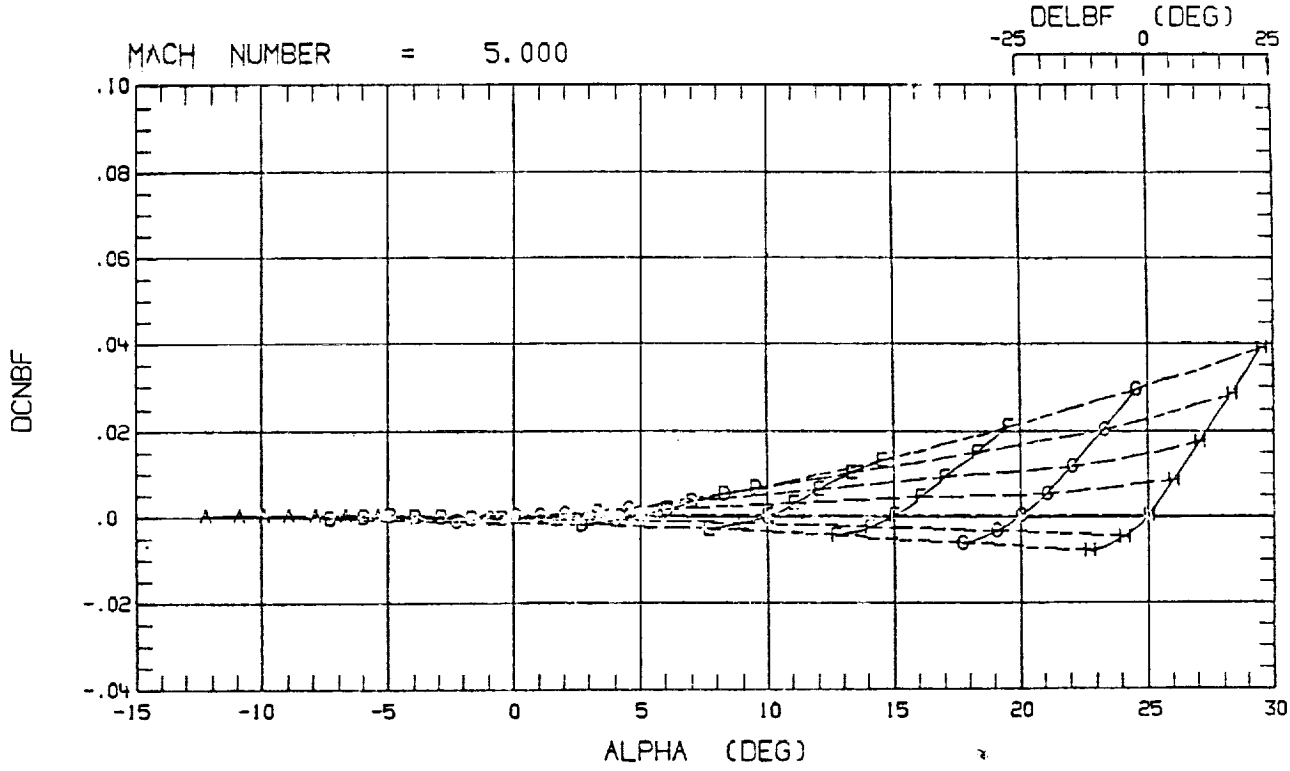


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT						
-11.700	-0.00456	-0.00636	-0.00847	-0.01103	-0.01457	-0.01874	-0.02361
-5.000	-0.00268	-0.00364	-0.00492	-0.00639	-0.00795	-0.00969	-0.01167
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00456	0.00549	0.00659	0.01102	0.01230	0.01351	0.01505
10.000	0.00976	0.01221	0.01779	0.02346	0.02668	0.02940	0.03241
16.300	0.01641	0.02141	0.02944	0.03814	0.04382	0.04900	0.05455
22.500	0.02305	0.03119	0.04103	0.05127	0.05878	0.06638	0.07472

ENGINEER WMZ
DATE 9-11-78

FIGURE 4.1.1.1-54
EFFECT OF BODY FLAP

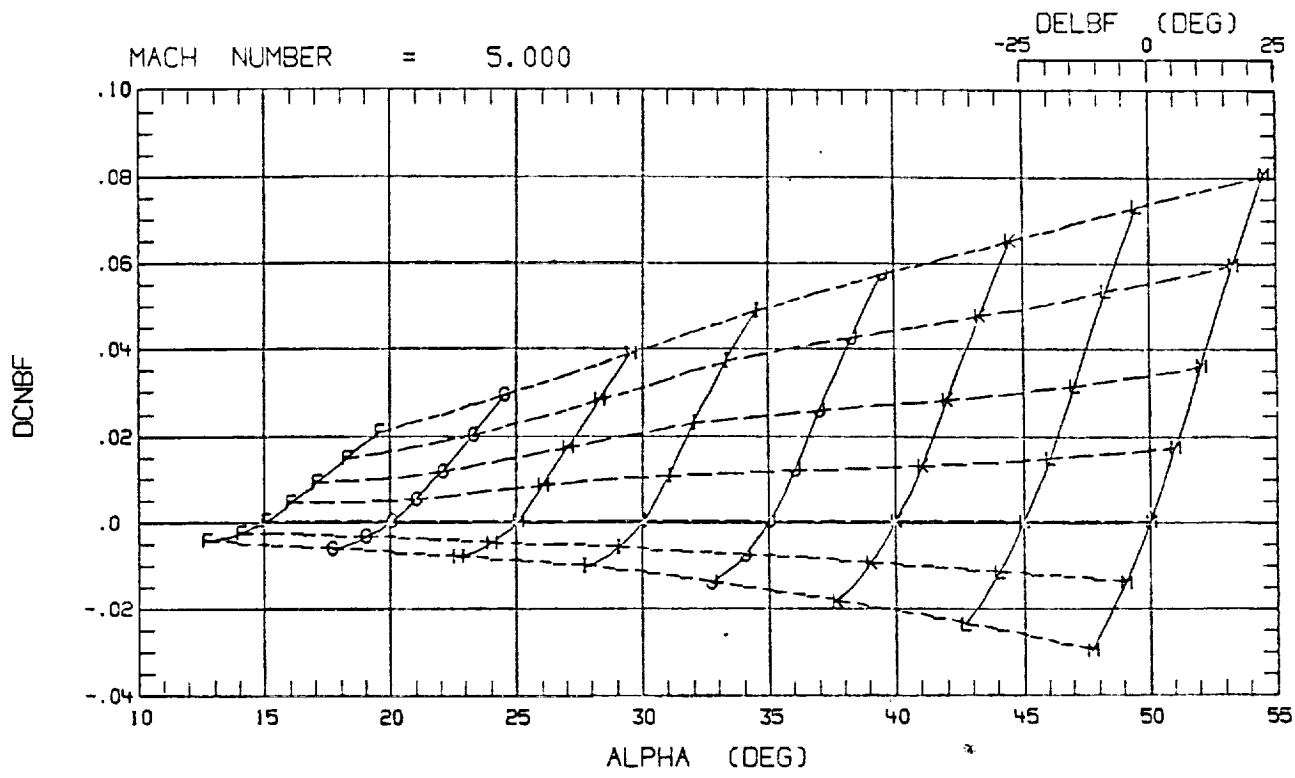


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00069	-0.00140	-0.00214	-0.00296	-0.00460	-0.00632	-0.00812
-5.000	0.0	-0.00019	-0.00051	-0.00108	-0.00170	-0.00259	-0.00354	-0.00471
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00010	0.00028	0.00148	0.00286	0.00424	0.00523	0.00849
10.000	0.0	-0.00038	0.00039	0.00321	0.00621	0.00896	0.01157	0.01729
16.300	0.0	-0.00056	0.00070	0.00513	0.00996	0.01487	0.02020	0.02827
22.500	0.0	-0.00039	0.00140	0.00650	0.01298	0.02067	0.02928	0.03896

ENGINEER WMZ
DATE 3-27-78

FIGURE 4.1.1.1-55
EFFECT OF BODY FLAP



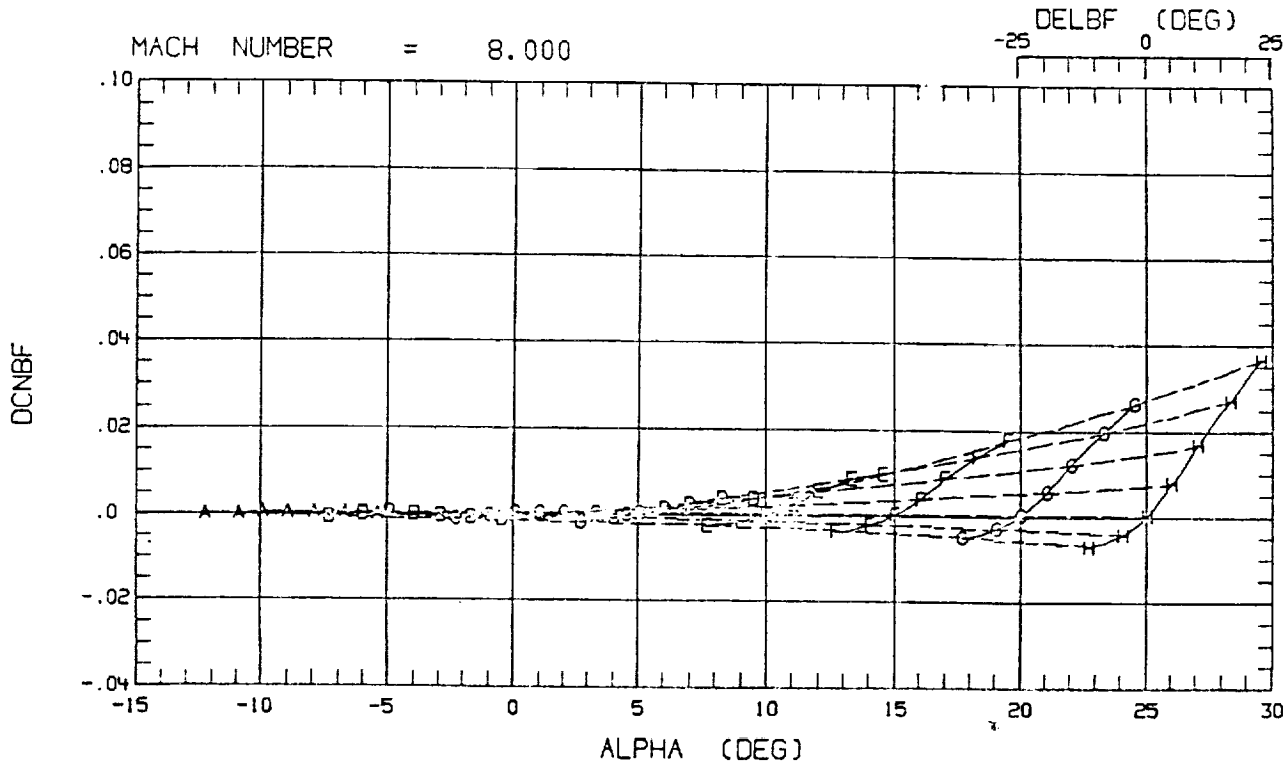
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00460	-0.00632	-0.00812	-0.01026	-0.01392	-0.01840	-0.02369	-0.02986
-5.000	-0.00259	-0.00354	-0.00471	-0.00605	-0.00765	-0.00948	-0.01161	-0.01407
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00424	0.00523	0.00849	0.01063	0.01173	0.01289	0.01469	0.01725
10.000	0.00896	0.01157	0.01729	0.02285	0.02571	0.02825	0.03159	0.03594
16.300	0.01487	0.02020	0.02827	0.03700	0.04253	0.04760	0.05329	0.05947
22.500	0.02067	0.02928	0.03896	0.04889	0.05720	0.06515	0.07284	0.08030

ENGINEER WWZ
DATE 9-21-78

FIGURE 4.1.1.1-56
EFFECT OF BODY FLAP



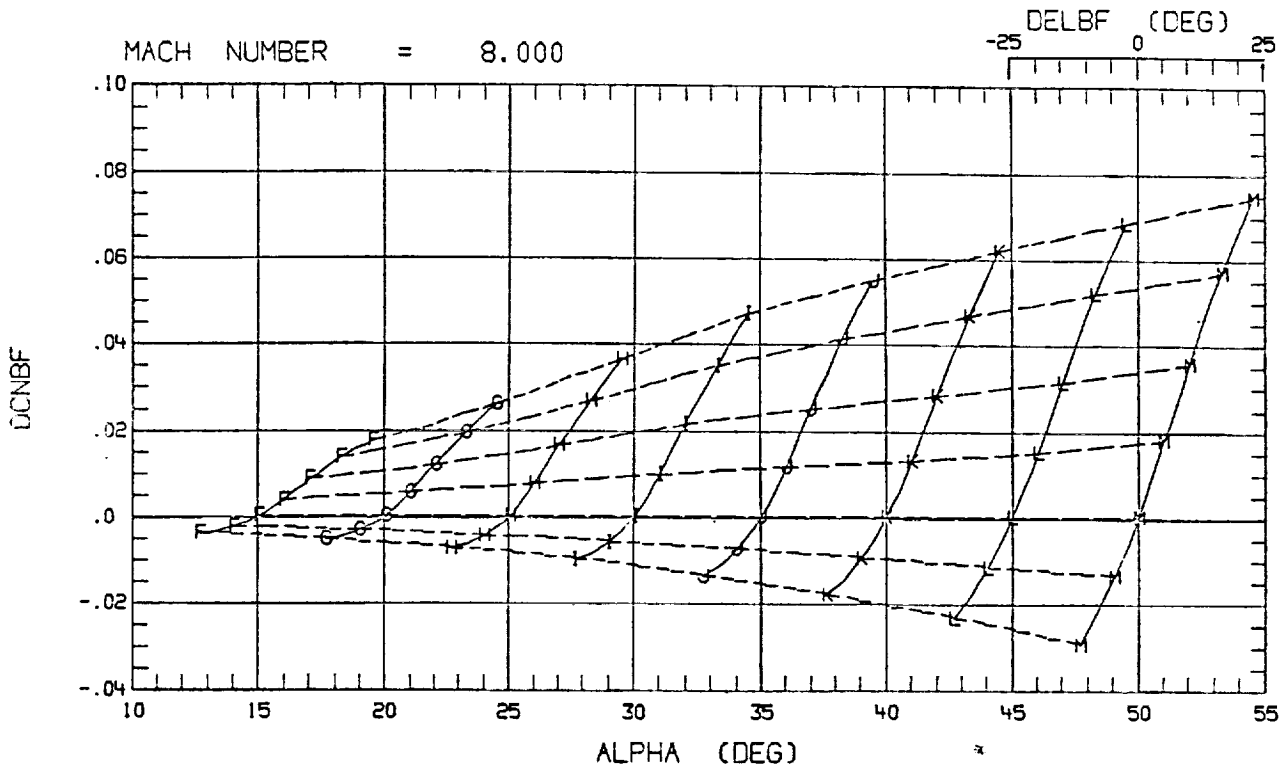
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00030	-0.00082	-0.00140	-0.00201	-0.00265	-0.00382	-0.00531	-0.00718
-5.000	-0.00010	-0.00020	-0.00046	-0.00093	-0.00148	-0.00225	-0.00315	-0.00431
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00007	-0.00026	0.00015	0.00110	0.00234	0.00388	0.00552	0.00761
10.000	0.00009	-0.00056	0.00012	0.00238	0.00534	0.00855	0.01193	0.01640
16.300	0.00003	-0.00091	0.0	0.00379	0.00841	0.01368	0.01946	0.02690
22.500	-0.00018	-0.00122	-0.00020	0.00360	0.00944	0.01739	0.02617	0.03651

ENGINEER WMR
DATE 9-21-78

FIGURE 4.1.1.1-57
EFFECT OF BODY FLAP



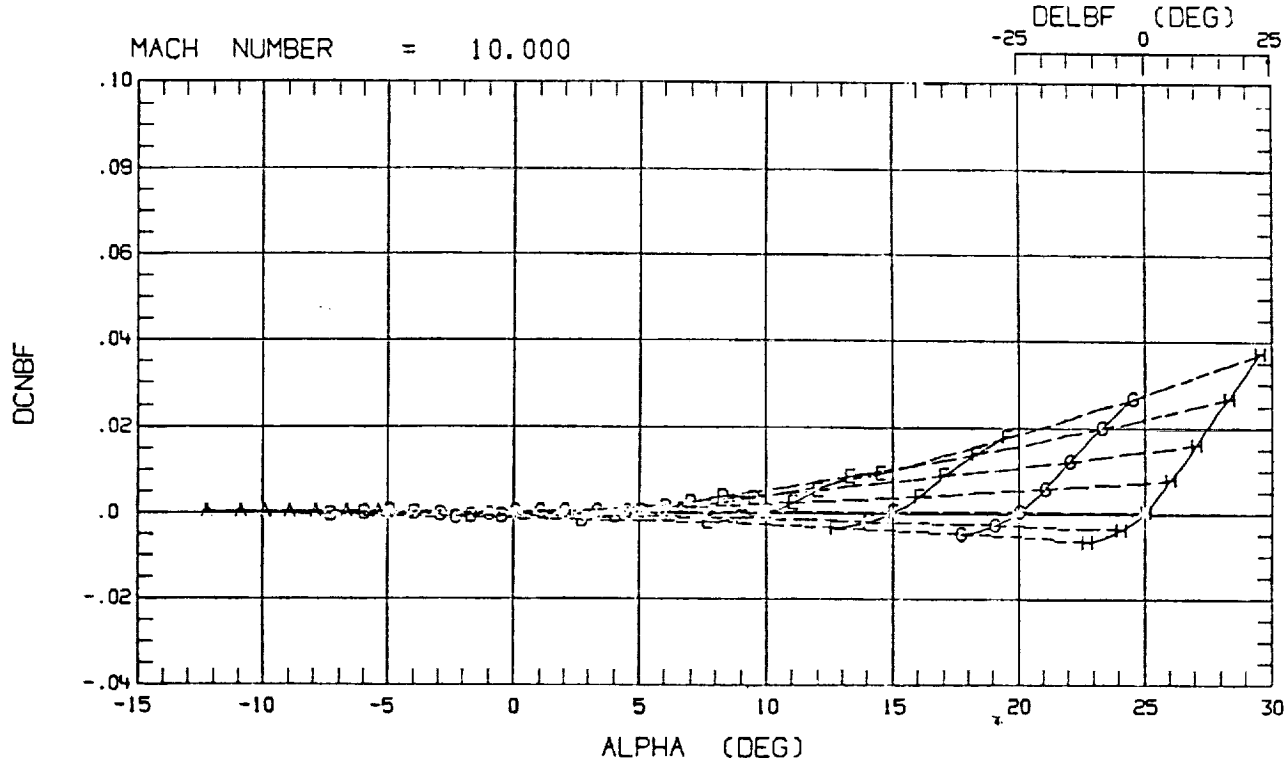
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00382	-0.00531	-0.00718	-0.00968	-0.01357	-0.01813	-0.02336	-0.02940
-5.000	-0.00225	-0.00315	-0.00431	-0.00572	-0.00744	-0.00932	-0.01141	-0.01374
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00388	0.00552	0.00761	0.00979	0.01147	0.01307	0.01508	0.01781
10.000	0.00855	0.01193	0.01640	0.02143	0.02506	0.02823	0.03149	0.03564
16.300	0.01368	0.01946	0.02690	0.03512	0.04120	0.04667	0.05192	0.05702
22.500	0.01739	0.02617	0.03651	0.04703	0.05488	0.06199	0.06841	0.07428

ENGINEER WMZ
DATE 9-27-78

FIGURE 4.1.1.1-58
EFFECT OF BODY FLAP



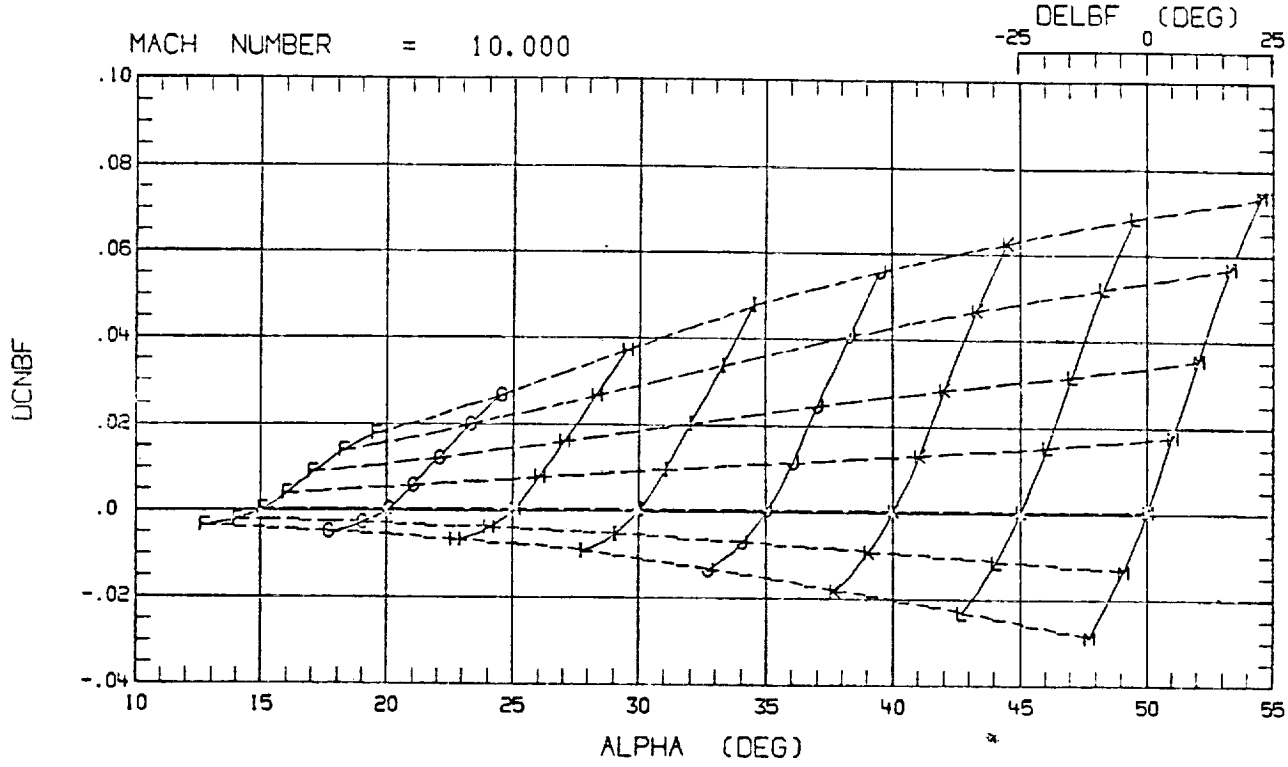
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00186	-0.00247	-0.00360	-0.00510	-0.00697
-5.000	0.0	-0.00015	-0.00042	-0.00087	-0.00141	-0.00218	-0.00310	-0.00421
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00022	0.0	0.00107	0.00227	0.00378	0.00554	0.00756
10.000	0.0	-0.00062	0.0	0.00233	0.00527	0.00851	0.01200	0.01587
16.300	0.0	-0.00094	0.0	0.00371	0.00834	0.01374	0.01956	0.02652
22.500	0.0	-0.00097	0.0	0.00345	0.00916	0.01751	0.02660	0.03717

ENGINEER KWZ
DATE 9-22-78

FIGURE 4.1.1.1-59
EFFECT OF BODY FLAP



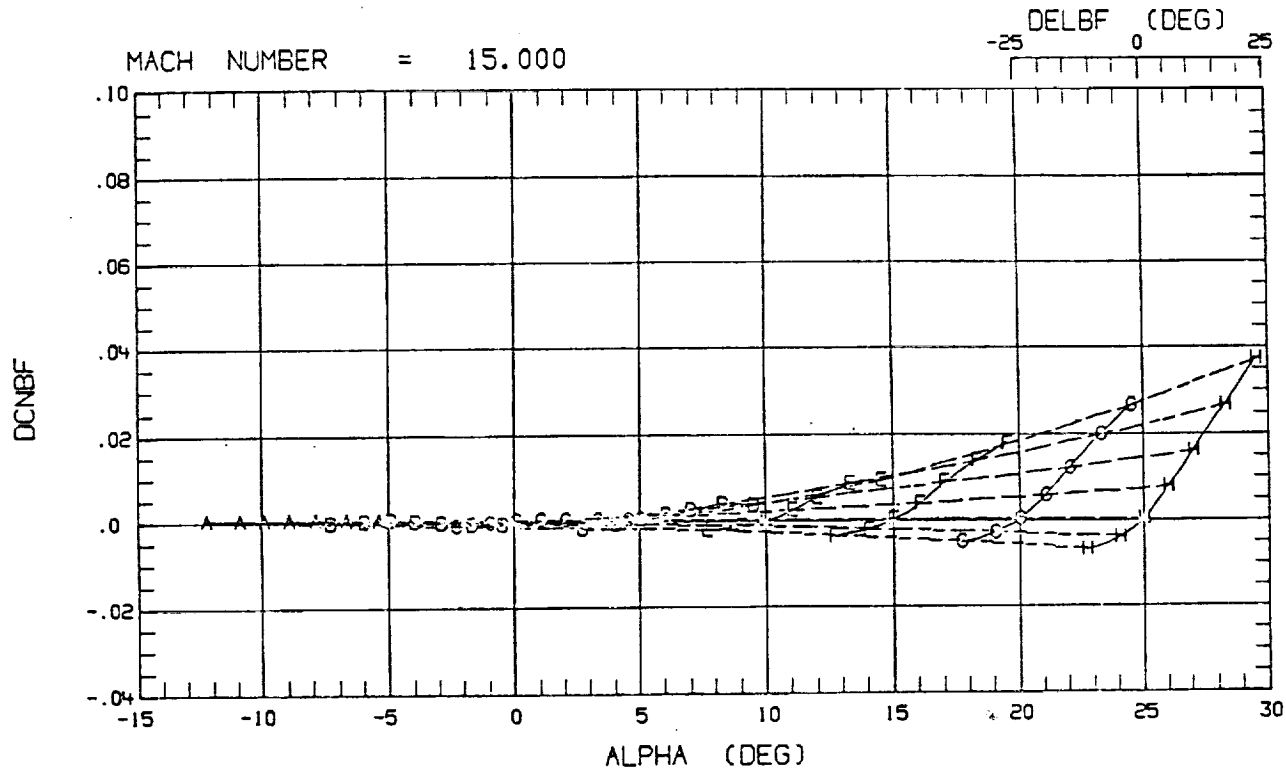
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00360	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00218	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00378	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.00851	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01374	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.01751	0.02660	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-60
EFFECT OF BODY FLAP

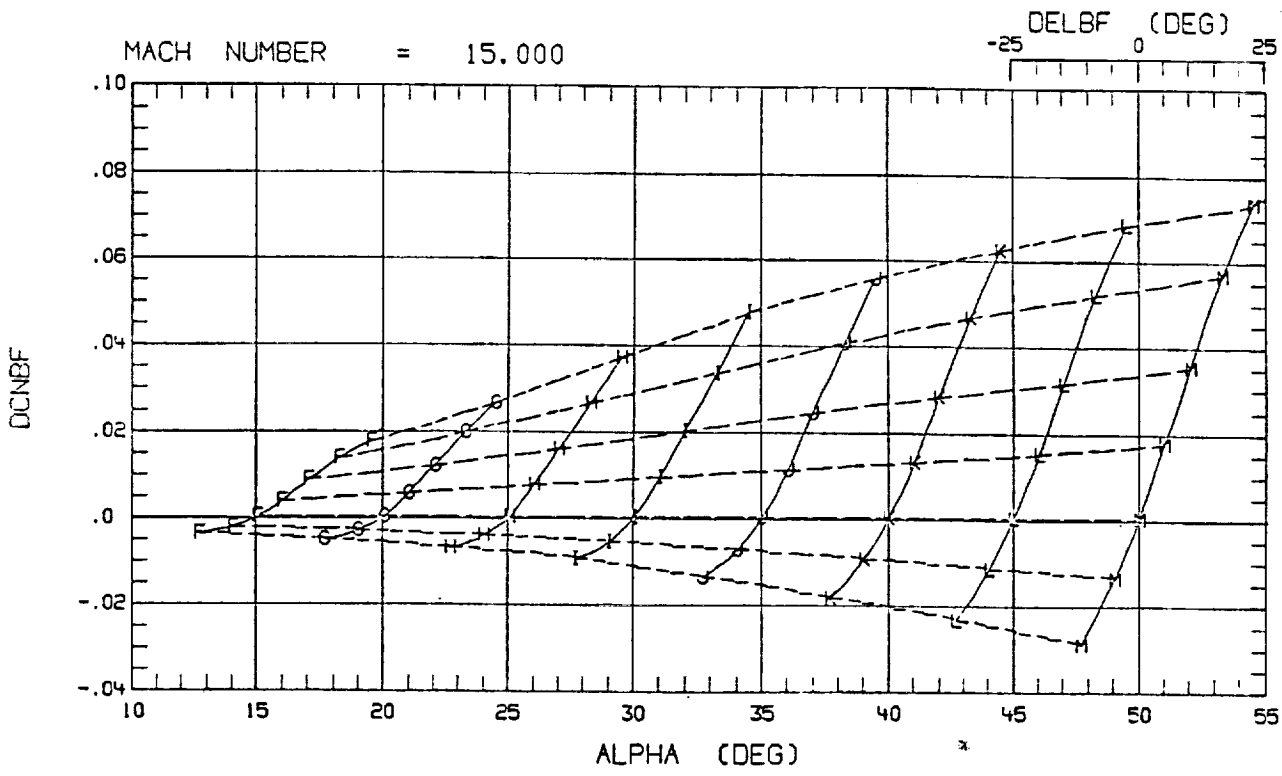


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00186	-0.00247	-0.00360	-0.00510	-0.00697
-5.000	0.0	-0.00015	-0.00042	-0.00087	-0.00141	-0.00218	-0.00310	-0.00421
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00022	0.0	0.00107	0.00227	0.00378	0.00554	0.00756
10.000	0.0	-0.00062	0.0	0.00233	0.00527	0.00851	0.01200	0.01587
16.300	0.0	-0.00094	0.0	0.00371	0.00834	0.01374	0.01966	0.02652
22.500	0.0	-0.00097	0.0	0.00345	0.00916	0.01751	0.02660	0.03717

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-61
EFFECT OF BODY FLAP



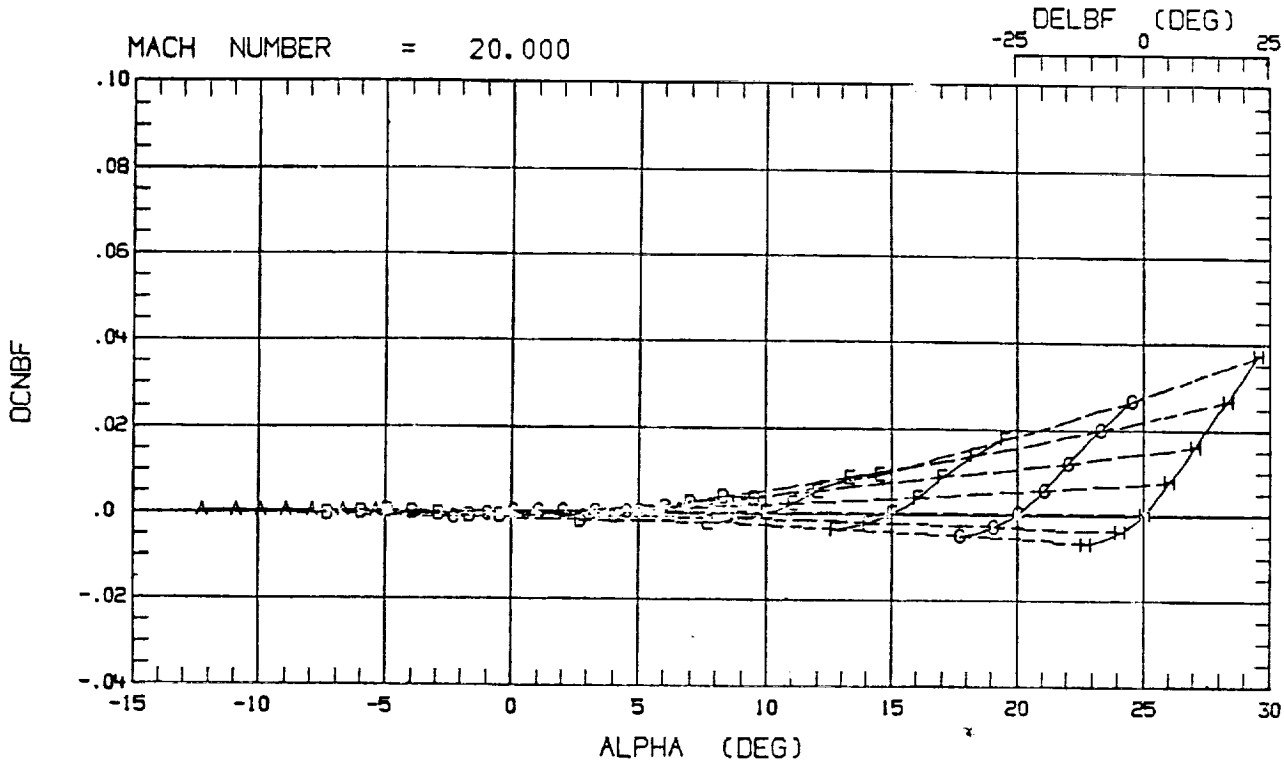
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00360	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00218	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00378	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.00851	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01374	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.01751	0.02560	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER WM3
DATE 9-21-78

FIGURE 4.1.1.1-62
EFFECT OF BODY FLAP



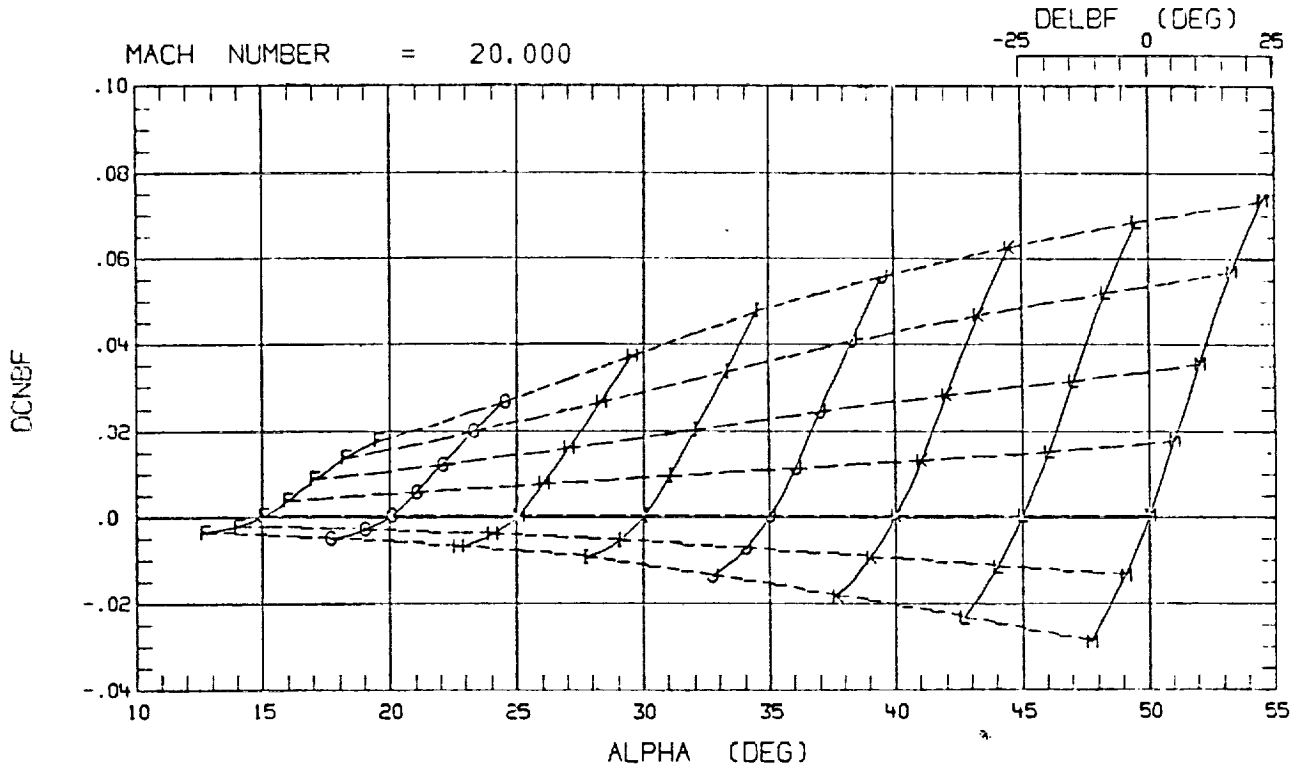
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00186	-0.00247	-0.00360	-0.00510	-0.00697
-5.000	0.0	-0.00015	-0.00042	-0.00087	-0.00141	-0.00218	-0.00310	-0.00421
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00022	0.0	0.00107	0.00227	0.00378	0.00554	0.00756
10.000	0.0	-0.00062	0.0	0.00233	0.00527	0.00851	0.01200	0.01587
16.300	0.0	-0.00094	0.0	0.00371	0.00834	0.01374	0.01966	0.02652
22.500	0.0	-0.00097	0.0	0.00345	0.00916	0.01751	0.02660	0.03717

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-63
EFFECT OF BODY FLAP

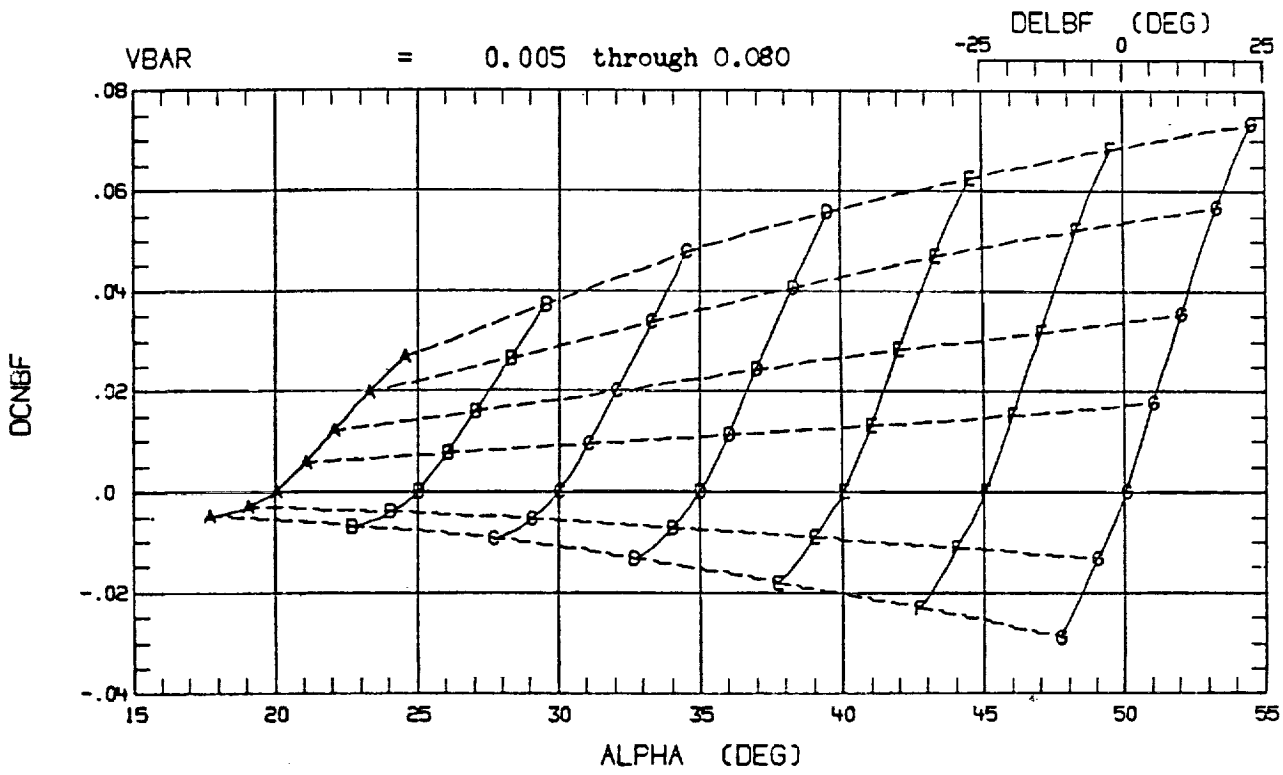


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00360	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00218	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00378	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.00851	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01374	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.01751	0.02560	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER WMZ
DATE 9-27-78

FIGURE 4.1.1.1-64
EFFECT OF BODY FLAP



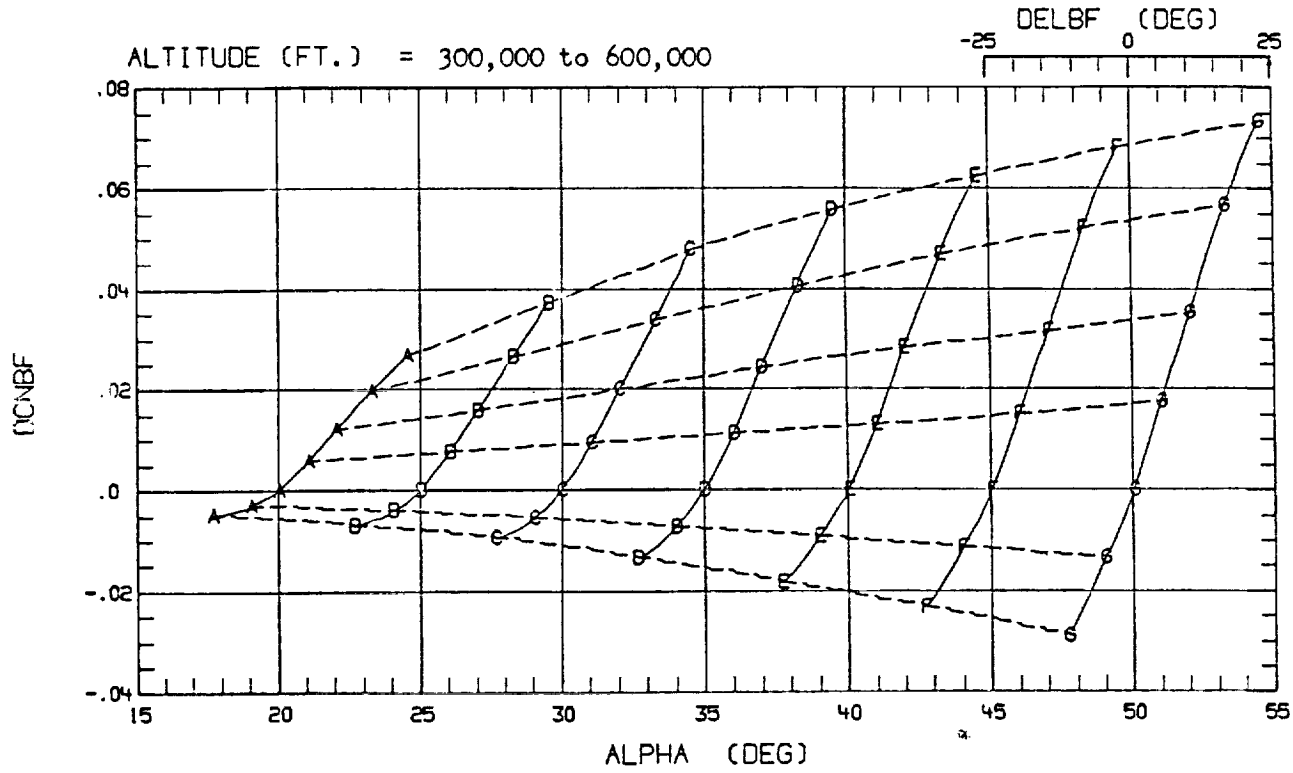
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP NORMAL FORCE INCREMEN						
-11.700	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.02660	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER NASA
DATE

FIGURE 4.1.1.1-65
EFFECT OF BODY FLAP

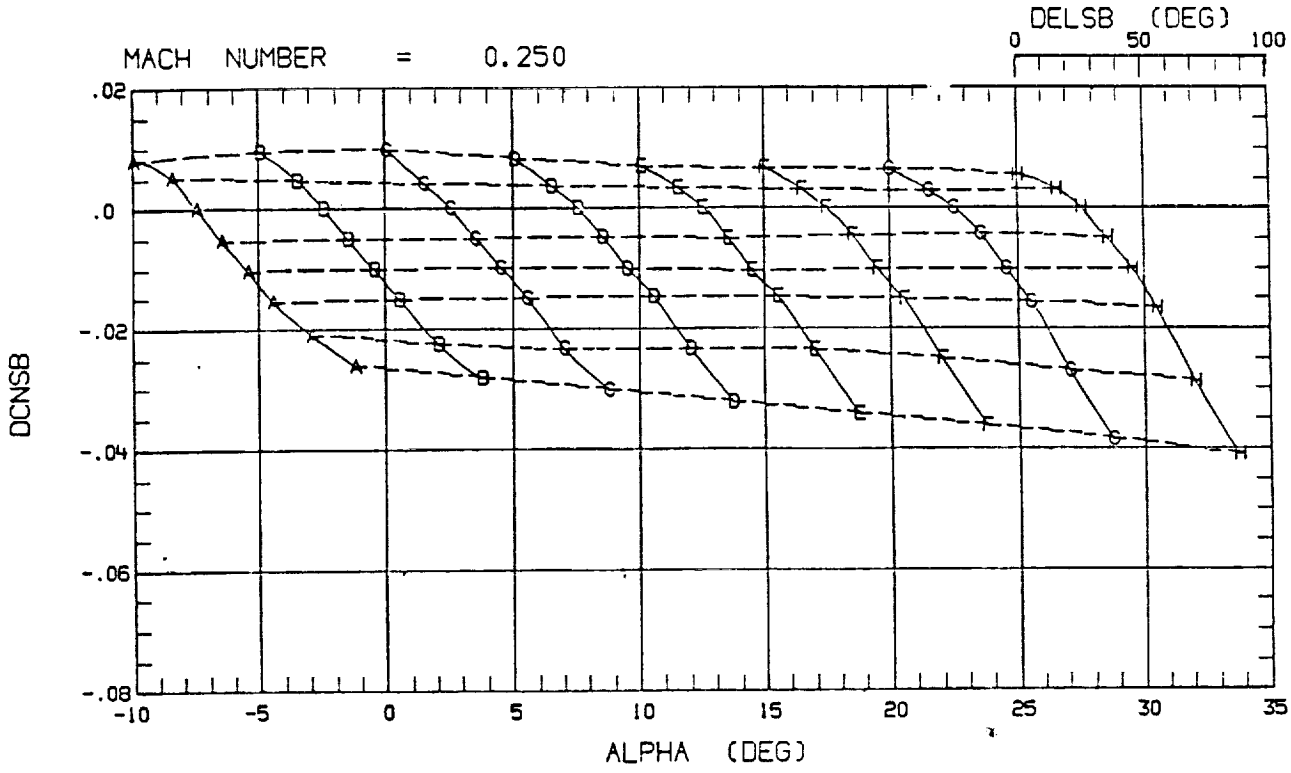


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELBF (DEG)	BODY FLAP NORMAL FORCE INCREMEN						
-11.700	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.02660	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER NASA
DATE

FIGURE 4.1.1.1-66
EFFECT OF BODY FLAP



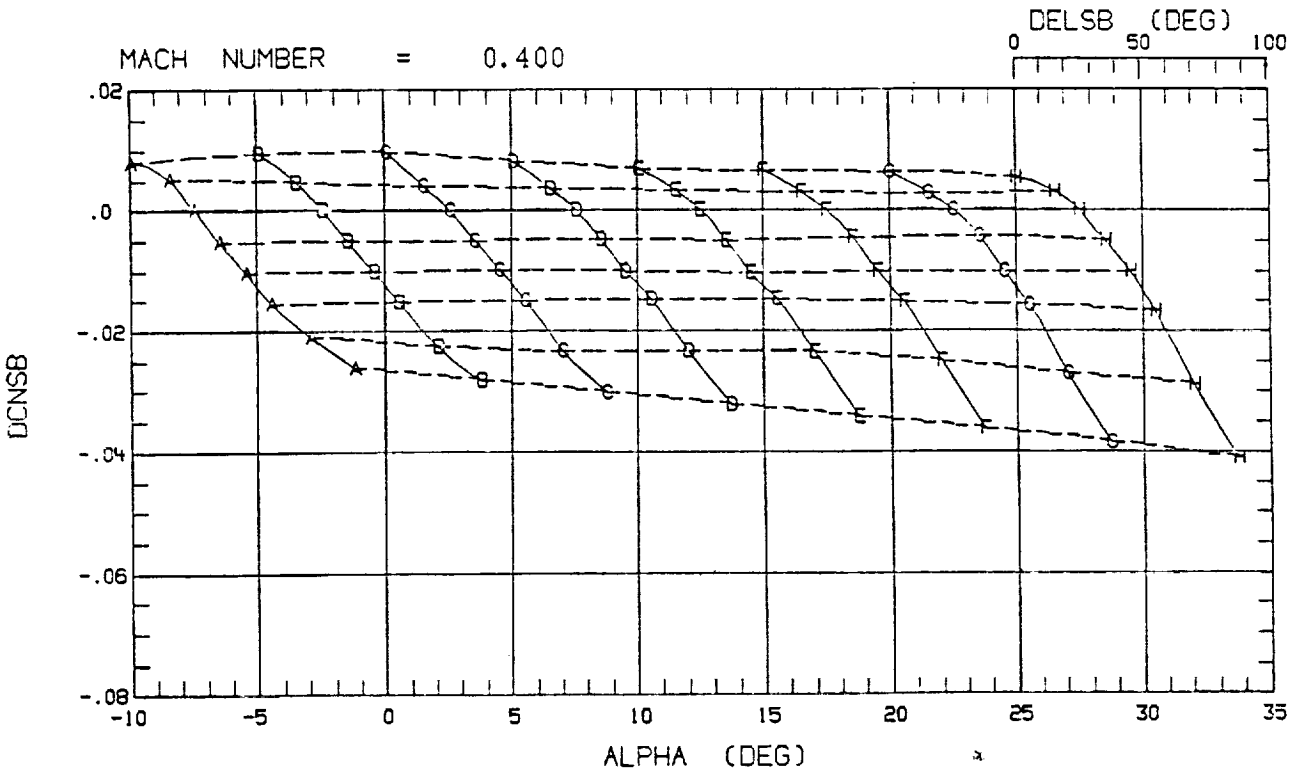
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00787	0.00936	0.00970	0.00818	0.00684	0.00652	0.00635	0.00532
15.000	0.00515	0.00450	0.00400	0.00359	0.00324	0.00296	0.00273	0.00303
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00533	-0.00515	-0.00500	-0.00496	-0.00504	-0.00463	-0.00427	-0.00508
45.000	-0.01039	-0.01015	-0.01000	-0.01009	-0.01047	-0.01026	-0.01010	-0.01032
55.000	-0.01553	-0.01522	-0.01490	-0.01467	-0.01484	-0.01521	-0.01567	-0.01685
70.000	-0.02101	-0.02263	-0.02350	-0.02331	-0.02357	-0.02516	-0.02714	-0.02892
87.200	-0.02619	-0.02825	-0.03020	-0.03225	-0.03442	-0.03640	-0.03654	-0.04129

ENGINEER J.GD
DATE 10-3-78

FIGURE 4.1.1.1- 67
EFFECT OF SPEEDBRAKE



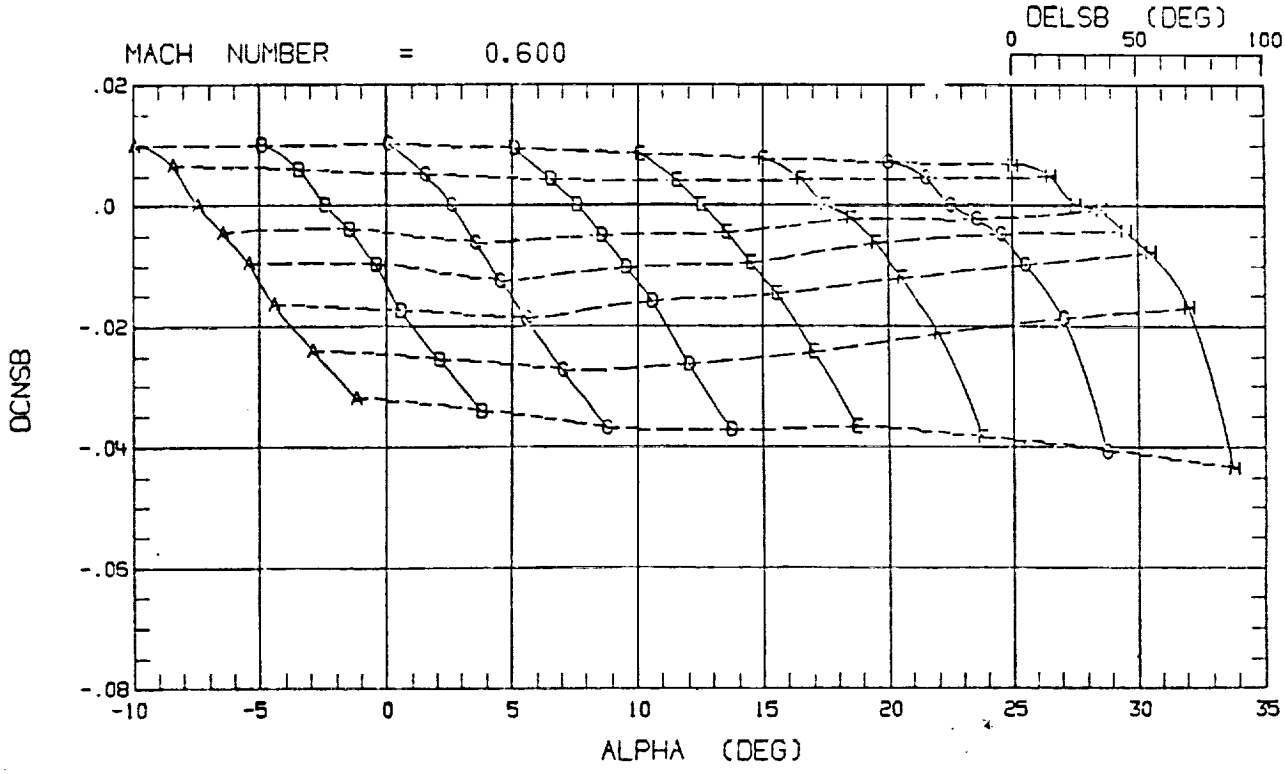
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00787	0.00936	0.00970	0.00818	0.00684	0.00652	0.00635	0.00532
15.000	0.00515	0.00450	0.00400	0.00359	0.00324	0.00296	0.00273	0.00303
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00533	-0.00515	-0.00500	-0.00496	-0.00504	-0.00463	-0.00427	-0.00508
45.000	-0.01039	-0.01015	-0.01000	-0.01009	-0.01047	-0.01026	-0.01010	-0.01032
55.000	-0.01553	-0.01522	-0.01490	-0.01467	-0.01484	-0.01521	-0.01567	-0.01685
70.000	-0.02101	-0.02263	-0.02350	-0.02331	-0.02357	-0.02516	-0.02714	-0.02992
87.200	-0.03619	-0.02825	-0.03020	-0.03225	-0.03442	-0.03640	-0.03854	-0.04129

ENGINEER D&D
DATE 10-3-78

FIGURE 4.1.1.1-68
EFFECT OF SPEEDBRAKE



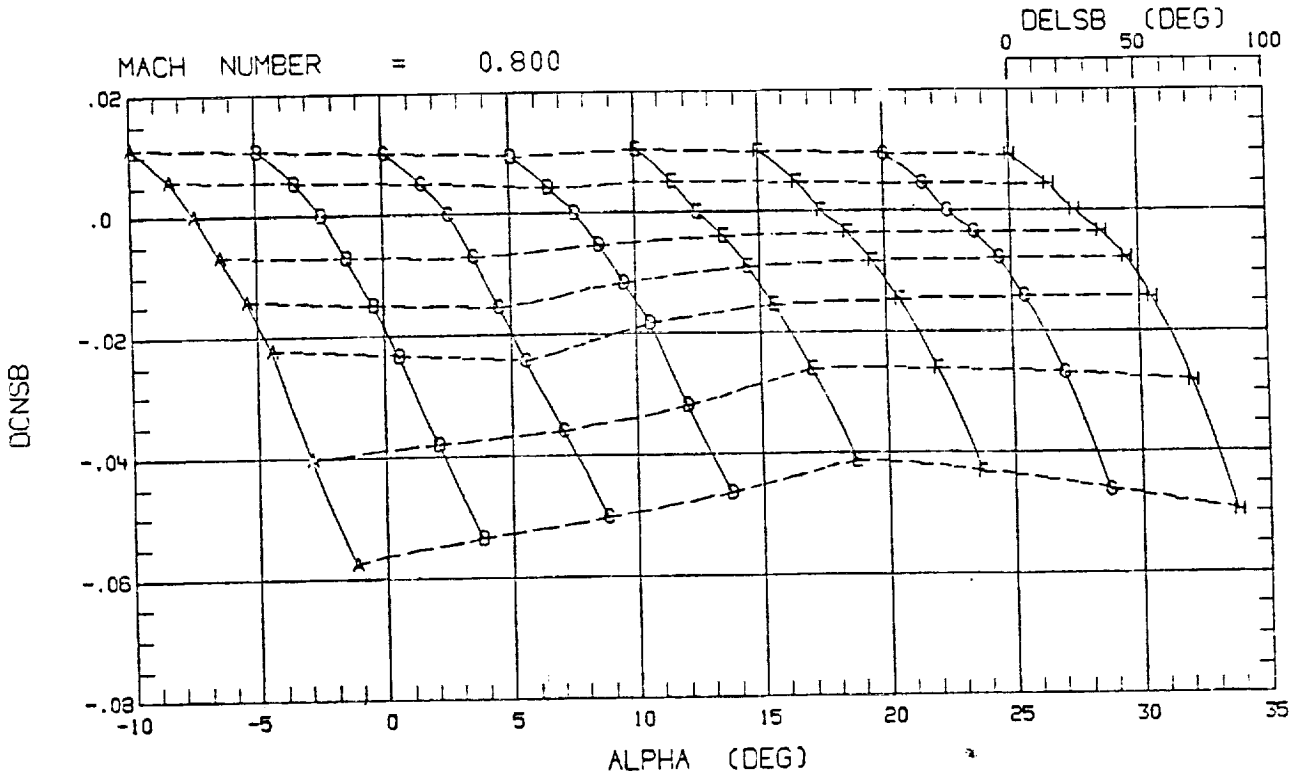
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00979	0.00932	0.01000	0.00932	0.00845	0.00766	0.00704	0.00659
15.000	0.00661	0.00580	0.00500	0.00416	0.00394	0.00418	0.00443	0.00467
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00461	-0.00412	-0.00639	-0.00500	-0.00465	-0.00236	-0.00241	-0.00082
45.000	-0.00975	-0.01002	-0.01269	-0.01035	-0.00958	-0.00637	-0.00489	-0.00442
55.000	-0.01659	-0.01759	-0.01882	-0.01604	-0.01478	-0.01222	-0.00997	-0.00804
70.000	-0.02405	-0.02558	-0.02746	-0.02642	-0.02432	-0.02131	-0.01888	-0.01705
87.200	-0.03194	-0.03421	-0.03711	-0.03742	-0.03679	-0.03854	-0.04065	-0.04360

ENGINEER XGD
DATE 10-3-78

FIGURE 4.1.1.1-69
EFFECT OF SPEEDBRAKE



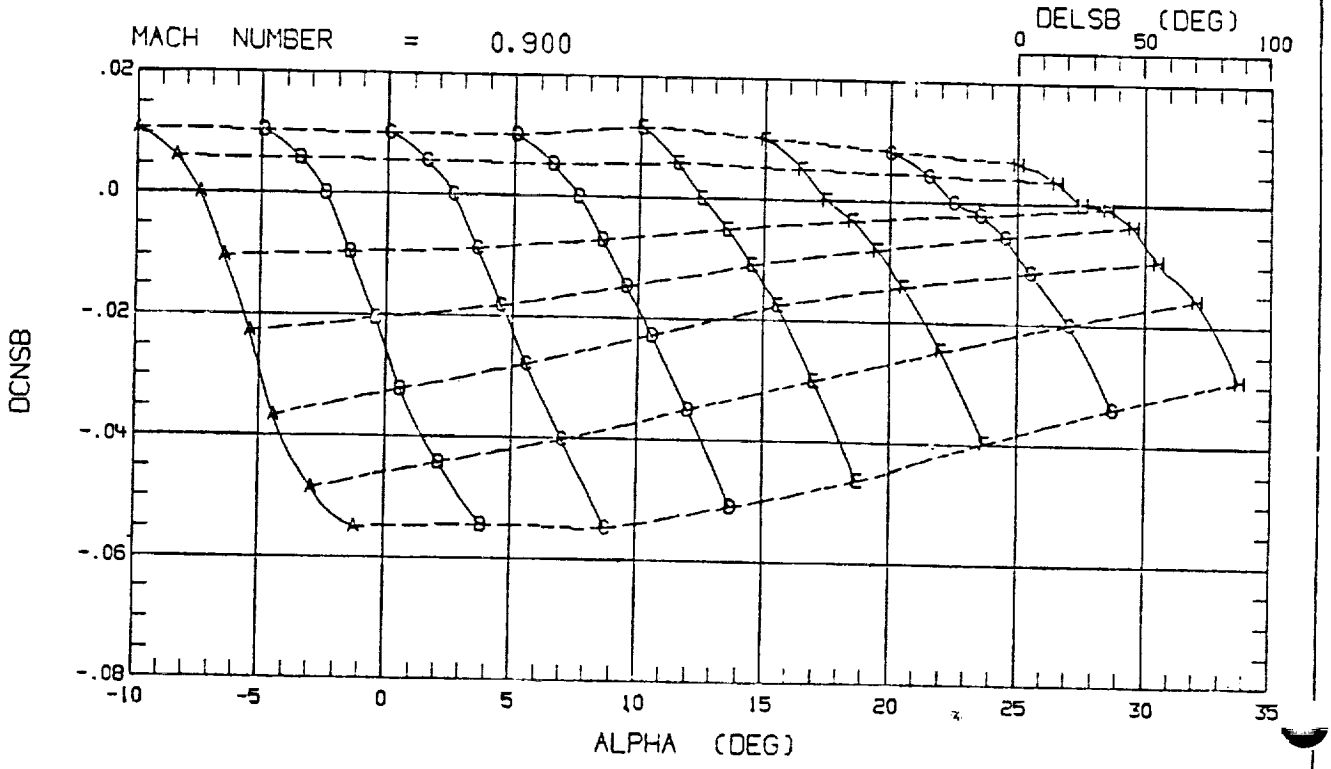
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.01100	0.01054	0.01000	0.00946	0.01023	0.00984	0.00945	0.00905
15.000	0.00570	0.00532	0.00500	0.00424	0.00507	0.00479	0.00448	0.00414
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00700	-0.00723	-0.00727	-0.00548	-0.00408	-0.00368	-0.00353	-0.00362
45.000	-0.01438	-0.01507	-0.01563	-0.01164	-0.00913	-0.00838	-0.00800	-0.00799
55.000	-0.02246	-0.02341	-0.02450	-0.01843	-0.01555	-0.01475	-0.01438	-0.01442
70.000	-0.04047	-0.03802	-0.03599	-0.03205	-0.02614	-0.02621	-0.02699	-0.02842
87.200	-0.05762	-0.05356	-0.05038	-0.04640	-0.04130	-0.04341	-0.04640	-0.05013

ENGINEER XGD
DATE 10-3-78

FIGURE 4.1.1.1-70
EFFECT OF SPEEDBRAKE



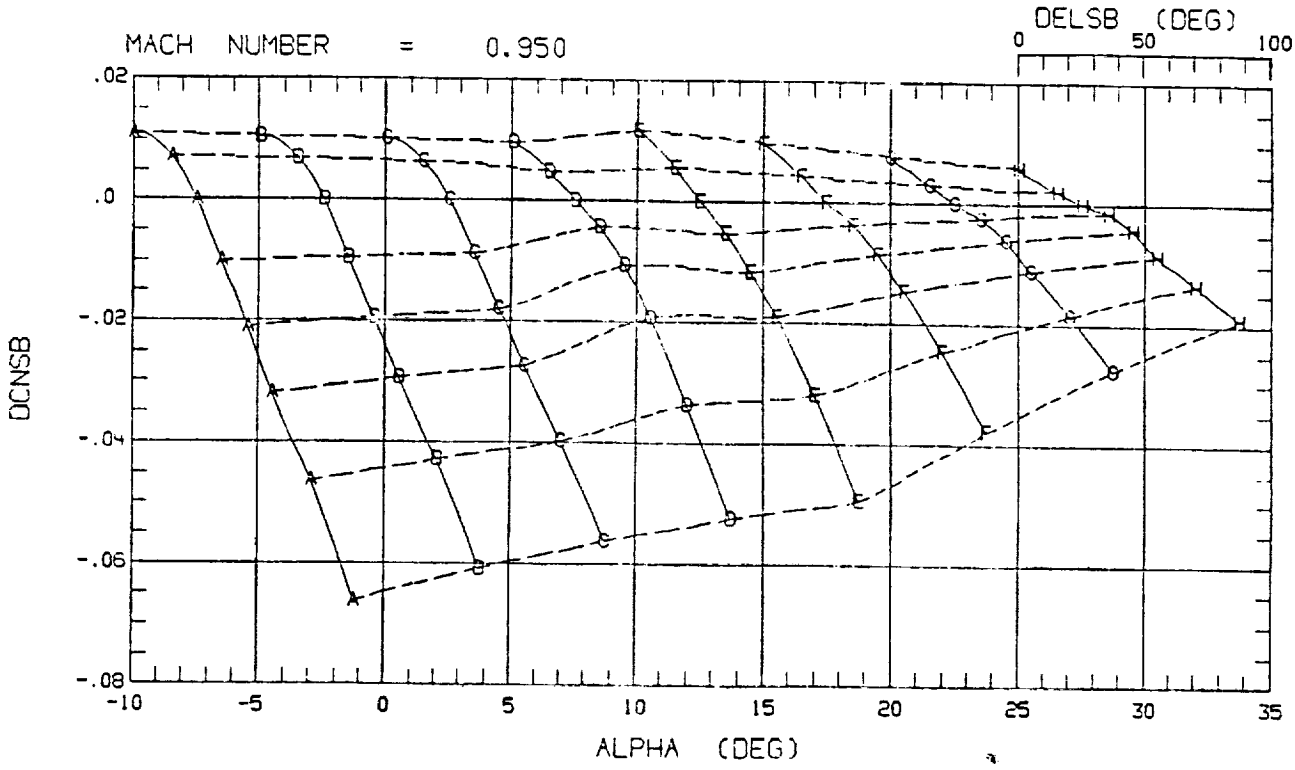
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.01058	0.01037	0.01000	0.01013	0.01174	0.00992	0.00818	0.00657
15.000	0.00593	0.00576	0.00550	0.00518	0.00567	0.00497	0.00426	0.00336
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.01035	-0.00972	-0.00885	-0.00707	-0.00505	-0.00343	-0.00202	-0.00085
45.000	-0.02298	-0.02070	-0.01829	-0.01482	-0.01093	-0.00809	-0.00566	-0.00369
55.000	-0.03677	-0.03227	-0.02800	-0.02284	-0.01767	-0.01430	-0.01152	-0.00936
70.000	-0.04689	-0.04440	-0.04050	-0.03501	-0.03001	-0.02479	-0.02003	-0.01578
87.200	-0.05511	-0.05464	-0.05500	-0.05107	-0.04653	-0.03988	-0.03409	-0.02922

ENGINEER DGD
DATE 10-3-85

FIGURE 4.1.1.1-71
EFFECT OF SPEEDBRAKE



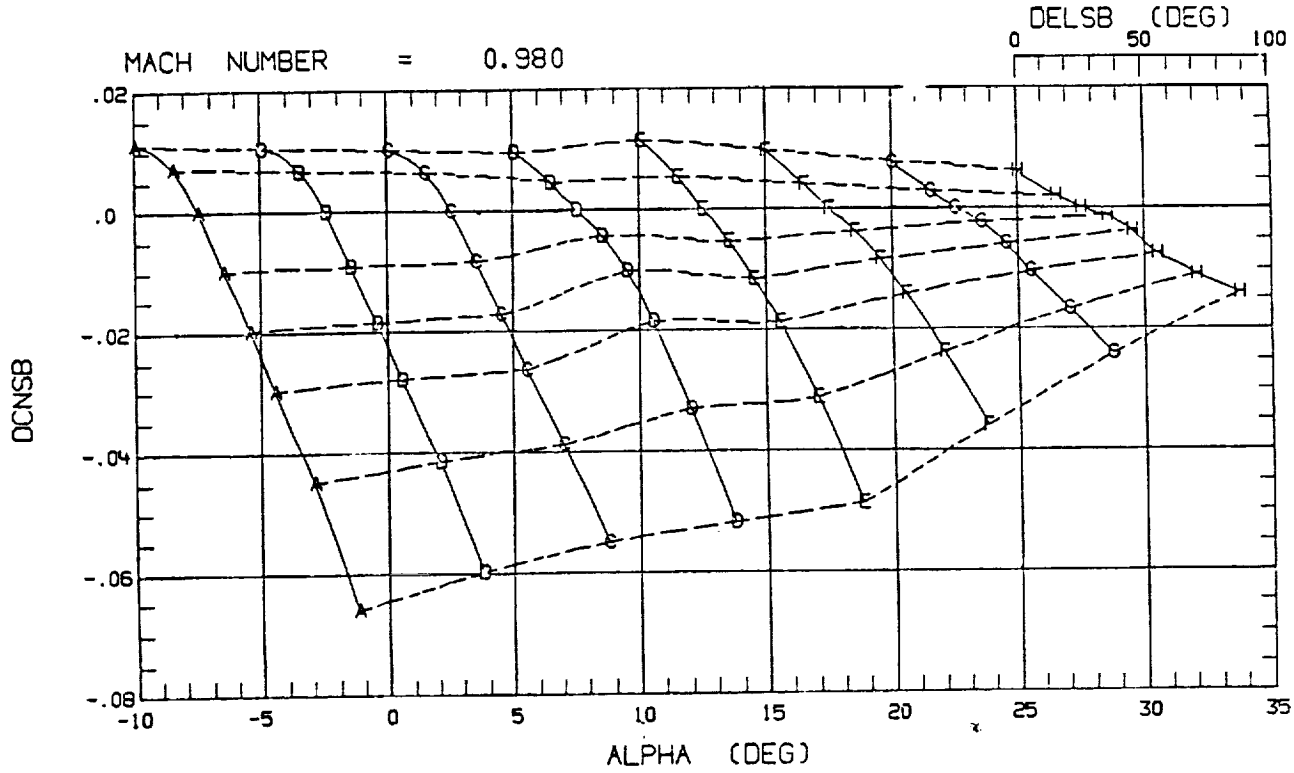
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.01098	0.01048	0.01000	0.00954	0.01153	0.00951	0.00756	0.00577
15.000	0.00707	0.00671	0.00630	0.00474	0.00544	0.00414	0.00290	0.00187
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.01028	-0.00965	-0.00892	-0.00446	-0.00544	-0.00381	-0.00247	-0.00145
45.000	-0.02105	-0.01956	-0.01814	-0.01064	-0.01178	-0.00874	-0.00626	-0.00440
55.000	-0.03211	-0.02957	-0.02750	-0.01925	-0.01913	-0.01479	-0.01128	-0.00865
70.000	-0.04662	-0.04305	-0.04000	-0.03383	-0.03209	-0.02475	-0.01848	-0.01340
87.200	-0.06630	-0.06094	-0.05650	-0.05267	-0.04965	-0.03795	-0.02768	-0.01904

ENGINEER DGJ
DATE 10-3-78

FIGURE 4.1.1.1- 72
EFFECT OF SPEEDBRAKE



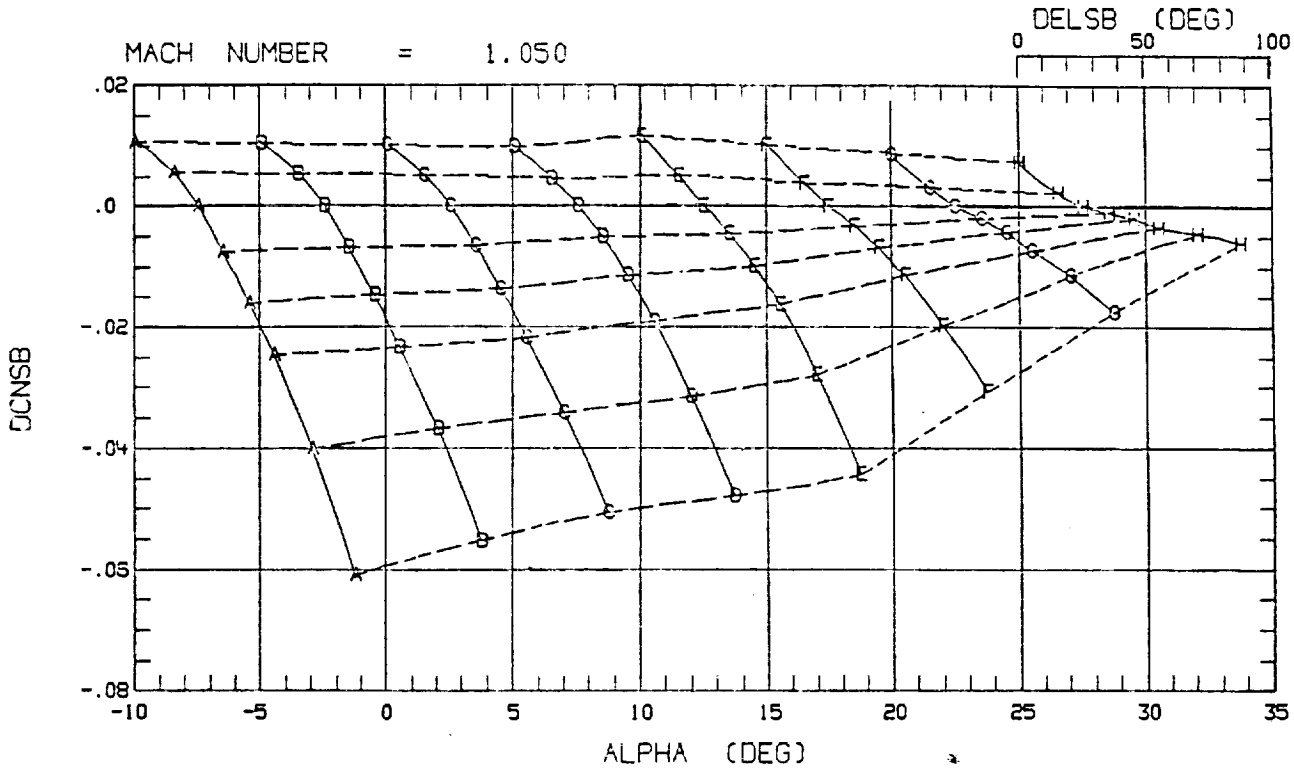
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.01100	0.01047	0.01000	0.00956	0.01148	0.00954	0.00767	0.00596
15.000	0.00705	0.00665	0.00623	0.00483	0.00533	0.00395	0.00278	0.00187
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00985	-0.00919	-0.00852	-0.00434	-0.00538	-0.00376	-0.00237	-0.00141
45.000	-0.01973	-0.01850	-0.01736	-0.01032	-0.01160	-0.00852	-0.00598	-0.00397
55.000	-0.02966	-0.02789	-0.02637	-0.01870	-0.01882	-0.01428	-0.01057	-0.00767
70.000	-0.04509	-0.04171	-0.03882	-0.03309	-0.03135	-0.02384	-0.01674	-0.01111
87.200	-0.06601	-0.06004	-0.05503	-0.05171	-0.04874	-0.03611	-0.02425	-0.01426

ENGINEER DGD
DATE 10-3-75

FIGURE 4.1.1.1-73
EFFECT OF SPEEDBRAKE



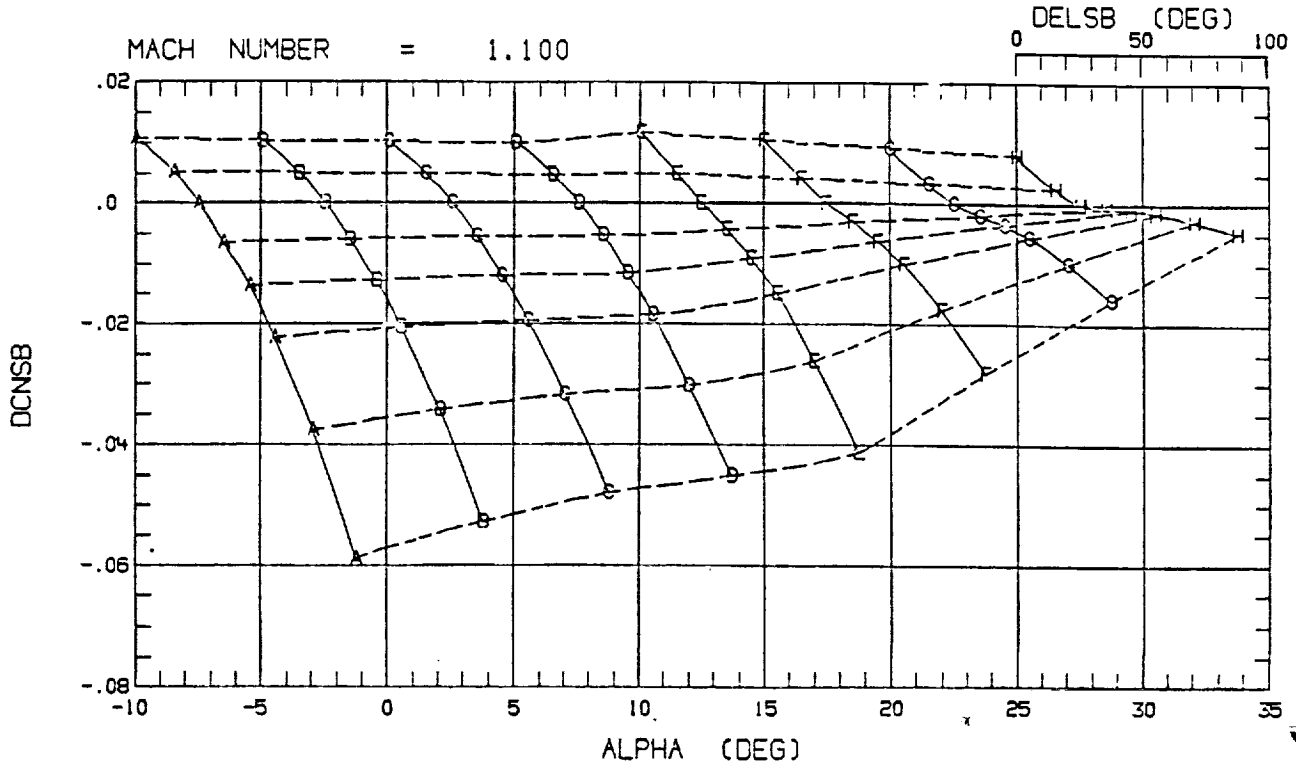
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.01069	0.01026	0.01000	0.00980	0.01156	0.01008	0.00862	0.00721
15.000	0.00551	0.00526	0.00507	0.00458	0.00493	0.00388	0.00297	0.00211
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00759	-0.00698	-0.00653	-0.00525	-0.00472	-0.00336	-0.00214	-0.00119
45.000	-0.01604	-0.01479	-0.01385	-0.01157	-0.00993	-0.00700	-0.00434	-0.00204
55.000	-0.02467	-0.02345	-0.02179	-0.01902	-0.01622	-0.01156	-0.00730	-0.00354
70.000	-0.04022	-0.03684	-0.03420	-0.03145	-0.02792	-0.01976	-0.01159	-0.00452
87.200	-0.06097	-0.05629	-0.05077	-0.04801	-0.04440	-0.03070	-0.01765	-0.00605

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.1- 74
EFFECT OF SPEEDBRAKE



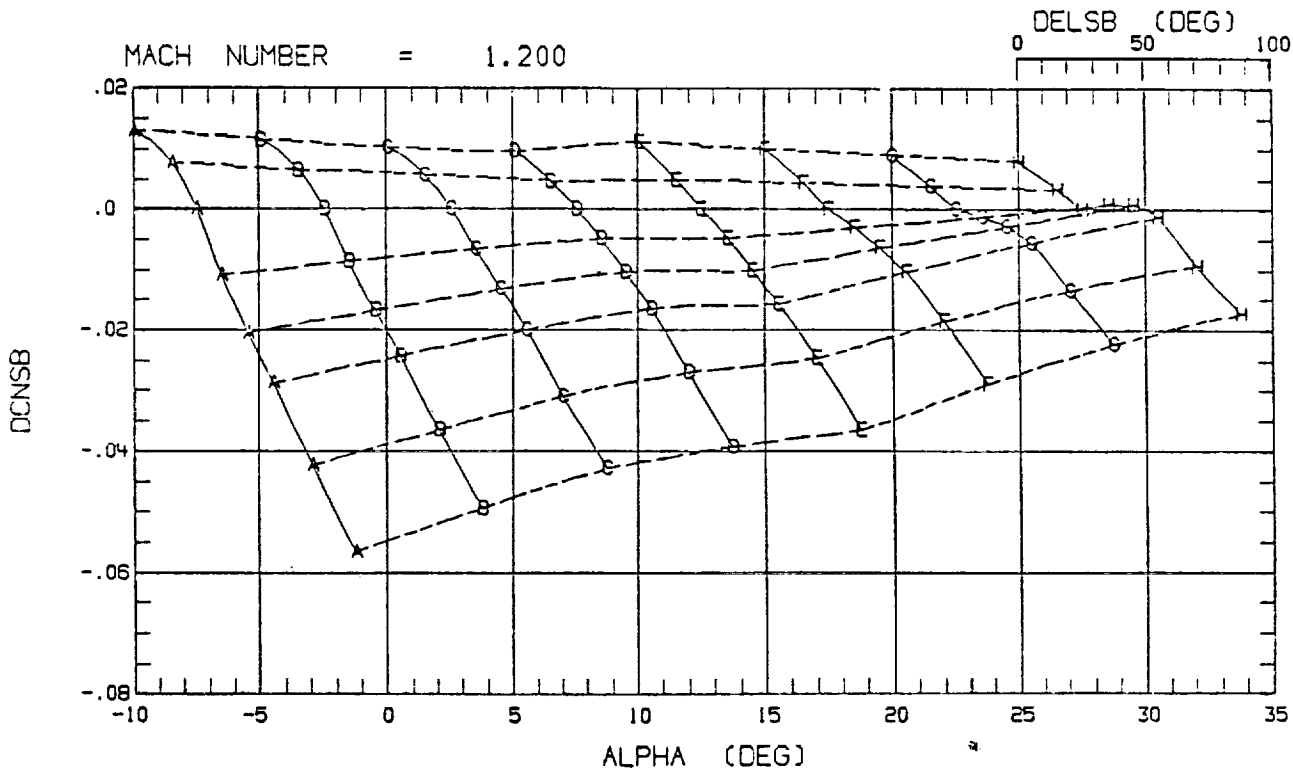
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.01062	0.01019	0.01000	0.00988	0.01153	0.01026	0.00900	0.00778
15.000	0.00511	0.00485	0.00468	0.00457	0.00473	0.00392	0.00314	0.00240
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00659	-0.00603	-0.00565	-0.00547	-0.00448	-0.00318	-0.00196	-0.00085
45.000	-0.01386	-0.01290	-0.01220	-0.01175	-0.00929	-0.00634	-0.00356	-0.00098
55.000	-0.02227	-0.02069	-0.01950	-0.01867	-0.01515	-0.01029	-0.00571	-0.00149
70.000	-0.03766	-0.03437	-0.03180	-0.03021	-0.02613	-0.01780	-0.01000	-0.00286
87.200	-0.05881	-0.05279	-0.04800	-0.04526	-0.04150	-0.02834	-0.01608	-0.00495

ENGINEER DGD
DATE 12-3-76

FIGURE 4.1.1.1-75
EFFECT OF SPEEDBRAKE



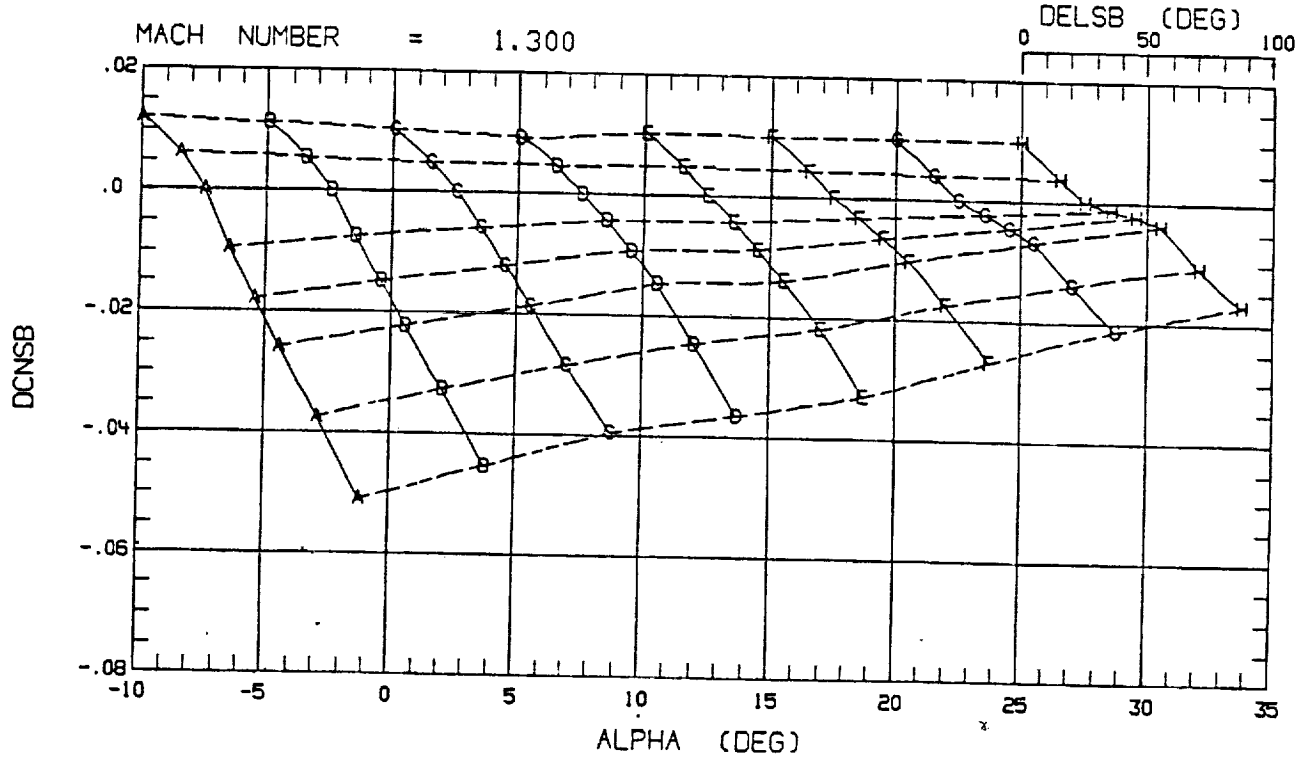
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.01296	0.01145	0.01000	0.00956	0.01110	0.00985	0.00874	0.00781
15.000	0.00749	0.00641	0.00550	0.00459	0.00485	0.00418	0.00364	0.00322
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.01099	-0.00876	-0.00667	-0.00495	-0.00485	-0.00316	-0.00128	0.00072
45.000	-0.02056	-0.01687	-0.01333	-0.01043	-0.01015	-0.00652	-0.00291	0.00063
55.000	-0.02880	-0.02436	-0.02000	-0.01649	-0.01573	-0.01042	-0.00557	-0.00125
70.000	-0.04250	-0.03656	-0.03100	-0.02708	-0.02458	-0.01855	-0.01344	-0.00933
87.200	-0.05677	-0.04951	-0.04300	-0.03942	-0.03656	-0.02888	-0.02241	-0.01725

ENGINEER DKD
DATE 8-3-78

FIGURE 4.1.1.1-76
EFFECT OF SPEEDBRAKE



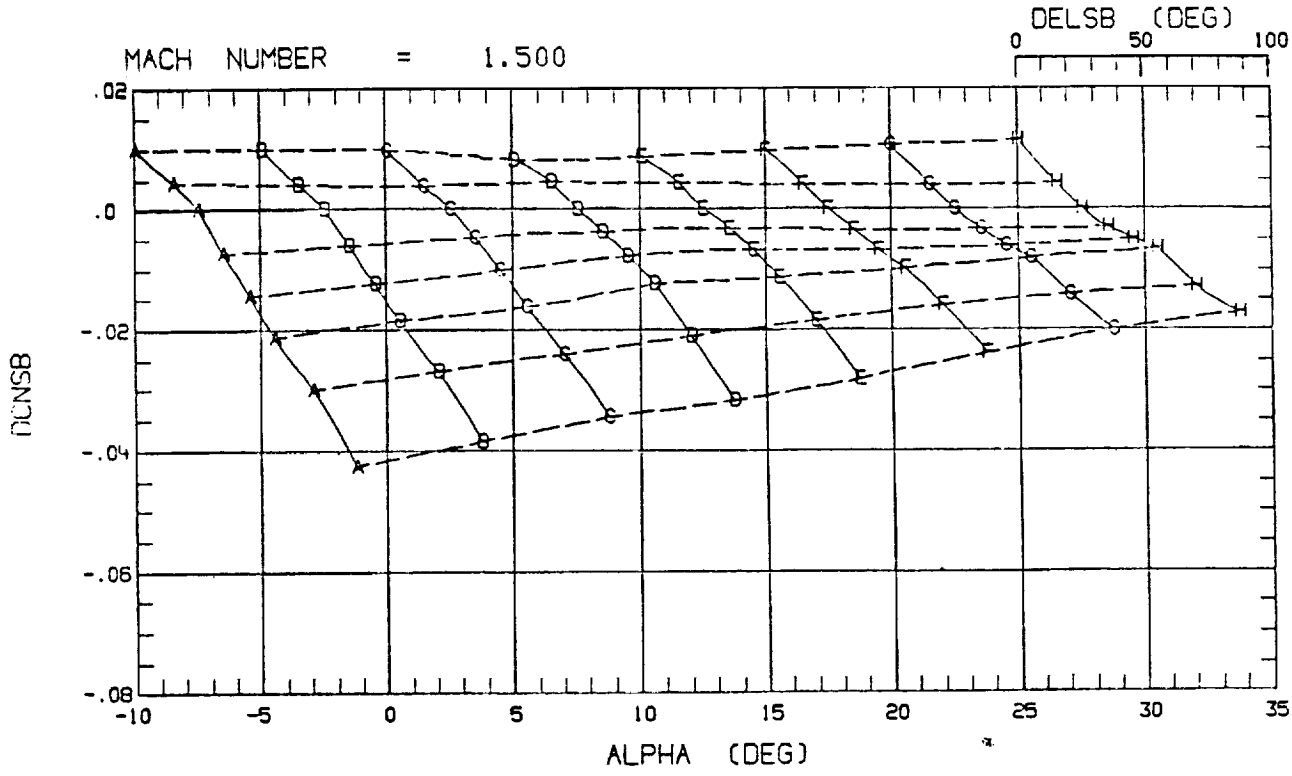
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.01183	0.01099	0.01000	0.00901	0.01016	0.00991	0.00978	0.00976
15.000	0.00608	0.00531	0.00475	0.00464	0.00468	0.00431	0.00401	0.00379
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00958	-0.00768	-0.00592	-0.00449	-0.00429	-0.00337	-0.00235	-0.00125
45.000	-0.01813	-0.01511	-0.01223	-0.00936	-0.00896	-0.00676	-0.00455	-0.00230
55.000	-0.02587	-0.02226	-0.01875	-0.01489	-0.01405	-0.01038	-0.00698	-0.00389
70.000	-0.03750	-0.03291	-0.02849	-0.02457	-0.02193	-0.01760	-0.01389	-0.01087
87.200	-0.05112	-0.04540	-0.03973	-0.03654	-0.03315	-0.02684	-0.02145	-0.01713

ENGINEER DKD
DATE 10-3-78

FIGURE 4.1.1.1-77
EFFECT OF SPEEDBRAKE



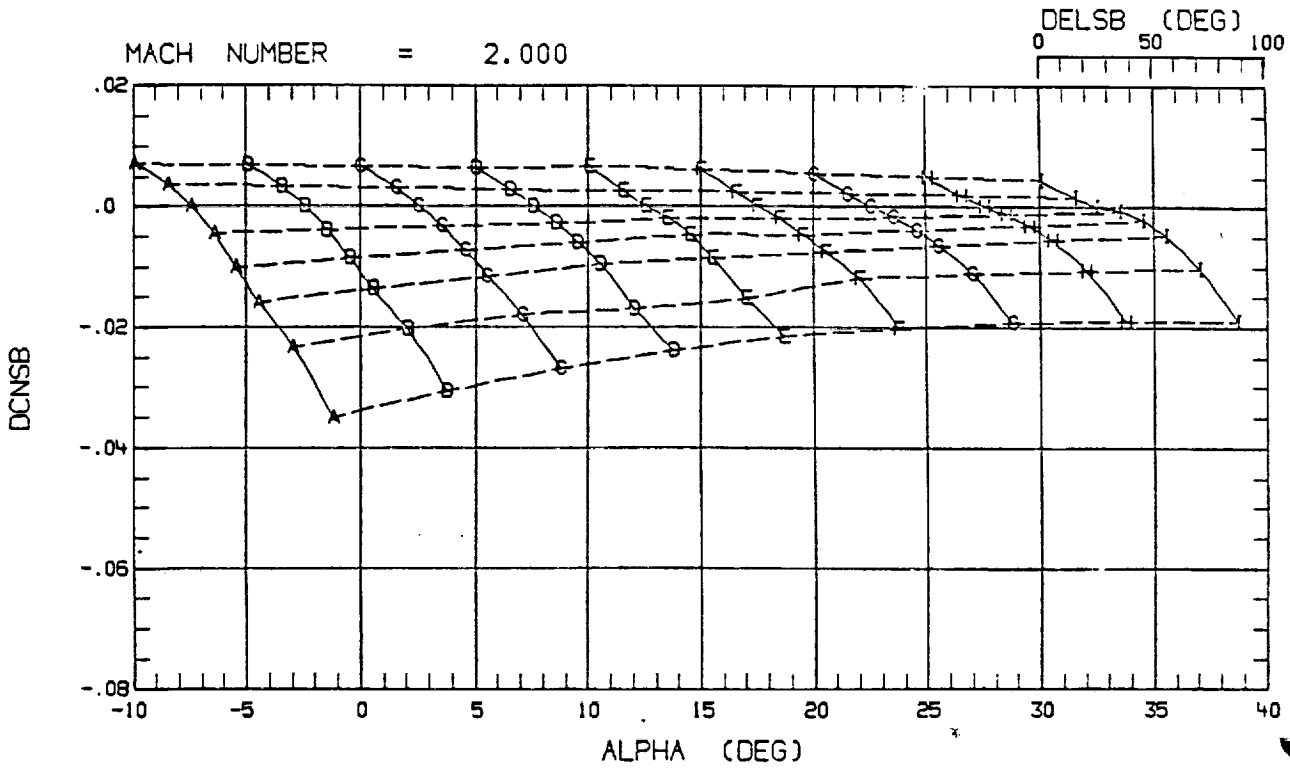
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00979	0.00990	0.00960	0.00807	0.00852	0.00959	0.01051	0.01145
15.000	0.00424	0.00392	0.00379	0.00440	0.00417	0.00412	0.00412	0.00414
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00745	-0.00616	-0.00476	-0.00379	-0.00327	-0.00354	-0.00345	-0.00322
45.000	-0.01456	-0.01259	-0.01030	-0.00782	-0.00685	-0.00682	-0.00608	-0.00507
55.000	-0.02132	-0.01867	-0.01635	-0.01261	-0.01136	-0.00997	-0.00818	-0.00674
70.000	-0.02996	-0.02694	-0.02405	-0.02112	-0.01853	-0.01598	-0.01416	-0.01304
87.200	-0.04261	-0.03852	-0.03462	-0.03180	-0.02813	-0.02379	-0.02014	-0.01769

ENGINEER DGD
DATE 10-3-85

FIGURE 4.1.1.1-78
EFFECT OF SPEEDBRAKE



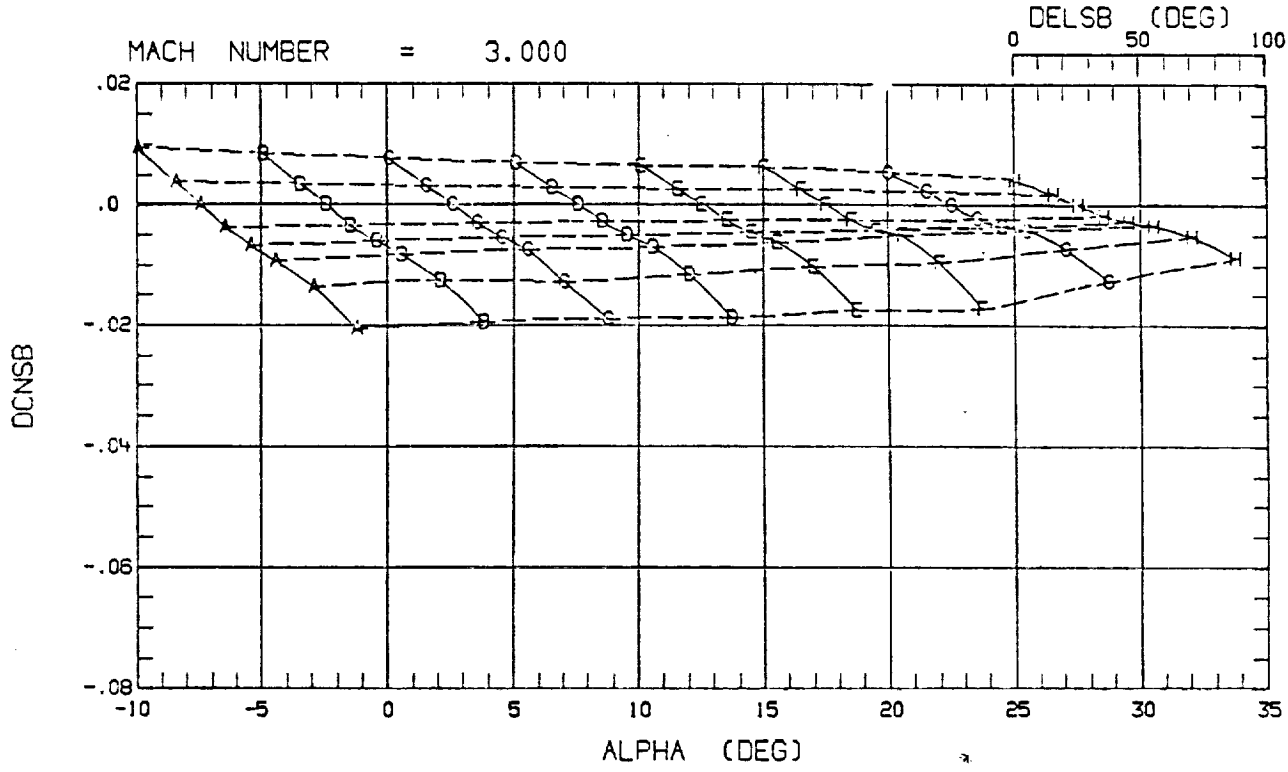
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.								
0.0	0.00698	0.00675	0.00650	0.00623	0.00657	0.00599	0.00539	0.00483	0.00433
15.000	0.00354	0.00324	0.00295	0.00268	0.00240	0.00234	0.00208	0.00179	0.00148
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00462	-0.00399	-0.00342	-0.00292	-0.00206	-0.00220	-0.00187	-0.00139	-0.00078
45.000	-0.01024	-0.00876	-0.00738	-0.00611	-0.00475	-0.00476	-0.00404	-0.00325	-0.00239
55.000	-0.01594	-0.01370	-0.01161	-0.00969	-0.00867	-0.00756	-0.00657	-0.00570	-0.00494
70.000	-0.02334	-0.02047	-0.01800	-0.01694	-0.01518	-0.01207	-0.01130	-0.01075	-0.01041
87.200	-0.03496	-0.03068	-0.02700	-0.02397	-0.02156	-0.02025	-0.01938	-0.01903	-0.01920

ENGINEER DAD
DATE 10-3-78

FIGURE 4.1.1.1-79
EFFECT OF SPEEDBRAKE



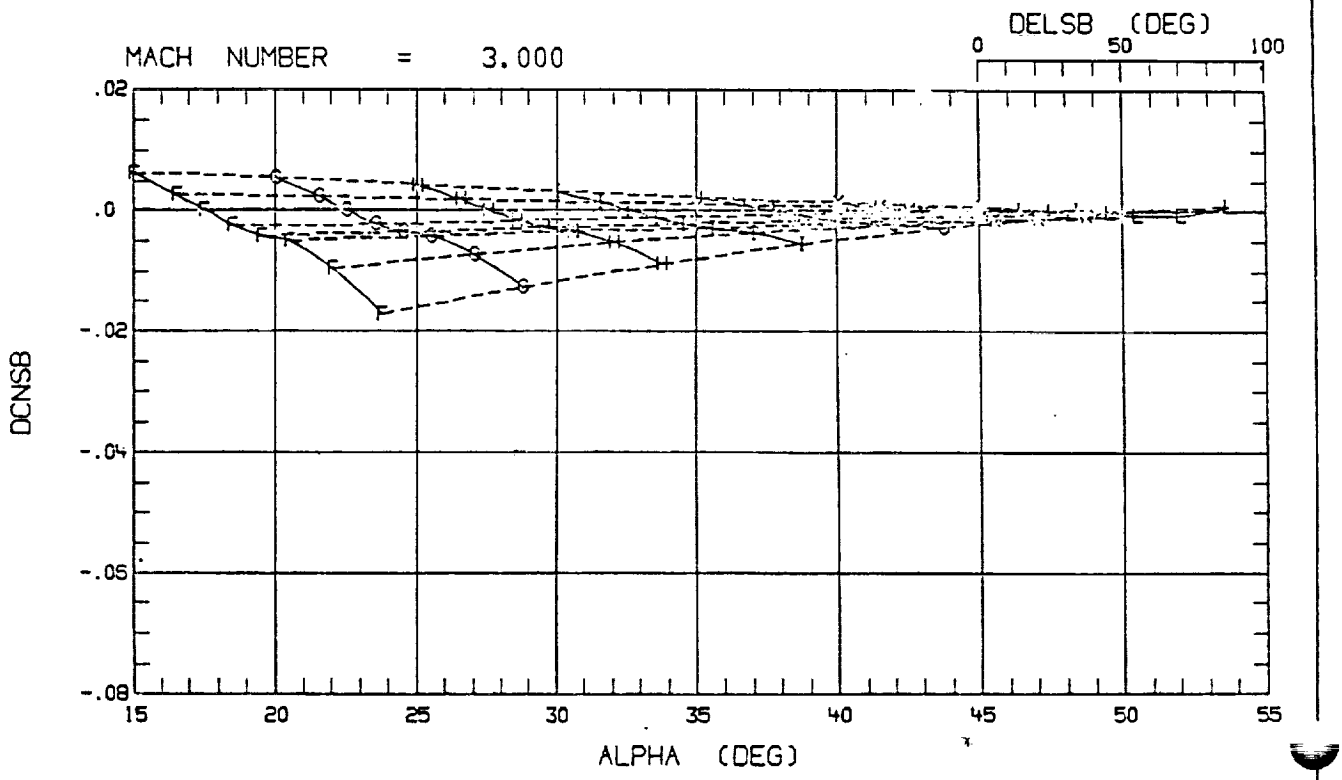
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00928	0.00837	0.00755	0.00685	0.00639	0.00608	0.00538	0.00412
15.000	0.00371	0.00335	0.00302	0.00274	0.00256	0.00243	0.00215	0.00165
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00390	-0.00353	-0.00318	-0.00286	-0.00269	-0.00267	-0.00240	-0.00181
45.000	-0.00692	-0.00617	-0.00559	-0.00518	-0.00474	-0.00427	-0.00365	-0.00294
55.000	-0.00950	-0.00838	-0.00760	-0.00717	-0.00638	-0.00520	-0.00430	-0.00355
70.000	-0.01379	-0.01272	-0.01300	-0.01175	-0.01036	-0.00975	-0.00741	-0.00544
87.200	-0.02065	-0.01957	-0.01897	-0.01882	-0.01766	-0.01725	-0.01275	-0.00938

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.1-80
EFFECT OF SPEEDBRAKE

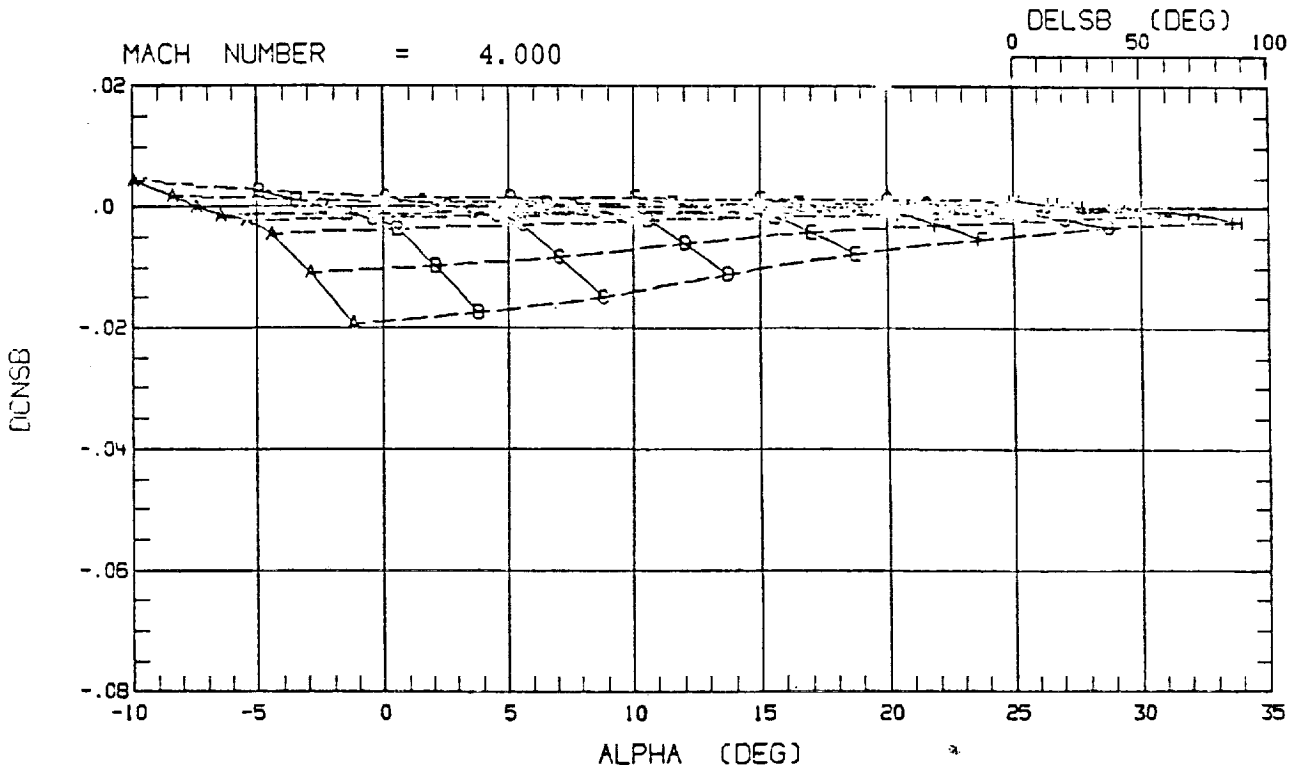


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.						
0.0	0.00608	0.00538	0.00412	0.00299	0.00201	0.00117	0.00052
15.000	0.00243	0.00215	0.00165	0.00120	0.00080	0.00047	0.00021
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00267	-0.00240	-0.00181	-0.00126	-0.00075	-0.00029	0.00010
45.000	-0.00427	-0.00385	-0.00294	-0.00240	-0.00158	-0.00100	-0.00025
55.000	-0.00520	-0.00430	-0.00355	-0.00308	-0.00201	-0.00162	-0.00081
70.000	-0.00975	-0.00741	-0.00544	-0.00376	-0.00241	-0.00139	-0.00074
87.200	-0.01725	-0.01275	-0.00899	-0.00569	-0.00293	-0.00075	0.00081

ENGINEER
DATE 10-2-78

FIGURE 4.1.1.1-81
EFFECT OF SPEEDBRAKE



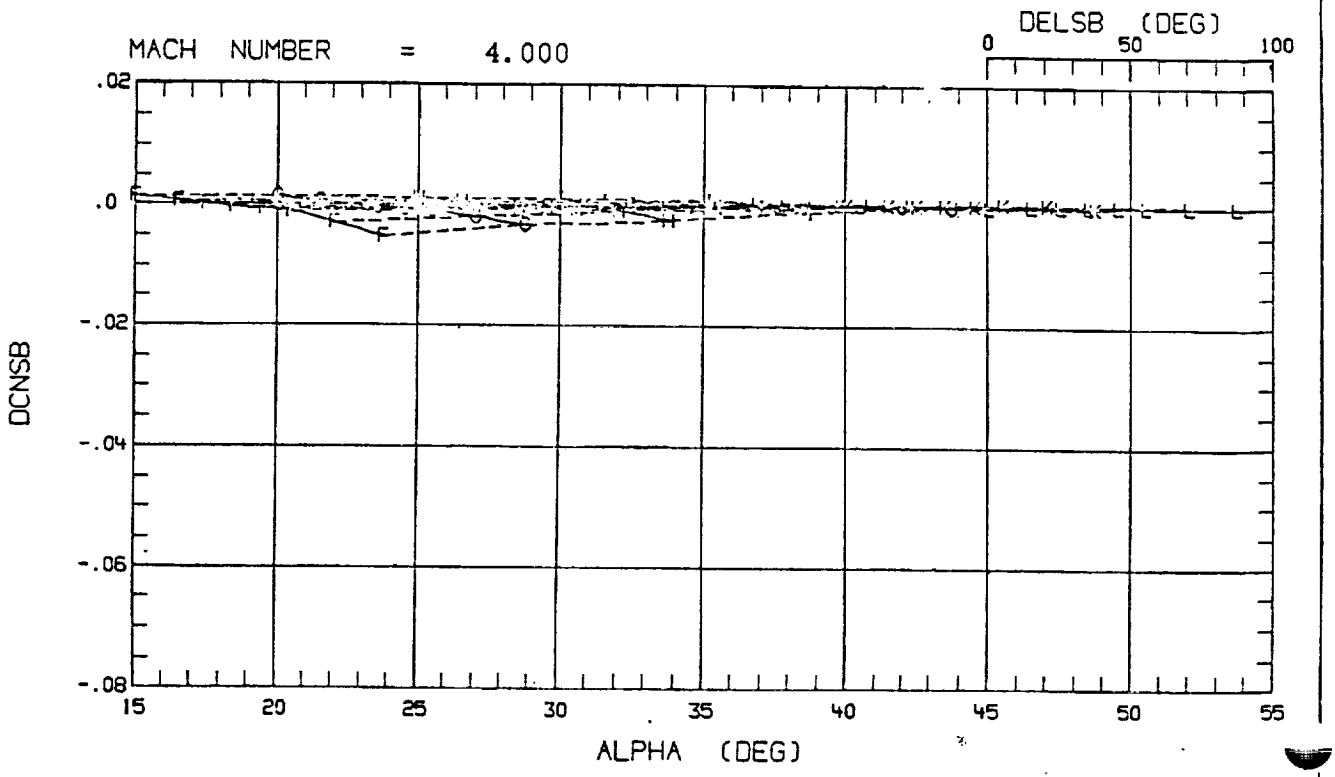
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00437	0.00255	0.00150	0.00143	0.00135	0.00127	0.00117	0.00106
15.000	0.00175	0.00102	0.00060	0.00057	0.00054	0.00050	0.00046	0.00042
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00147	-0.00129	-0.00110	-0.00089	-0.00072	-0.00059	-0.00050	-0.00060
45.000	-0.00243	-0.00199	-0.00160	-0.00126	-0.00099	-0.00082	-0.00071	-0.00044
55.000	-0.00463	-0.00382	-0.00310	-0.00237	-0.00173	-0.00126	-0.00099	-0.00079
70.000	-0.01105	-0.00990	-0.00840	-0.00620	-0.00426	-0.00300	-0.00207	-0.00107
87.200	-0.01937	-0.01753	-0.01500	-0.01121	-0.00783	-0.00538	-0.00344	-0.00255

ENGINEER DGD
DATE 10-3-88

FIGURE 4.1.1.1-82
EFFECT OF SPEEDBRAKE



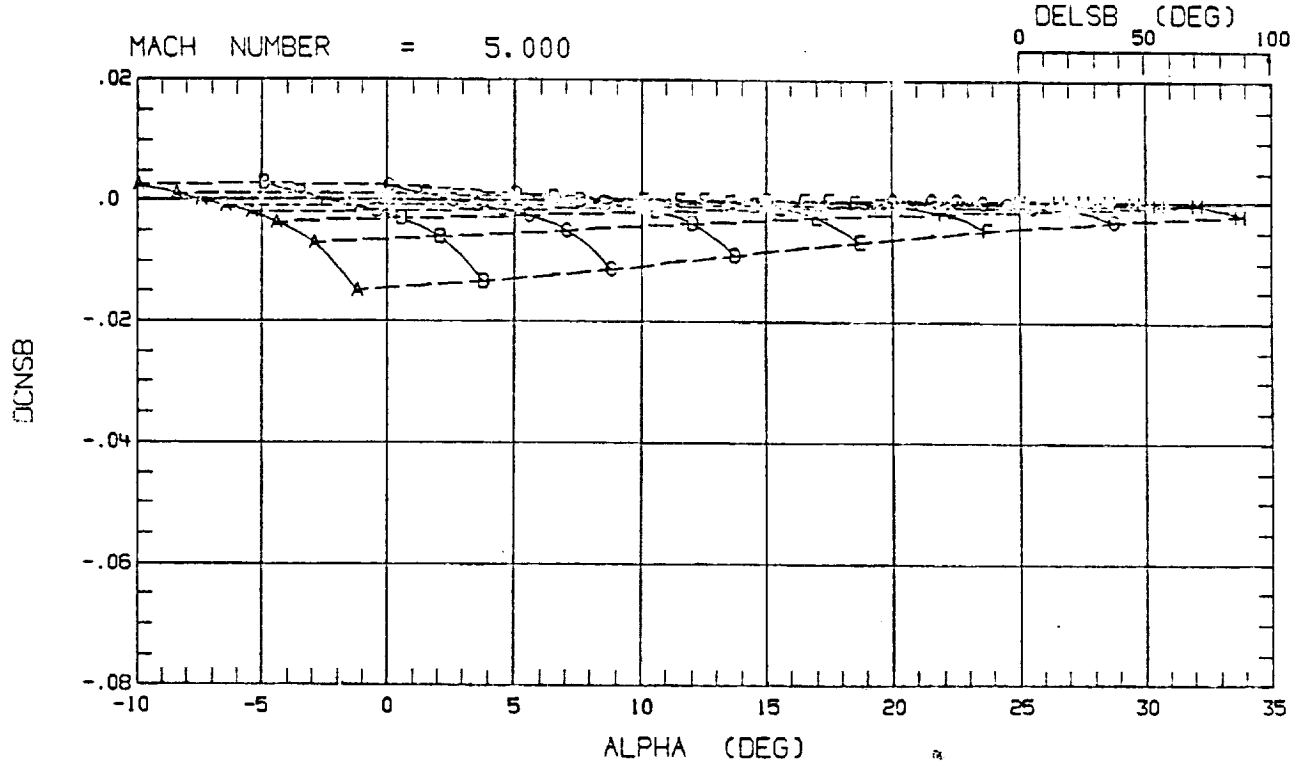
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.						
0.0	0.00127	0.00117	0.00106	0.00095	0.00060	0.00006	-0.00028
15.000	0.00050	0.00046	0.00042	0.00037	0.00024	0.00004	-0.00011
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00059	-0.00050	-0.00060	-0.00044	-0.00022	0.0	0.0
45.000	-0.00082	-0.00071	-0.00044	-0.00032	-0.00013	0.0	0.0
55.000	-0.00126	-0.00099	-0.00079	-0.00029	0.00004	0.00019	0.0
70.000	-0.00300	-0.00207	-0.00107	-0.00043	0.00002	0.00032	0.0
87.200	-0.00538	-0.00344	-0.00255	-0.00103	-0.00034	-0.00021	0.0

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.1-83
EFFECT OF SPEEDBRAKE



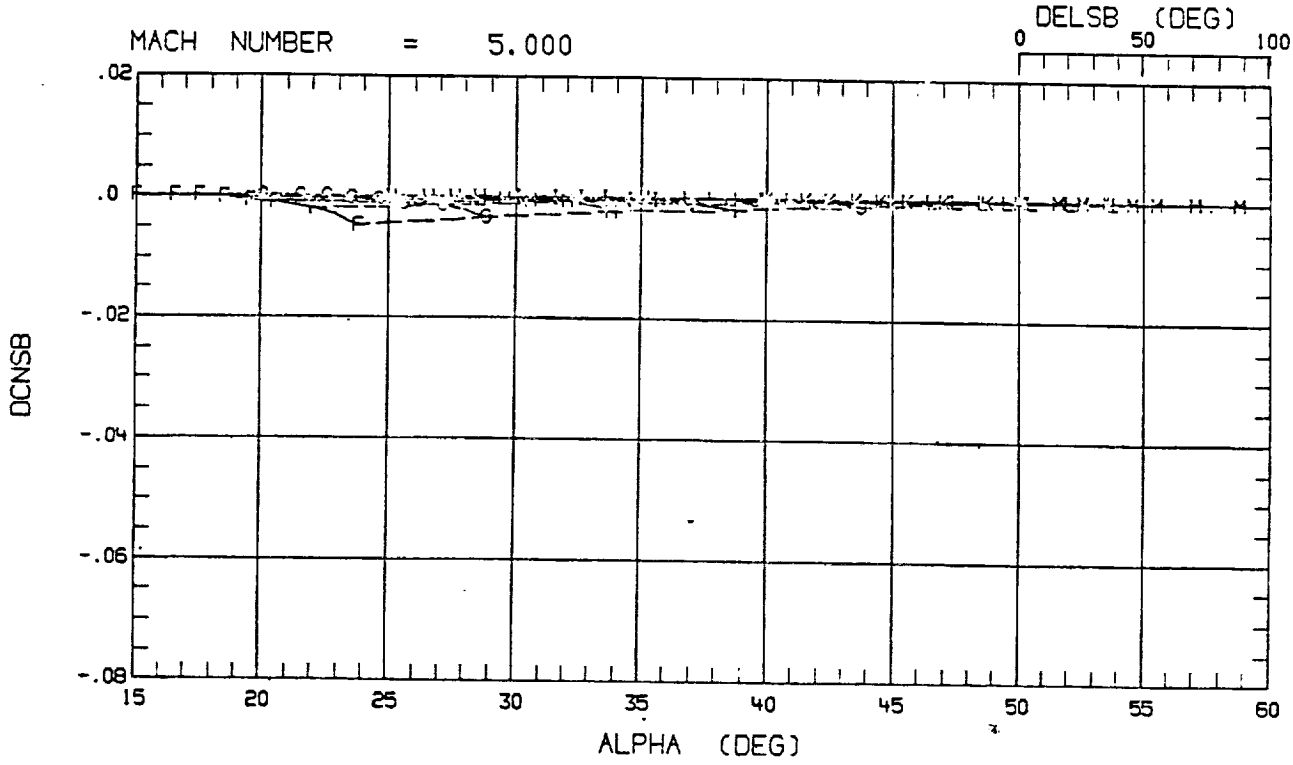
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00244	0.00262	0.00220	0.00103	0.0	0.0	0.0	0.0
15.000	0.00099	0.00106	0.00090	0.00042	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00107	-0.00096	-0.00080	-0.00059	-0.00042	-0.00029	-0.00020	-0.00015
45.000	-0.00213	-0.00190	-0.00160	-0.00118	-0.00082	-0.00069	-0.00066	-0.00033
55.000	-0.00374	-0.00318	-0.00260	-0.00190	-0.00133	-0.00110	-0.00099	-0.00048
70.000	-0.00720	-0.00613	-0.00500	-0.00381	-0.00281	-0.00203	-0.00141	-0.00064
87.200	-0.01499	-0.01338	-0.01150	-0.00911	-0.00685	-0.00489	-0.00341	-0.00234

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.1-84
EFFECT OF SPEEDBRAKE



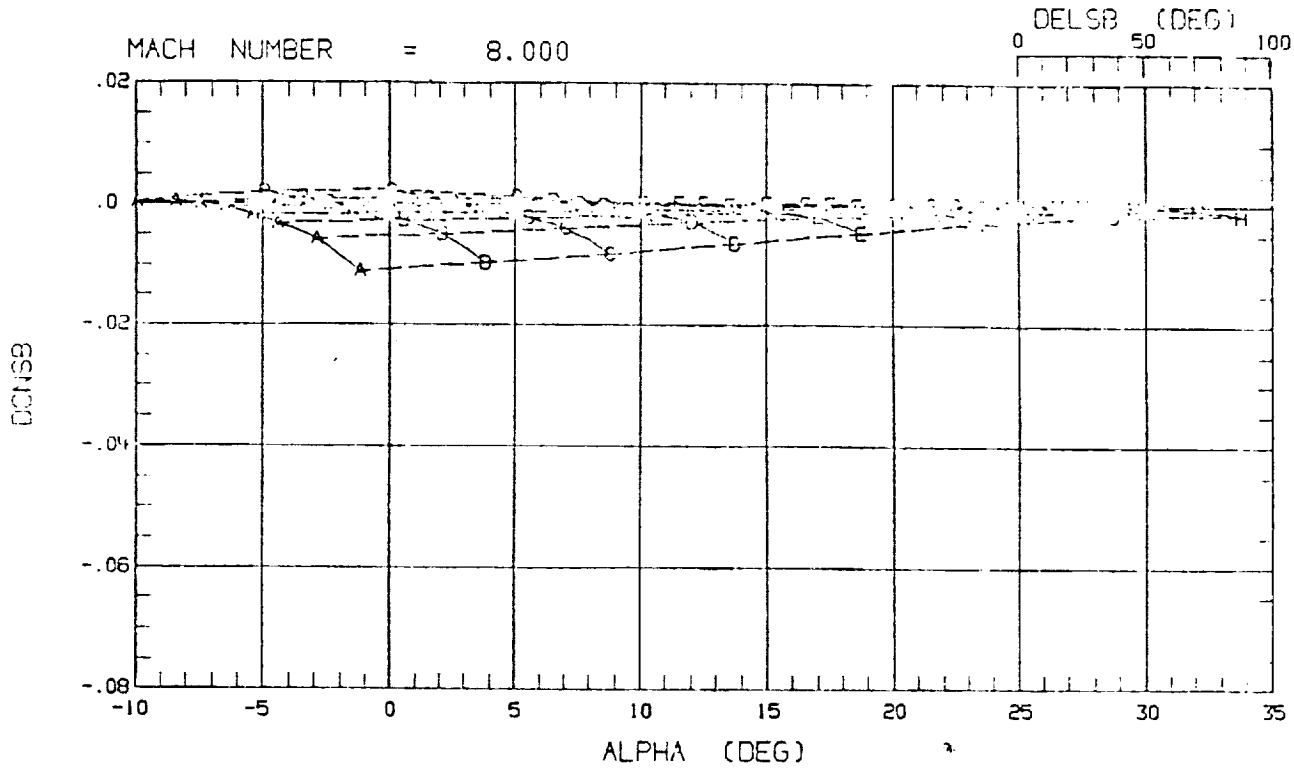
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00029	-0.00020	-0.00015	-0.00017	-0.00008	0.0	0.0	0.0
45.000	-0.00069	-0.00066	-0.00033	-0.00026	-0.00009	0.0	0.0	0.0
55.000	-0.00110	-0.00099	-0.00048	-0.00026	-0.00007	0.0	0.0	0.0
70.000	-0.00203	-0.00141	-0.00064	-0.00087	-0.00041	0.0	0.0	0.0
87.200	-0.00489	-0.00341	-0.00224	-0.00190	-0.00097	0.0	0.0	0.0

ENGINEER DrD
DATE 10-3-78

FIGURE 4.1.1.1-85
EFFECT OF SPEEDBRAKE

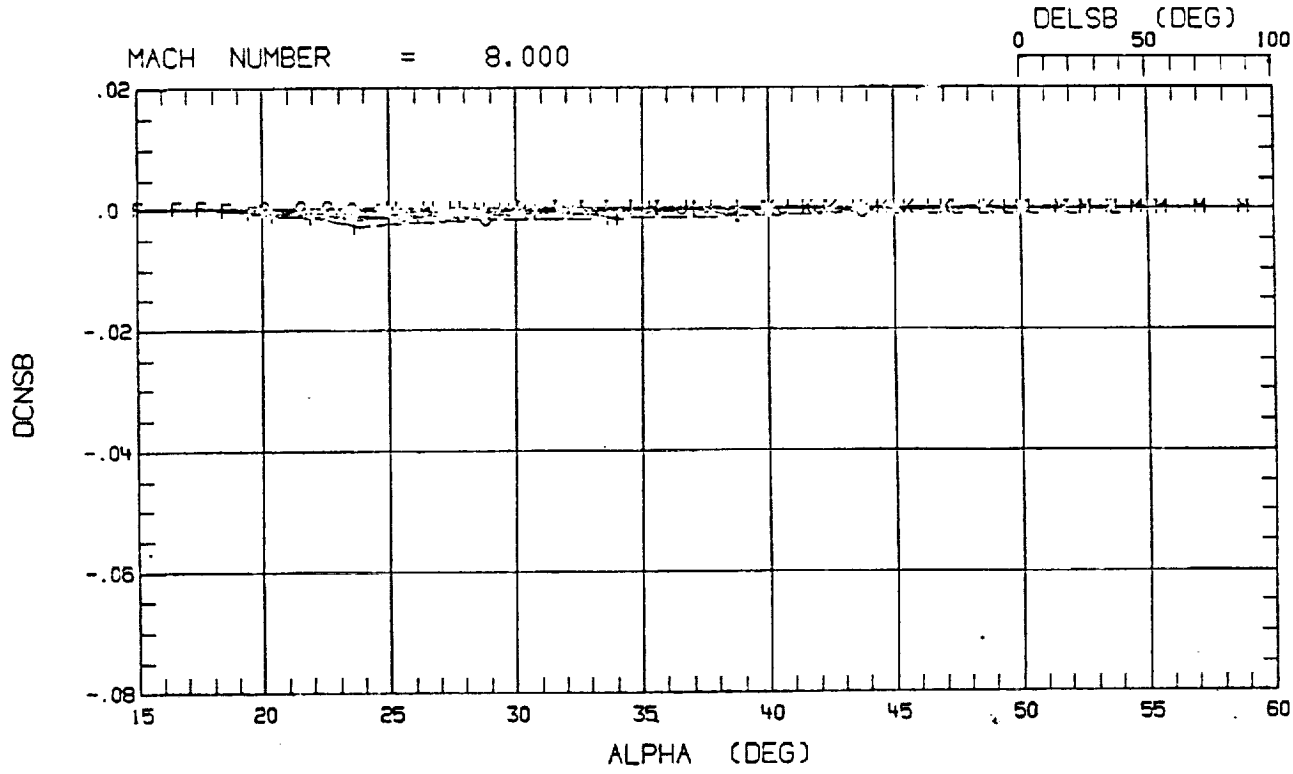


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00031	0.00174	0.00210	0.00097	0.0	0.0	0.0	0.0
15.000	0.00012	0.00067	0.00080	0.00037	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00067	-0.00054	-0.00050	-0.00040	-0.00032	-0.00029	-0.00029	-0.00019
45.000	-0.00186	-0.00170	-0.00150	-0.00120	-0.00094	-0.00077	-0.00066	-0.00038
55.000	-0.00325	-0.00294	-0.00240	-0.00187	-0.00148	-0.00123	-0.00113	-0.00054
70.000	-0.00591	-0.00508	-0.00420	-0.00307	-0.00219	-0.00164	-0.00135	-0.00079
87.200	-0.01132	-0.00983	-0.00830	-0.00654	-0.00475	-0.00307	-0.00190	-0.00175

ENGINEER DGD
DATE 10-3-85

FIGURE 4.1.1.1-86
EFFECT OF SPEEDBRAKE



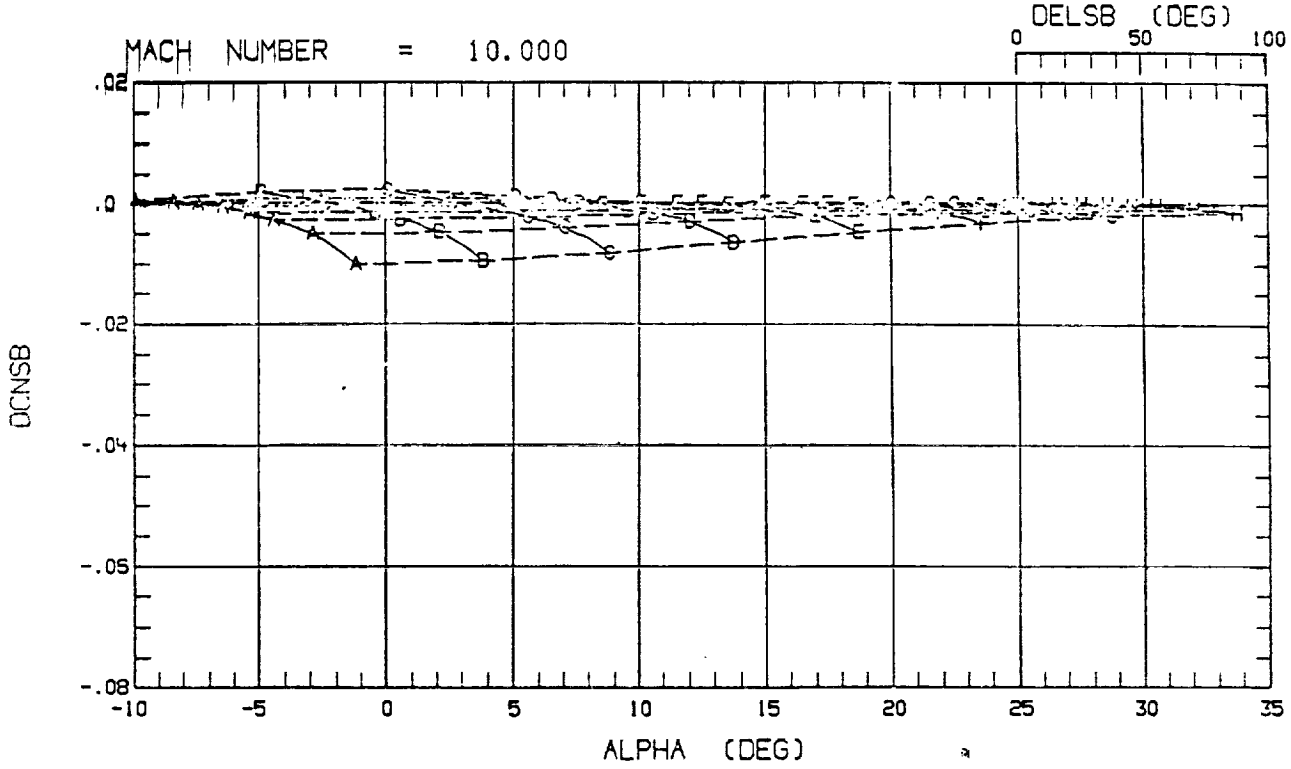
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00029	-0.00028	-0.00018	0.0	0.0	0.0	0.0	0.0
45.000	-0.00077	-0.00066	-0.00036	0.0	0.0	0.0	0.0	0.0
55.000	-0.00123	-0.00113	-0.00054	-0.00017	-0.00005	0.0	0.0	0.0
70.000	-0.00164	-0.00135	-0.00079	-0.00035	-0.00010	0.0	0.0	0.0
87.200	-0.00307	-0.00190	-0.00175	-0.00140	-0.00067	0.0	0.0	0.0

ENGINEER DCD
DATE 10-3-78

FIGURE 4.1.1.1- 87
EFFECT OF SPEEDBRAKE



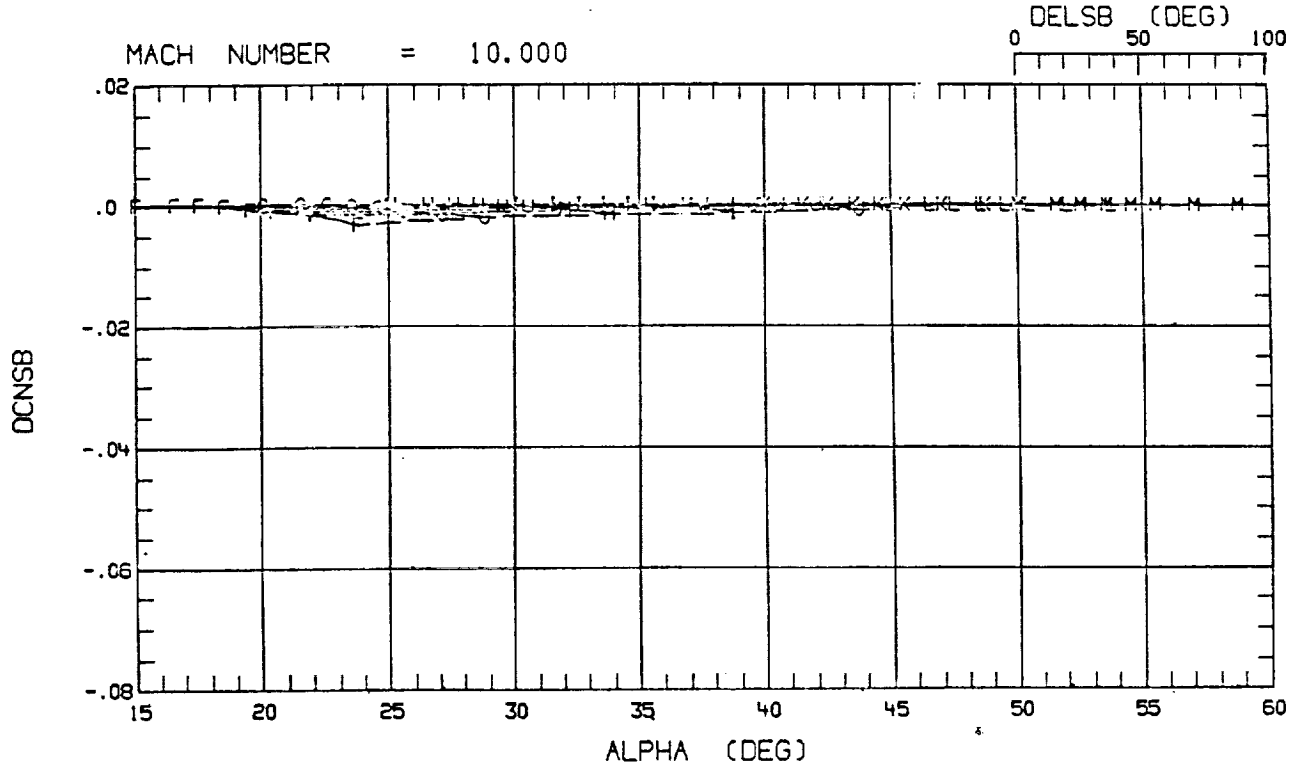
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00036	0.00177	0.00210	0.00095	0.0	0.0	0.0	0.0
15.000	0.00014	0.00068	0.00080	0.00036	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00061	-0.00057	-0.00050	-0.00040	-0.00033	-0.00028	-0.00023	-0.00014
45.000	-0.00170	-0.00166	-0.00150	-0.00121	-0.00096	-0.00075	-0.00056	-0.00028
55.000	-0.00288	-0.00273	-0.00240	-0.00187	-0.00143	-0.00114	-0.00099	-0.00042
70.000	-0.00525	-0.00493	-0.00420	-0.00308	-0.00220	-0.00169	-0.00145	-0.00079
87.200	-0.01021	-0.00960	-0.00830	-0.00659	-0.00489	-0.00326	-0.00211	-0.00163

ENGINEER DGD
DATE 10-3-88

FIGURE 4.1.1.1-88
EFFECT OF SPEEDBRAKE



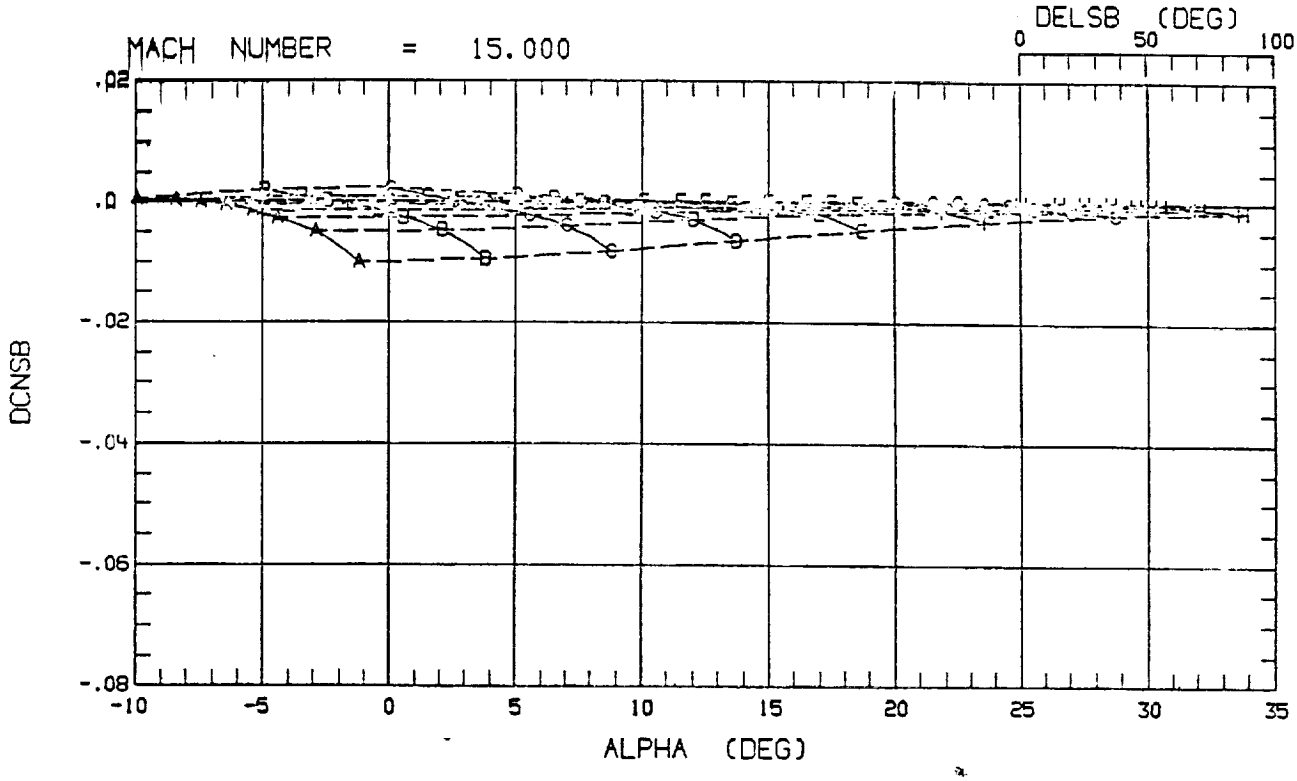
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00028	-0.00023	-0.00014	0.0	0.0	0.0	0.0	0.0
45.000	-0.00075	-0.00056	-0.00028	0.0	0.0	0.0	0.0	0.0
55.000	-0.00114	-0.00099	-0.00042	-0.00017	-0.00005	0.0	0.0	0.0
70.000	-0.00169	-0.00145	-0.00079	-0.00035	-0.00010	0.0	0.0	0.0
87.200	-0.00326	-0.00211	-0.00163	-0.00140	-0.00069	0.0	0.0	0.0

ENGINEER DSD
DATE 10-3-78

FIGURE 4.1.1.1-89
EFFECT OF SPEEDBRAKE



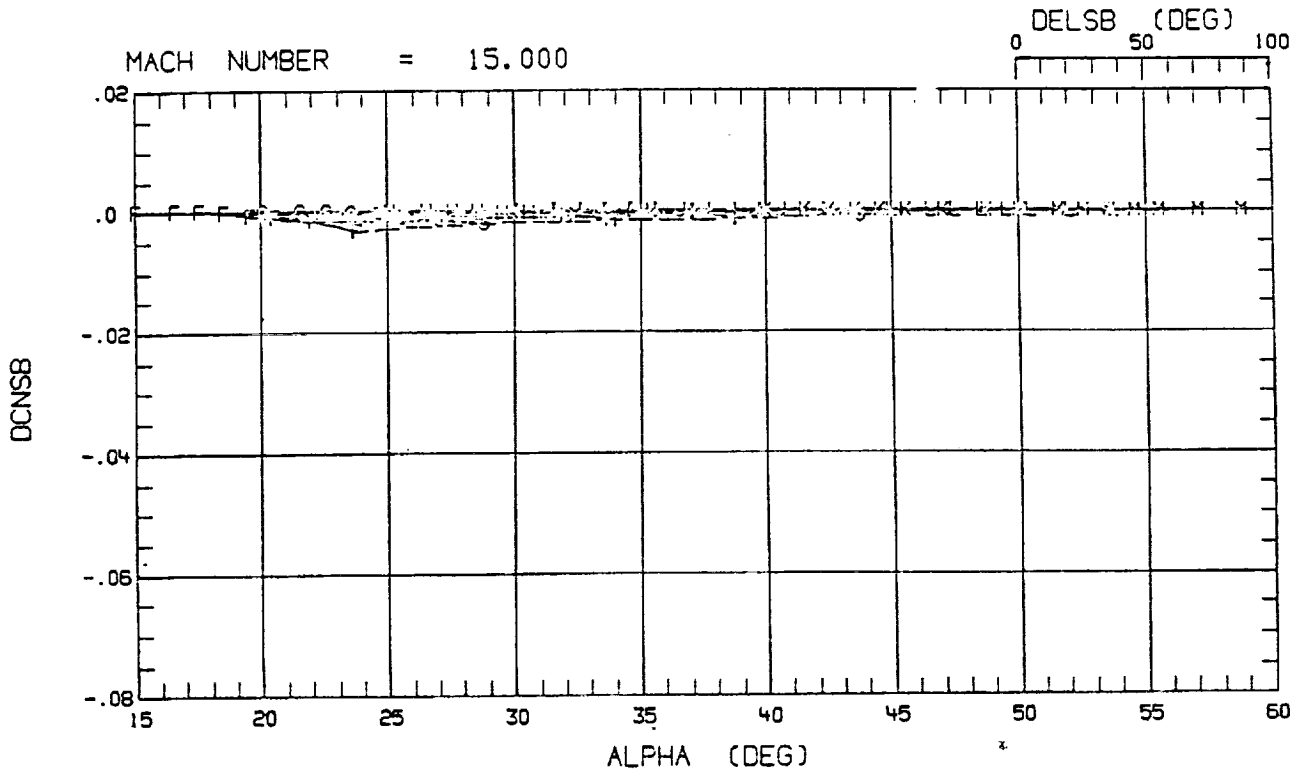
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00036	0.00177	0.00210	0.00095	0.0	0.0	0.0	0.0
15.000	0.00014	0.00068	0.00080	0.00036	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00061	-0.00057	-0.00050	-0.00040	-0.00033	-0.00028	-0.00023	-0.00014
45.000	-0.00170	-0.00166	-0.00150	-0.00121	-0.00096	-0.00075	-0.00056	-0.00028
55.000	-0.00288	-0.00273	-0.00240	-0.00187	-0.00143	-0.00114	-0.00099	-0.00042
70.000	-0.00525	-0.00493	-0.00420	-0.00308	-0.00220	-0.00169	-0.00145	-0.00079
87.200	-0.01021	-0.00960	-0.00830	-0.00659	-0.00469	-0.00326	-0.00211	-0.00163

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.1-90
EFFECT OF SPEEDBRAKE



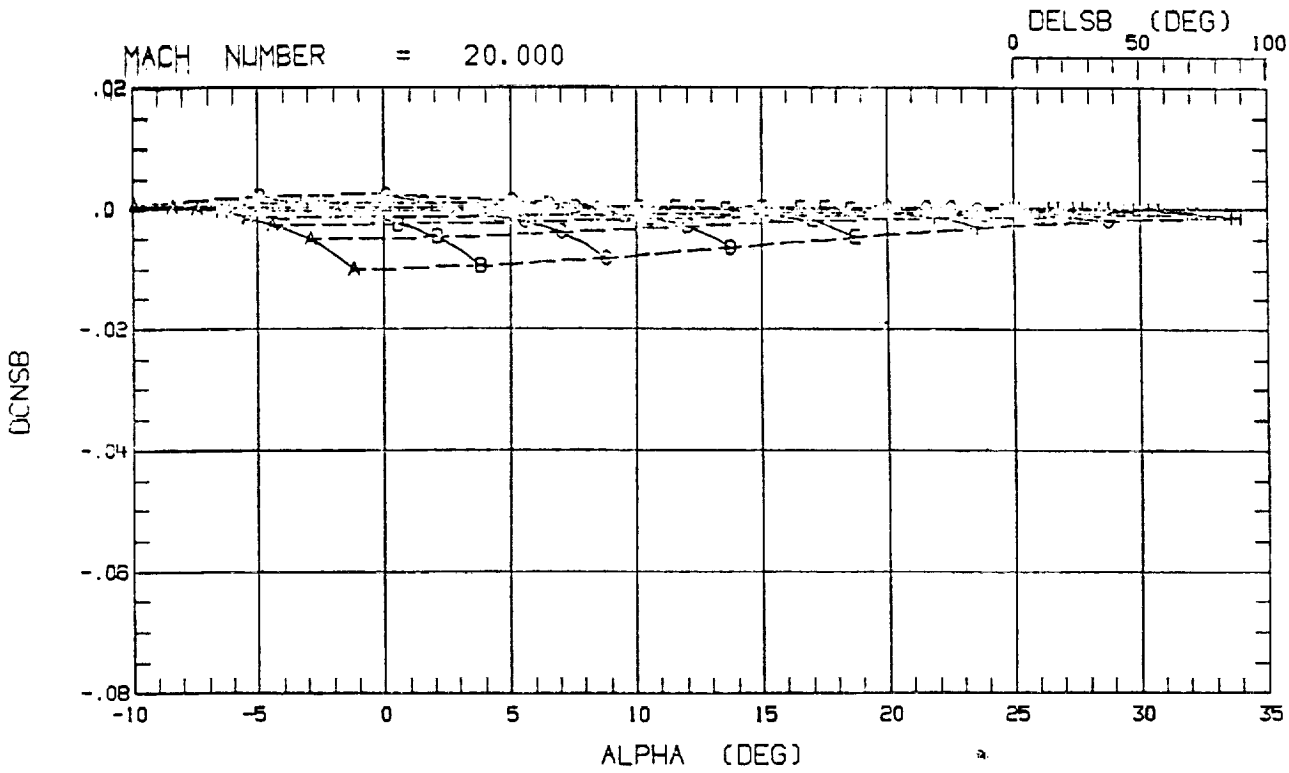
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00028	-0.00023	-0.00014	0.0	0.0	0.0	0.0	0.0
45.000	-0.00075	-0.00056	-0.00028	0.0	0.0	0.0	0.0	0.0
55.000	-0.00114	-0.00099	-0.00042	-0.00017	-0.00005	0.0	0.0	0.0
70.000	-0.00169	-0.00145	-0.00079	-0.00035	-0.00010	0.0	0.0	0.0
87.200	-0.00326	-0.00211	-0.00163	-0.00140	-0.00069	0.0	0.0	0.0

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.1-91
EFFECT OF SPEEDBRAKE



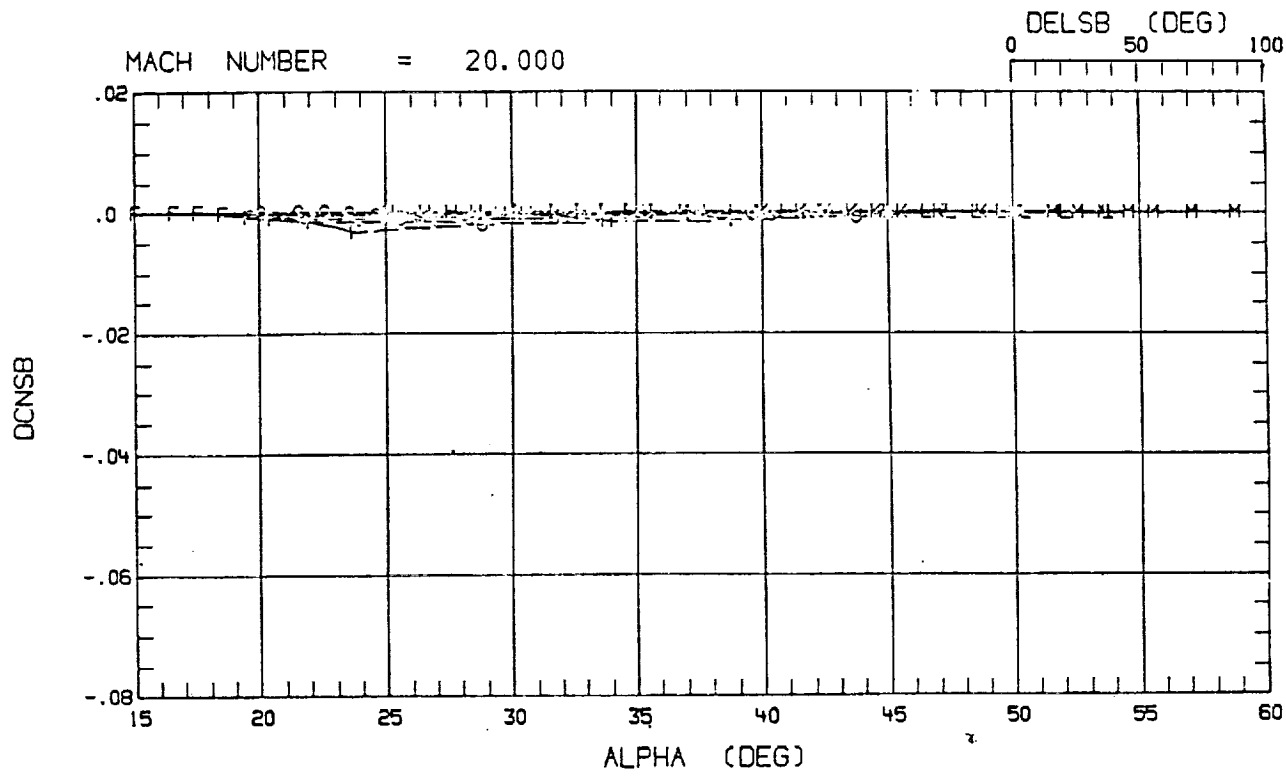
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.00036	0.00177	0.00210	0.00095	0.0	0.0	0.0	0.0
15.000	0.00014	0.00068	0.00080	0.00036	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00061	-0.00057	-0.00050	-0.00040	-0.00033	-0.00028	-0.00023	-0.00014
45.000	-0.00170	-0.00166	-0.00150	-0.00121	-0.00096	-0.00075	-0.00056	-0.00028
55.000	-0.00298	-0.00273	-0.00240	-0.00187	-0.00143	-0.00114	-0.00099	-0.00042
70.000	-0.00525	-0.00493	-0.00420	-0.00308	-0.00220	-0.00169	-0.00145	-0.00079
87.200	-0.01021	-0.00960	-0.00830	-0.00659	-0.00489	-0.00326	-0.00211	-0.00163

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.1-92
EFFECT OF SPEEDBRAKE



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

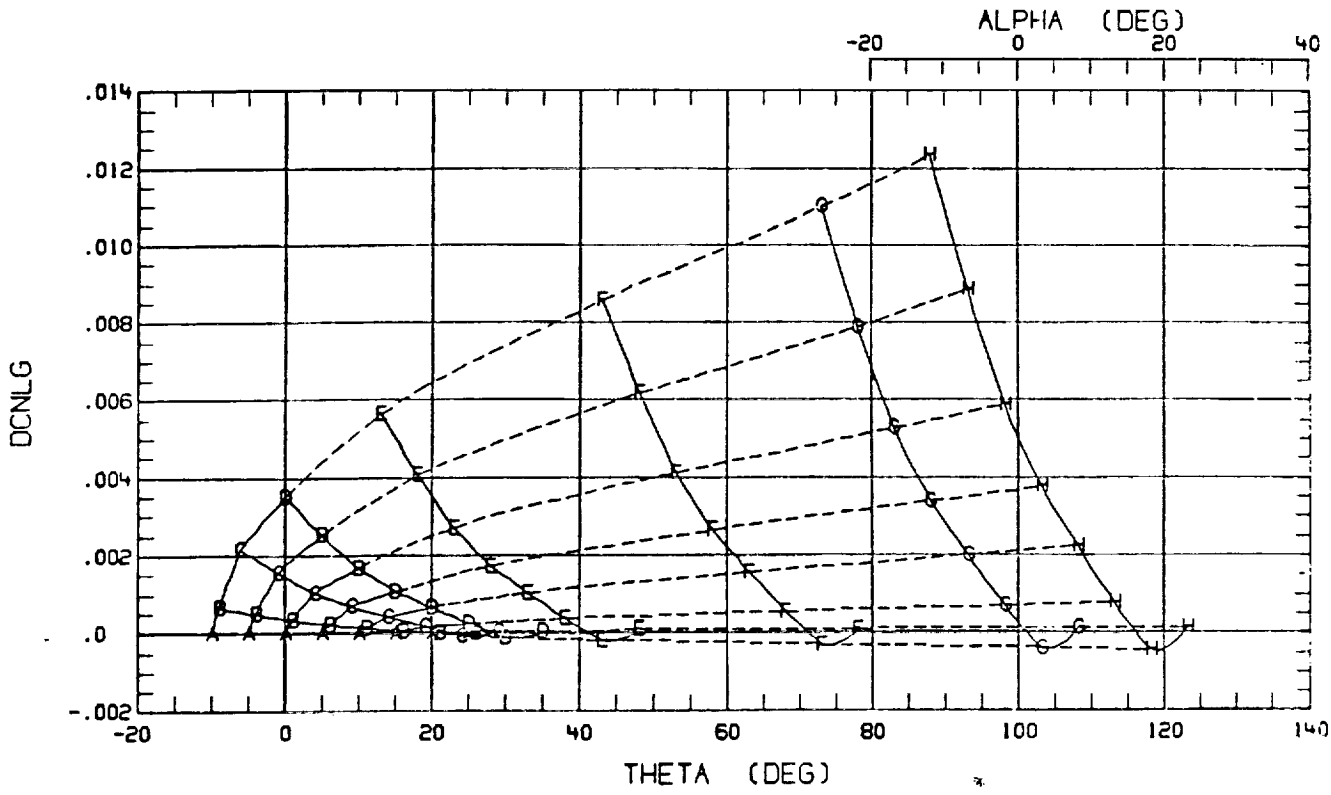
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE NORMAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00028	-0.00023	-0.00014	0.0	0.0	0.0	0.0	0.0
45.000	-0.00075	-0.00056	-0.00028	0.0	0.0	0.0	0.0	0.0
55.000	-0.00114	-0.00099	-0.00042	-0.00017	-0.00005	0.0	0.0	0.0
70.000	-0.00169	-0.00145	-0.00079	-0.00035	-0.00010	0.0	0.0	0.0
87.200	-0.00326	-0.00211	-0.00163	-0.00140	-0.00069	0.0	0.0	0.0

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.1-93
EFFECT OF SPEEDBRAKE



CONFIGURATION

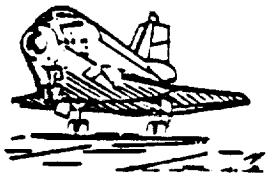
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	THETA (DEG)							
	0.0	1.000	4.000	10.000	23.000	53.000	83.000	98.000
	A	B	C	D	E	F	G	H
ALPHA (DEG)	LANDING GEAR NORMAL FORCE COEFFI							
-10.000	0.0	0.00064	0.00214	0.00348	0.00563	0.00857	0.01098	0.01232
-5.000	0.0	0.00046	0.00154	0.00250	0.00404	0.00615	0.00789	0.00884
0.0	0.0	0.00031	0.00102	0.00166	0.00269	0.00410	0.00525	0.00589
5.000	0.0	0.00020	0.00066	0.00106	0.00171	0.00261	0.00335	0.00375
10.000	0.0	0.00011	0.00039	0.00063	0.00101	0.00154	0.00197	0.00221
15.000	0.0	0.00004	0.00014	0.00022	0.00034	0.00053	0.00068	0.00076
20.000	0.0	-0.00003	-0.00008	-0.00013	-0.00021	-0.00032	-0.00041	-0.00046
25.000	0.0	0.00001	0.00002	0.00003	0.00006	0.00009	0.00011	0.00012

ENGINEER D&D
DATE 10-29-[illegible]

FIGURE 4.1.1.1-94
LANDING GEAR NORMAL FORCE COEFFICIENT INCREMENT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

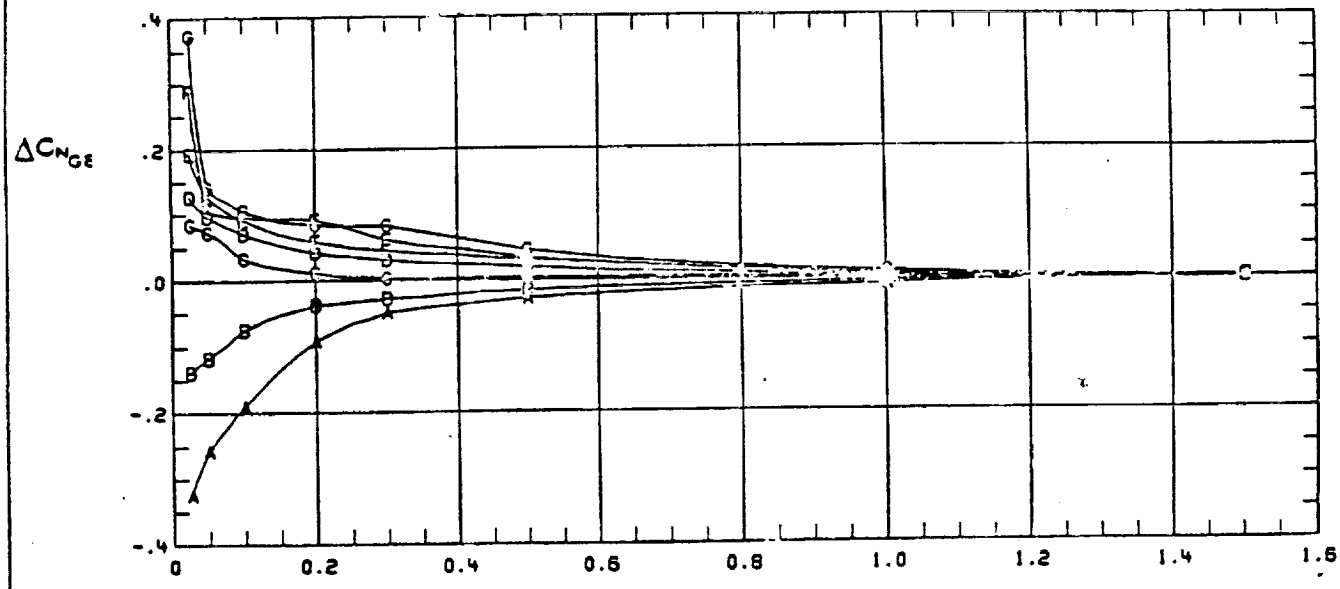
BASELINE ORBITER VEHICLE

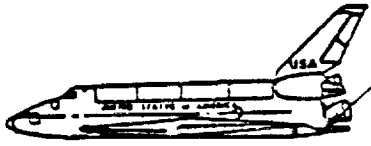
CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1676.70, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

AREA	S_{ref} = 2690.000 ft²
SPAN	b_{ref} = 78.056 in
MAC	c_{ref} = 39.560 in
BODY LENGTH	L_B = 1296.300 in

$\delta_e = -40.000$ $\quad \delta_{BF} = -11.7°$ $\quad \delta_{SB} = ALL$





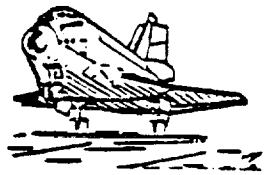
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.32480	-0.14000	0.08343	0.12607	0.19062	0.28655	0.37164
0.050	-0.25924	-0.11810	0.07243	0.09493	0.12470	0.10494	0.13964
0.100	-0.19079	-0.07600	0.03247	0.06978	0.09086	0.09409	0.10369
0.200	-0.09188	-0.03880	0.00947	0.04010	0.05632	0.08984	0.08217
0.300	-0.05063	-0.02960	0.00082	0.02933	0.04265	0.06071	0.08059
0.500	-0.02889	-0.01720	0.00044	0.01717	0.02878	0.03250	0.04332
1.000	-0.01001	-0.00500	0.0	0.00198	0.00412	0.00618	0.00820
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED:

Figure 4.1.1.1-95
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

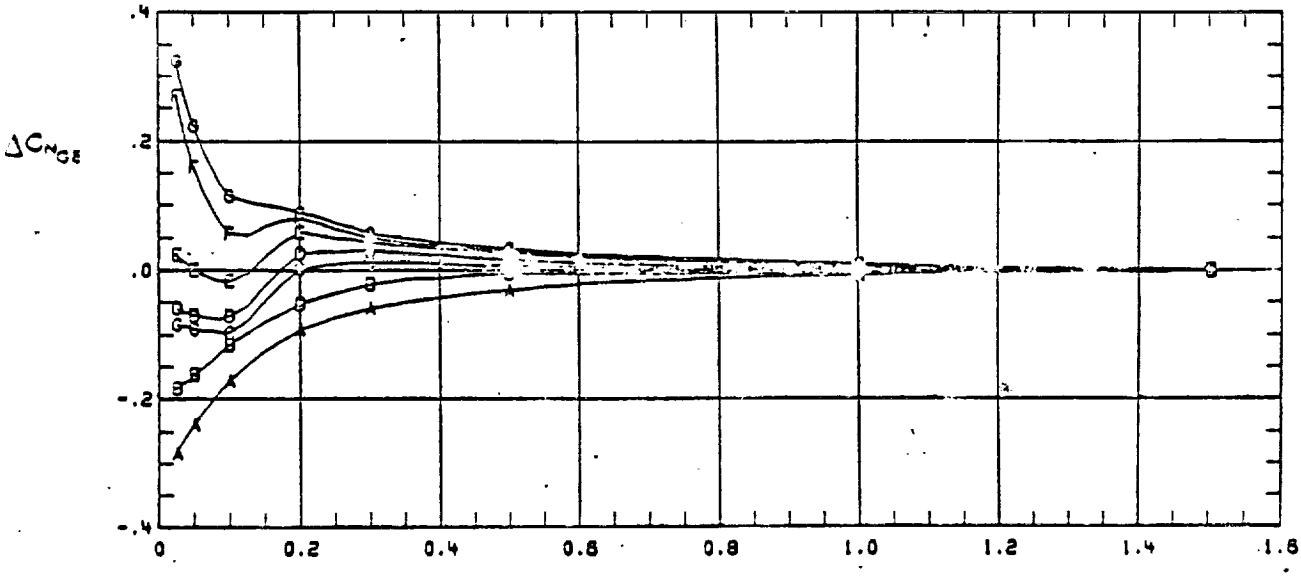
BASELINE ORBITER VEHICLE

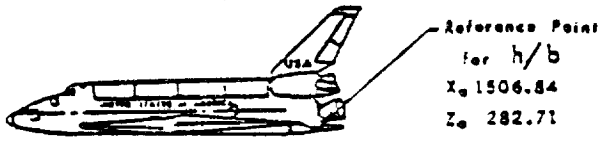
CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = 1076.70, Y_{cg} = 0.00, Z_{cg} = 175.00

REFERENCE DIMENSIONS

AREA S_{ref} = 2690.000 ft²
SPAN b_{ref} = 78.056 in
MAC $\bar{c}_{ref}$ = 38.560 in
BODY LENGTH L_B = 1290.300 in

$\delta_e = -30.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



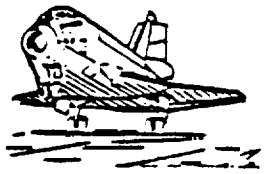


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.28434	-0.18500	-0.08546	-0.06069	0.02267	0.26788	0.32295
0.050	-0.23952	-0.16380	-0.09166	-0.07108	-0.00047	0.15903	0.22115
0.100	-0.17154	-0.11730	-0.09671	-0.07258	-0.01859	0.05422	0.11294
0.200	-0.09381	-0.05340	0.00088	0.02400	0.05700	0.07782	0.08865
0.300	-0.06001	-0.02240	0.01118	0.02852	0.04119	0.04775	0.05582
0.500	-0.03051	-0.00620	0.00541	0.01423	0.02501	0.02731	0.03205
1.000	-0.00705	-0.00500	0.0	0.00198	0.00391	0.00632	0.00820
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED: _____

Figure 4.1.1.1-96
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

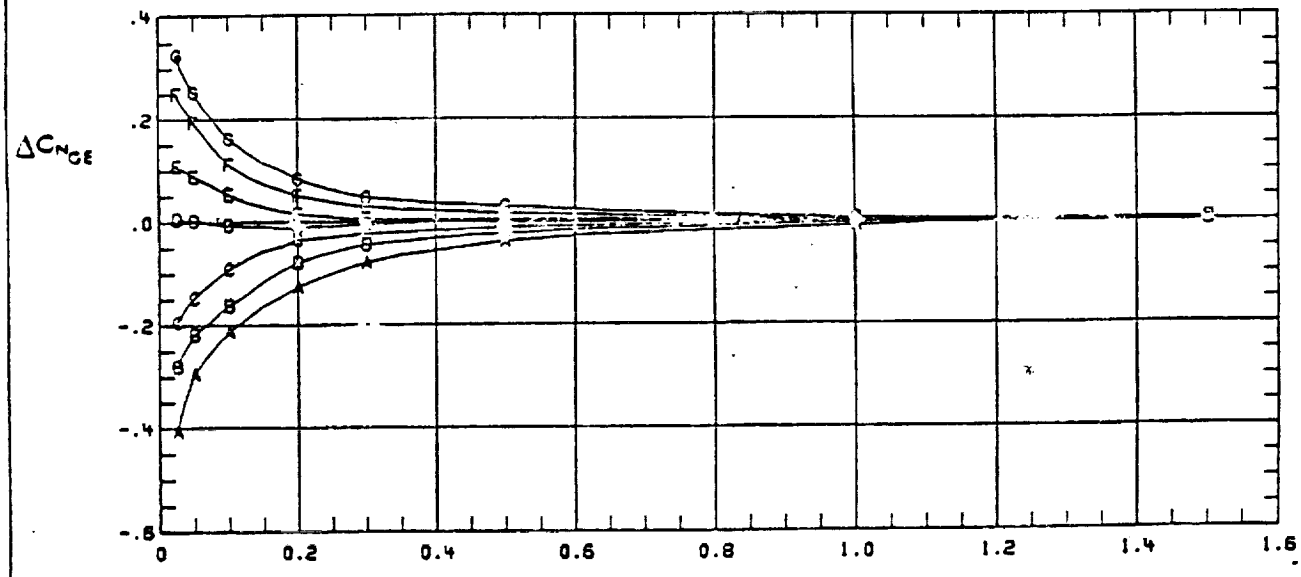
BASELINE ORBITER VEHICLE

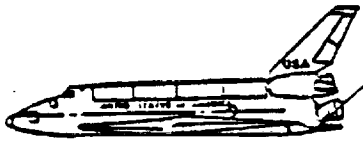
CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.70, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

AREA S_w = 2690.000 ft²
SPAN b_w = 78.056 ft
MAC c_w = 39.560 ft
BODY LENGTH L_B = 1296.300 in

δ_e = -20.000 δ_{sp} = -11.7° δ_{sb} = ALL



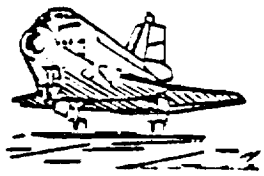


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.40532	-0.28000	-0.19674	0.00420	0.10698	0.24834	0.32302
0.050	-0.29492	-0.22000	-0.14722	0.00034	0.08669	0.19228	0.24961
0.100	-0.21372	-0.16320	-0.09236	-0.00938	0.05038	0.10873	0.16087
0.200	-0.12707	-0.08060	-0.03819	-0.01208	0.01221	0.04937	0.08169
0.300	-0.08111	-0.04600	-0.02427	-0.00619	0.00297	0.02650	0.04381
0.500	-0.04037	-0.02500	-0.01472	-0.00060	0.00073	0.01337	0.02702
1.000	-0.00998	-0.00500	-0.00399	-0.00198	0.0	0.00192	0.00470
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: J³
DATE: 10-19-72
REVISED: _____

Figure 4.1.1.1-97
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

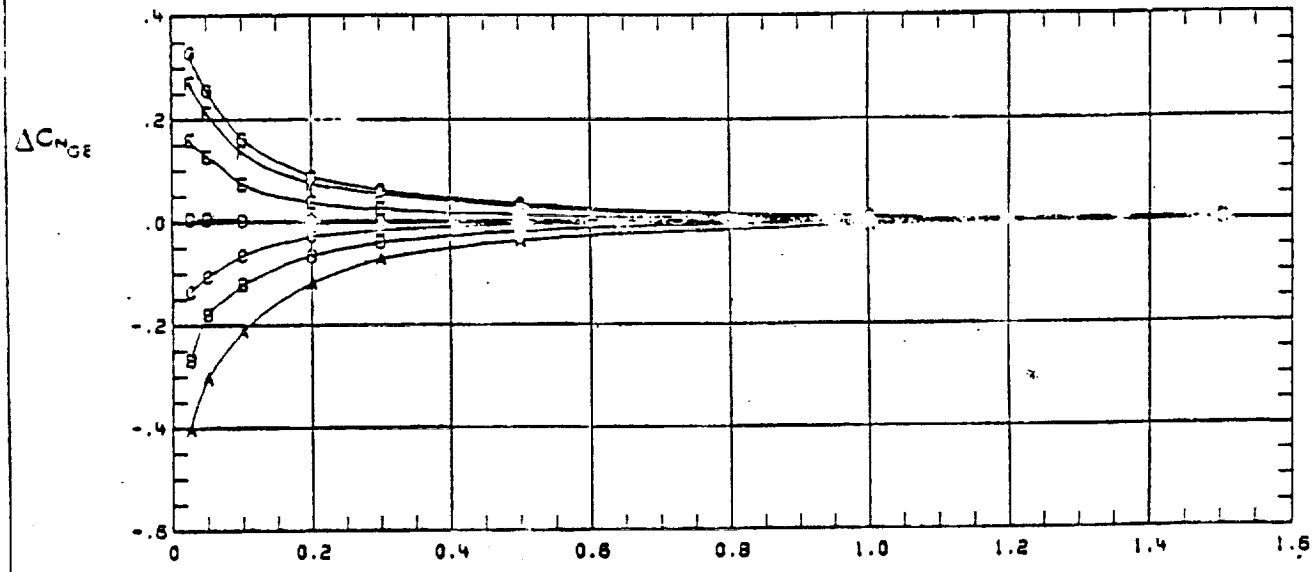
BASELINE ORBITER VEHICLE

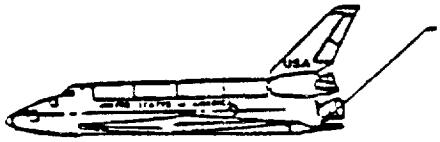
CENTER OF GRAVITY OR MOMENT REFERENCE	X_{cg} = FS	1078.70
	Y_{cg} = BL	0.00
	Z_{cg} = WL	375.00

REFERENCE DIMENSIONS

AREA	S_{ref} =	2690.000 ft²
SPAN	b_{ref} =	78.056 in
MAC	$\bar{c}_{ref}$ =	39.560 in
BODY LENGTH	L_B =	1296.200 in

$\delta_e = -15.000$ $\quad \delta_{sf} = -11.7°$ $\quad \delta_{ss} = ALL$



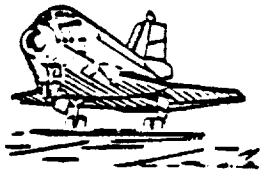


HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.40414	-0.27000	-0.13727	0.00381	0.15552	0.26762	0.32642
0.050	-0.30312	-0.18050	-0.10773	0.00331	0.12567	0.21037	0.25358
0.100	-0.21279	-0.12330	-0.06527	0.00262	0.07104	0.13238	0.15932
0.200	-0.11782	-0.06520	-0.02961	0.00166	0.03527	0.07251	0.08688
0.300	-0.07240	-0.04130	-0.01724	0.00100	0.02351	0.05252	0.06091
0.500	-0.03699	-0.01900	-0.00526	0.00045	0.01250	0.02866	0.03318
1.000	-0.00798	-0.00200	-0.00100	0.0	0.00196	0.00385	0.00564
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [signature]
DATE: 10-19-77
REVISED: _____

Figure 4.1.1.1-98
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

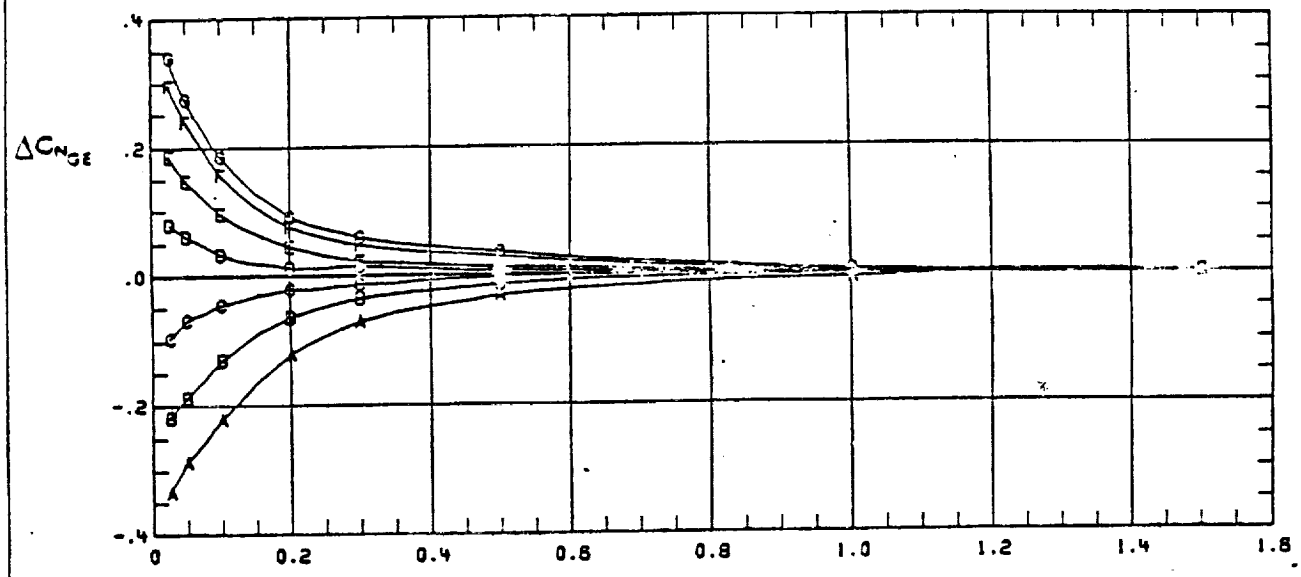
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = FS 1076.78; Y_{cg} = BL 0.00; Z_{cg} = WL 375.00

REFERENCE DIMENSIONS

AREA	S_{ref} = 2690.000 ft²
SPAN	b_{ref} = 78.056 in
MAC	$\bar{c}_{ref}$ = 35.560 in
BODY LENGTH	L_B = 1290.300 in

$\delta_e = -10.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$

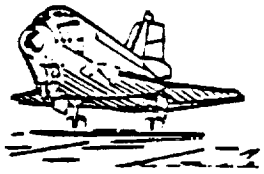


HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.33366	-0.22000	-0.09764	0.07747	0.18372	0.29495	0.33956
0.050	-0.28825	-0.18780	-0.06978	0.06026	0.14701	0.23816	0.27258
0.100	-0.22275	-0.13060	-0.04626	0.03188	0.09535	0.15655	0.18468
0.200	-0.12009	-0.06380	-0.02341	0.01127	0.04277	0.07365	0.09089
0.300	-0.07104	-0.03630	-0.01585	0.01181	0.02108	0.04571	0.05662
0.500	-0.03260	-0.01530	-0.00398	0.00518	0.01101	0.02641	0.03384
1.000	-0.00709	-0.00200	0.00007	0.00014	0.00119	0.00234	0.00350
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED: _____

Figure 4.1.1.1-99
GROUND EFFECT

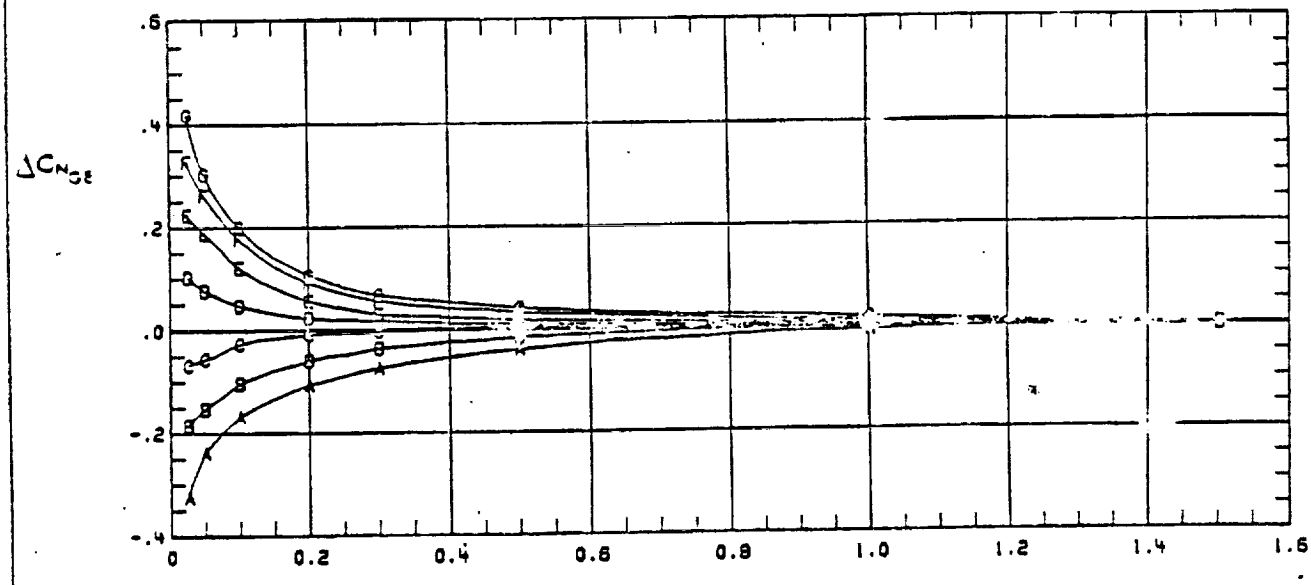
Landing Gear Down

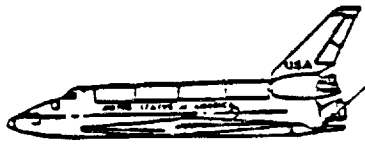


$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY X_{cg} = FS 1076.70
OR Y_{cg} = BL 0.00
MOMENT REFERENCE Z_{cg} = WL 375.00
REFERENCE DIMENSIONS
AREA S_{ref} = 2690.000 ft²
SPAN b_{ref} = 78.056 in
MAC c_{ref} = 39.560 in
BODY LENGTH L_B = 1290.300 in

$\delta_e = -5.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



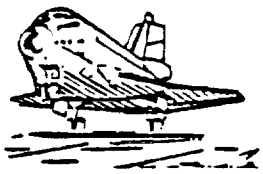


HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.32278	-0.18500	-0.06805	0.10213	0.22182	0.32458	0.41439
0.050	-0.23765	-0.15240	-0.05725	0.07396	0.18575	0.25966	0.30012
0.100	-0.16838	-0.10430	-0.02647	0.04603	0.11940	0.17373	0.19680
0.200	-0.10714	-0.05860	-0.00996	0.02205	0.05401	0.08949	0.10464
0.300	-0.07376	-0.03760	-0.00440	0.01592	0.02867	0.05397	0.06556
0.500	-0.03872	-0.01610	0.00190	0.00862	0.01590	0.03133	0.03950
1.000	-0.00606	0.0	0.00003	0.00304	0.00705	0.01085	0.01666
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED: _____

Figure 4.1.1.1-100
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

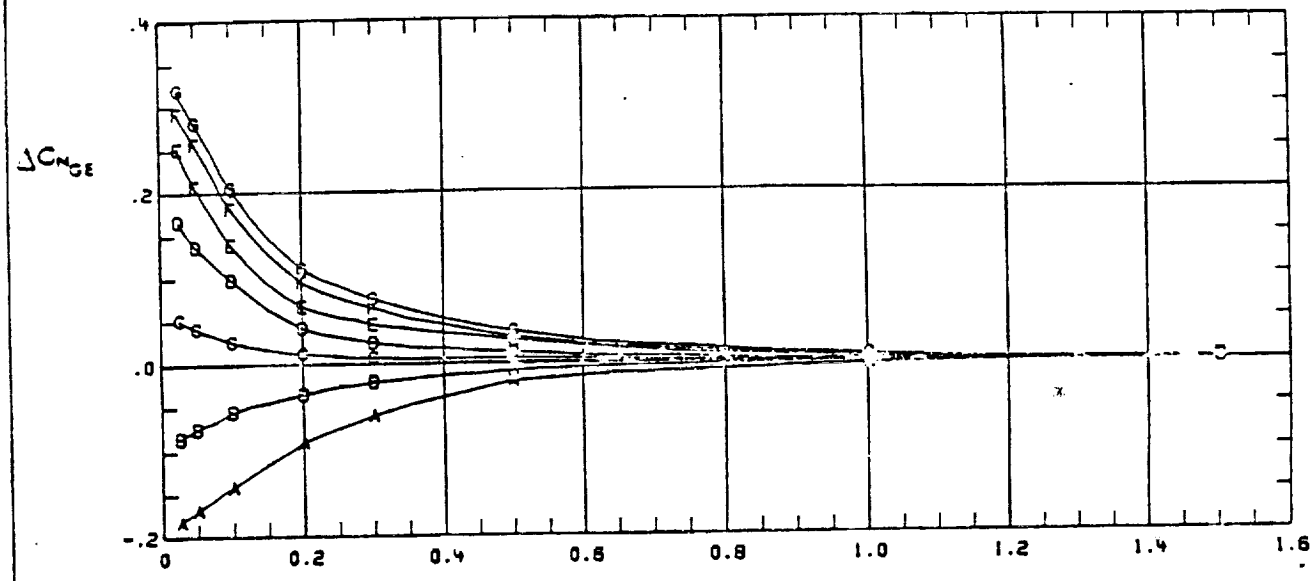
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE	X_{cg} = FS	1076.70
	Y_{cg} = BL	0.00
	Z_{cg} = WL	375.00

REFERENCE DIMENSIONS

AREA	S_{ref} =	2690.000 ft²
SPAN	b_{ref} =	78.058 ft
MAC	$\bar{c}_{ref}$ =	39.568 ft
BODY LENGTH	l_B =	1290.300 in

$\delta_e = 0.0$ $\quad \delta_{BF} = -11.7°$ $\quad \delta_{SB} = ALL$



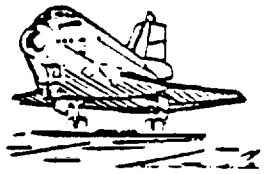
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.18283	-0.08500	0.05136	0.16636	0.25129	0.29008	0.31932
0.050	-0.16753	-0.07520	0.04055	0.13627	0.20690	0.25509	0.27979
0.100	-0.14121	-0.05580	0.02583	0.09666	0.13848	0.17991	0.20400
0.200	-0.09073	-0.03590	0.01075	0.04134	0.06514	0.09354	0.10974
0.300	-0.06121	-0.02230	0.00548	0.02296	0.04502	0.06332	0.07383
0.500	-0.02259	-0.01080	0.00351	0.01084	0.02563	0.02912	0.03504
1.000	-0.00495	-0.00200	-0.00014	-0.00028	0.00164	0.00371	0.00564
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: FB
DATE: 10-19-77
REVISED: _____

Figure 4.1.1.1-101
GROUND EFFECT

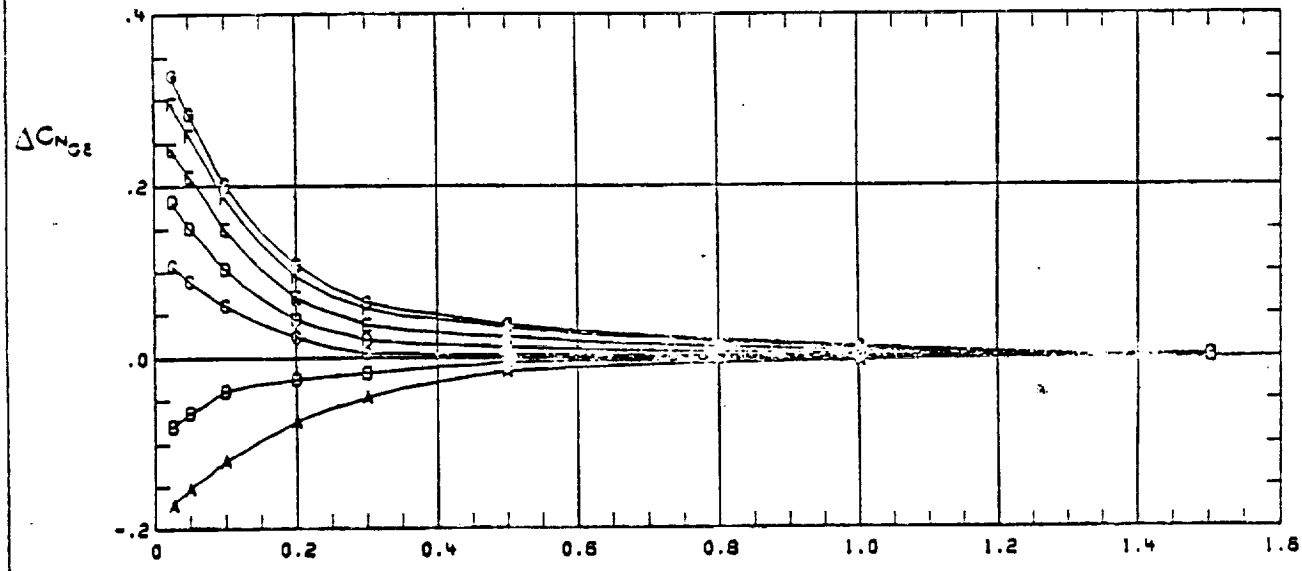
Landing Gear Down

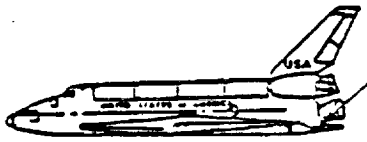


$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY OR MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 5.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$





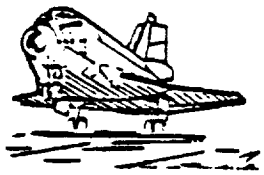
Reference Point for h/b
X_e 1506.84
Z_e 282.71

HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.17233	-0.08000	0.10615	0.18108	0.24106	0.29371	0.32798
0.050	-0.15216	-0.06530	0.08815	0.15056	0.21077	0.25687	0.28245
0.100	-0.12166	-0.04020	0.05973	0.10256	0.14811	0.18471	0.20177
0.200	-0.07540	-0.02620	0.02329	0.04436	0.06966	0.09399	0.10791
0.300	-0.04720	-0.01830	0.00358	0.02019	0.03793	0.05623	0.06357
0.500	-0.01697	-0.00710	0.00242	0.01064	0.02271	0.03460	0.03834
1.000	-0.00399	-0.00200	0.0	0.00198	0.00587	0.00961	0.01128
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JF3
DATE: 10-19-77
REVISED:

Figure 4.1.1.1-102
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

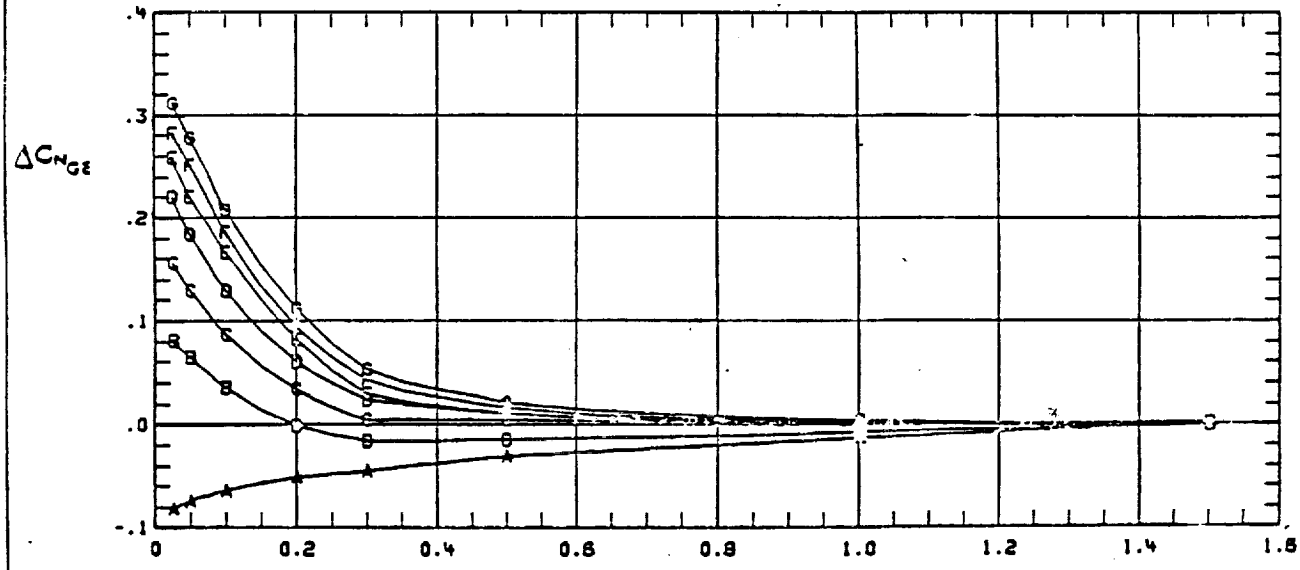
AREA

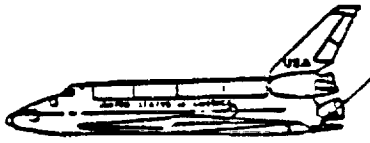
SPAN

MAC

BODY LENGTH

$\delta_e = 10.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



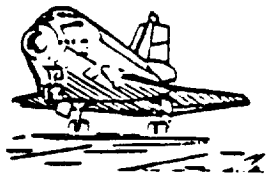


HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.08254	0.08000	0.15582	0.22024	0.25781	0.28150	0.31129
0.050	-0.07442	0.06360	0.12847	0.18348	0.22031	0.25070	0.27634
0.100	-0.06412	0.03460	0.08593	0.12872	0.16570	0.18388	0.20714
0.200	-0.05183	-0.00130	0.03306	0.06009	0.08120	0.09402	0.11084
0.300	-0.04526	-0.01670	0.00350	0.02329	0.02883	0.04167	0.05190
0.500	-0.03130	-0.01520	0.00387	0.00986	0.00952	0.01548	0.02083
1.000	-0.01397	-0.00800	0.0	0.0	0.00098	0.00192	0.00282
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

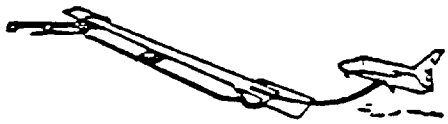
ENGINEER:
DATE: 10-19-77
REVISED:

Figure 4.1.1.1-103
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$



CONFIGURATION

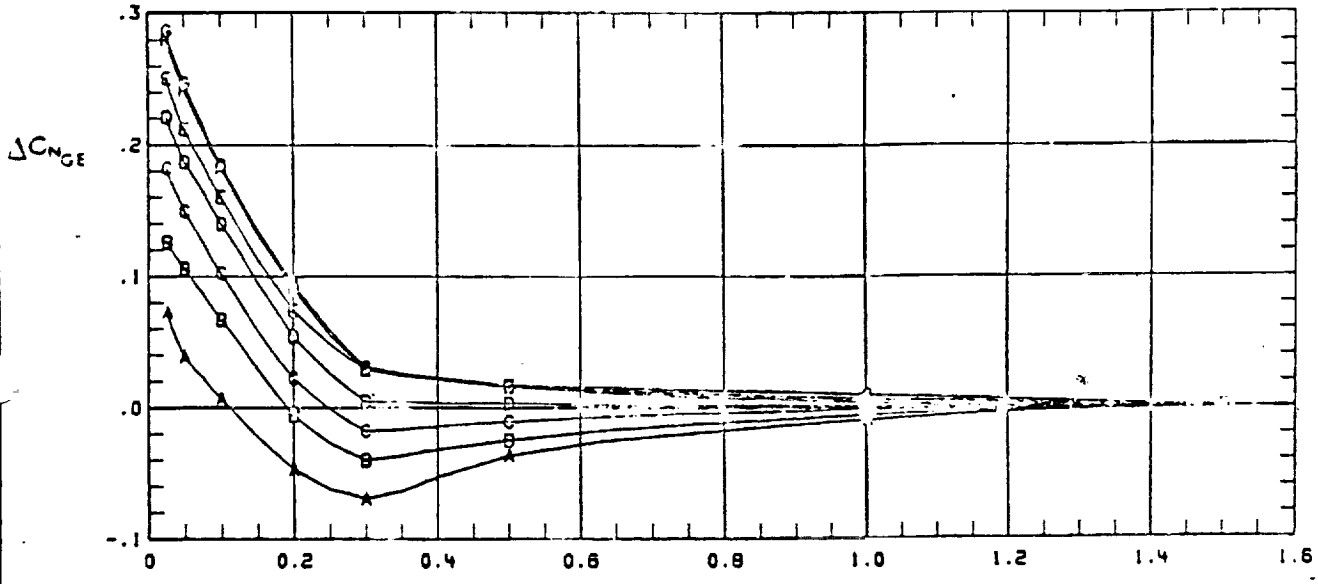
BASELINE ORBITER VEHICLE

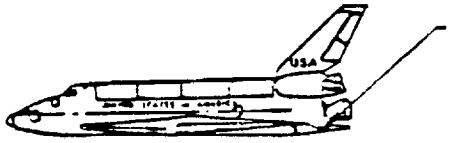
CENTER OF GRAVITY	X_{cg} = FS	1076.70
OR	Y_{cg} = BL	0.00
MOMENT REFERENCE	Z_{cg} = WL	375.00

REFERENCE DIMENSIONS

AREA	S_{ref} =	2690.000 ft²
SPAN	b_{ref} =	78.056 ft
MAC	ℓ_{ref} =	39.568 ft
BODY LENGTH	ℓ_B =	1296.300 in

$\delta_e = 15.000$ $\quad \delta_{BF} = -11.7°$ $\quad \delta_{SB}$ = ALL

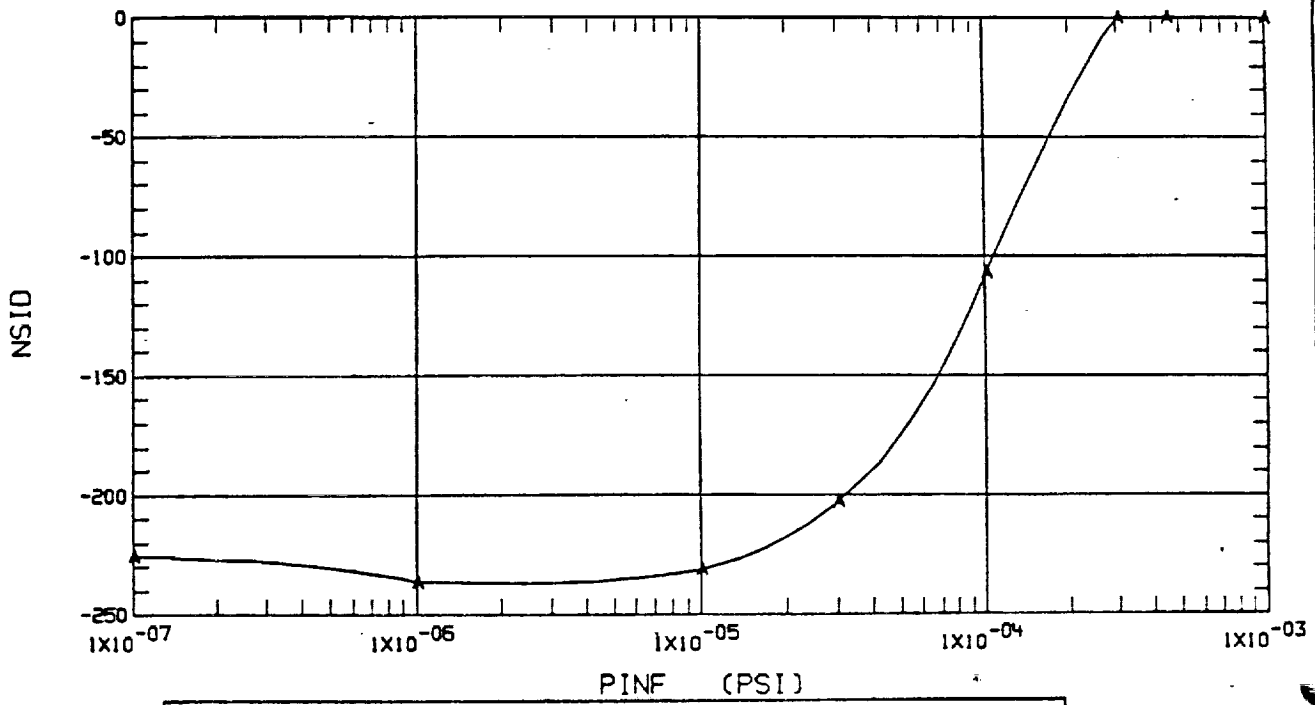




HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	0.07221	0.12500	0.18098	0.22068	0.24976	0.27946	0.28555
0.050	0.03845	0.10500	0.14884	0.18640	0.21058	0.23999	0.24560
0.100	0.00658	0.06640	0.10137	0.13958	0.15870	0.18100	0.18431
0.200	-0.04734	-0.00560	0.02197	0.05382	0.07388	0.08962	0.09381
0.300	-0.06948	-0.03980	-0.01769	0.00490	0.02860	0.02929	0.03064
0.500	-0.03704	-0.02480	-0.01034	0.00264	0.01624	0.01648	0.01661
1.000	-0.00998	-0.00600	-0.00200	0.0	0.00293	0.00577	0.00940
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JF
DATE 10-19-77
REVISED:

Figure 4.1.1.1-104
GROUND EFFECT

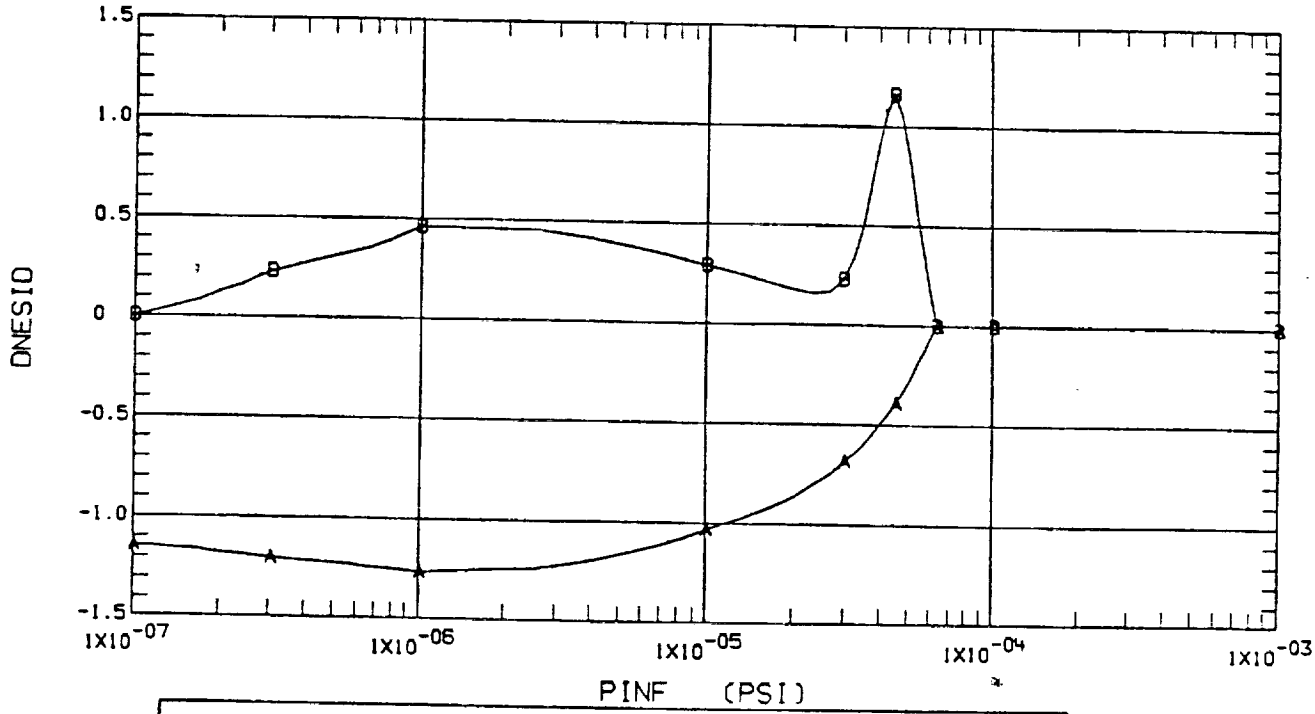


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$N_{SURF\ IMP}$ LB/n NORMAL FOR
1.000E-07	-225.660
1.000E-06	-236.400
1.000E-05	-231.520
3.000E-05	-203.190
1.000E-04	-107.460
3.000E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

ENGINEER HJD
DATE 10/Ac/15

FIGURE 4.1.1.1-105
NORMAL FORCE SURFACE IMPINGEMENT, DOWN-FIRING

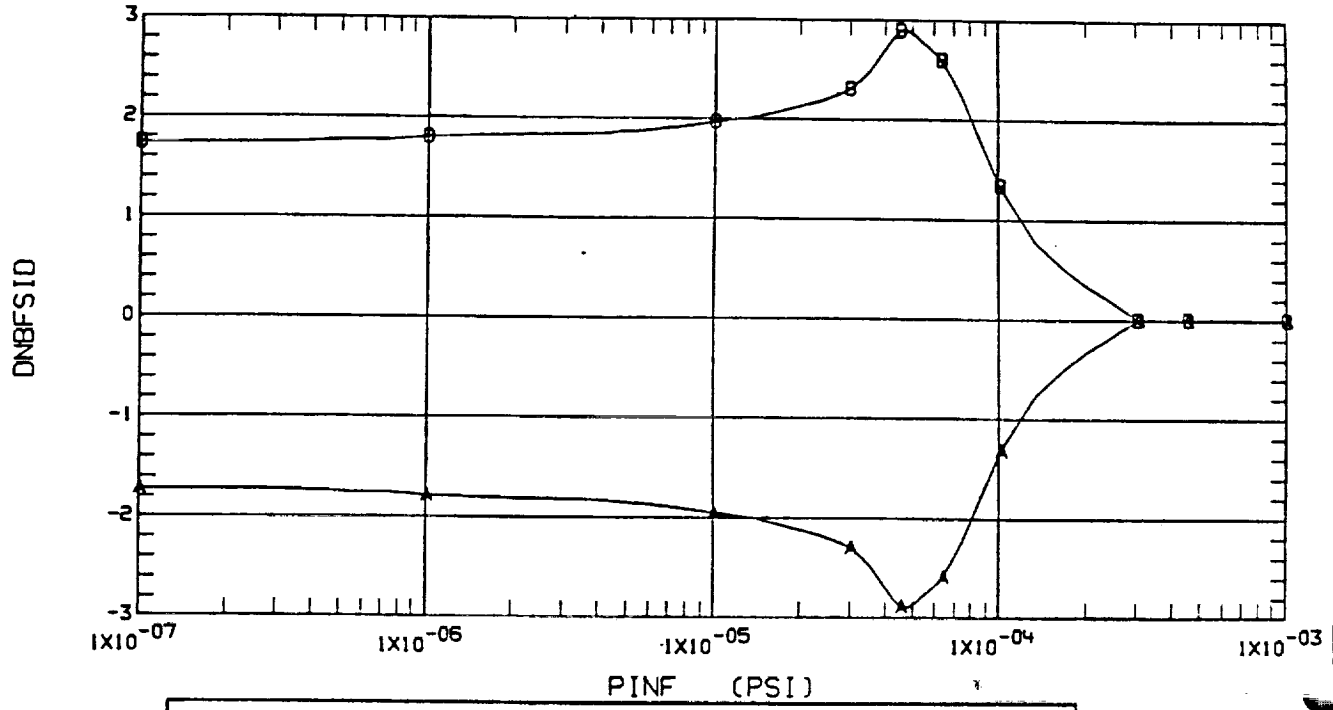


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	$\partial N/\partial\delta_e$ ~ lb/n-deg	
	$\delta_e < 0$	$\delta_e > 0$
PINF (PSI)	DE NORMAL FORCE SLOPE	
1.000E-07	-1.150	0.0
3.000E-07	-1.210	0.230
1.000E-06	-1.270	0.460
1.000E-05	-1.040	0.290
3.000E-05	-0.690	0.230
4.500E-05	-0.400	1.160
6.300E-05	0.0	0.0
1.000E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER
DATE 4/13/6

FIGURE 4.1.1.1-10A ELEVON NORMAL FORCE SURFACE IMPINGEMENT, DOWN-FIRING



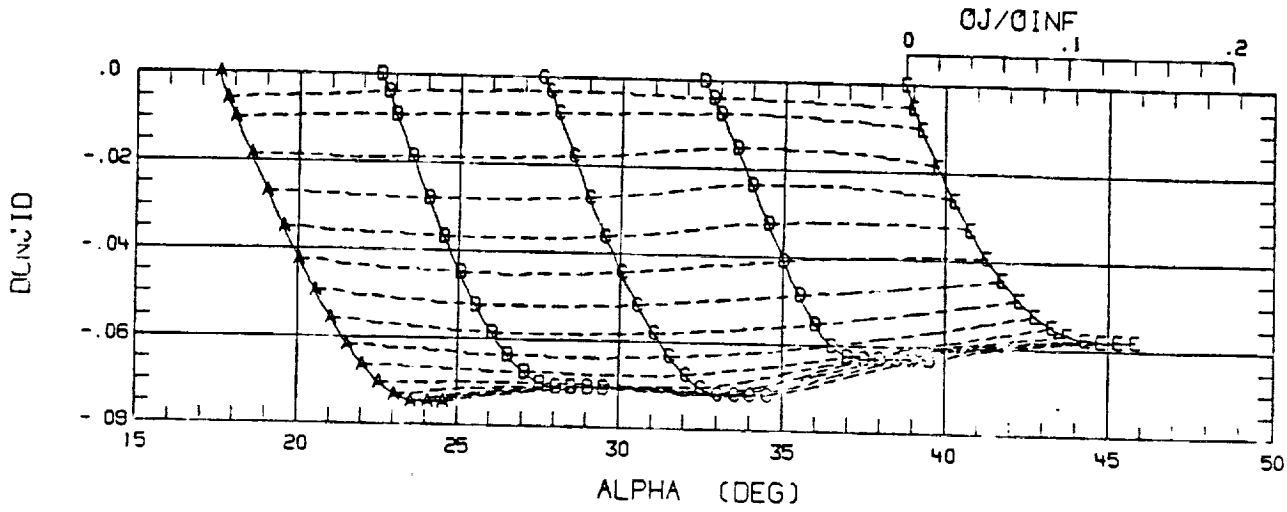
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	$\partial N/\partial\delta_{BF}$ ~ lb/n-deg	
	$\delta_{BF}<0$	$\delta_{BF}>0$
PINF (PSI)	DBF NORMAL FORCE SI.D	
1.000E-07	-1.730	1.730
1.000E-06	-1.790	1.790
1.000E-05	-1.960	1.960
3.000E-05	-2.310	2.310
4.500E-05	-2.890	2.890
6.300E-05	-2.600	2.600
1.000E-04	-1.330	1.330
3.000E-04	0.0	0.0
4.500E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER [signature]
DATE 10/4/83

FIGURE 4.1.1.1-107
BODYFLAP NORMAL FORCE SURFACE IMPINGEMENT, DOWN-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	NORMAL FORCE JET OF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00591	-0.00404	-0.00307	-0.00405	-0.00543
0.0100	-0.01022	-0.00903	-0.00816	-0.00749	-0.01005
0.0200	-0.01875	-0.01881	-0.01608	-0.01523	-0.01854
0.0300	-0.02708	-0.02821	-0.02752	-0.02374	-0.02639
0.0400	-0.03511	-0.03705	-0.03638	-0.03260	-0.03330
0.0500	-0.04272	-0.04520	-0.04464	-0.04102	-0.03888
0.0600	-0.04979	-0.05250	-0.05167	-0.04881	-0.04465
0.0700	-0.05621	-0.05881	-0.05826	-0.05534	-0.04891
0.0800	-0.06188	-0.06396	-0.06359	-0.06014	-0.05242
0.0900	-0.06667	-0.06781	-0.06774	-0.06269	-0.05509
0.1000	-0.07047	-0.07021	-0.07060	-0.06297	-0.05660
0.1100	-0.07318	-0.07100	-0.07204	-0.06297	-0.05787
0.1200	-0.07467	-0.07100	-0.07195	-0.06297	-0.05795
0.1300	-0.07467	-0.07100	-0.07195	-0.06297	-0.05795
0.1400	-0.07467	-0.07100	-0.07195	-0.06297	-0.05795

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{N_{JI}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	NORMAL FORCE JET OF					
17.500	-0.0016	-0.8620	-0.1470	18.8000	0.0050	0.1200
22.500	0.0010	-1.0100	0.4590	26.2000	0.0050	0.1100
27.500	0.0021	-1.0400	1.1600	19.7000	0.0050	0.1200
32.500	-0.0010	-0.5690	-8.8000	83.4000	0.0050	0.0950
38.750	-0.0006	-0.9970	4.2400	0.0	0.0050	0.1200

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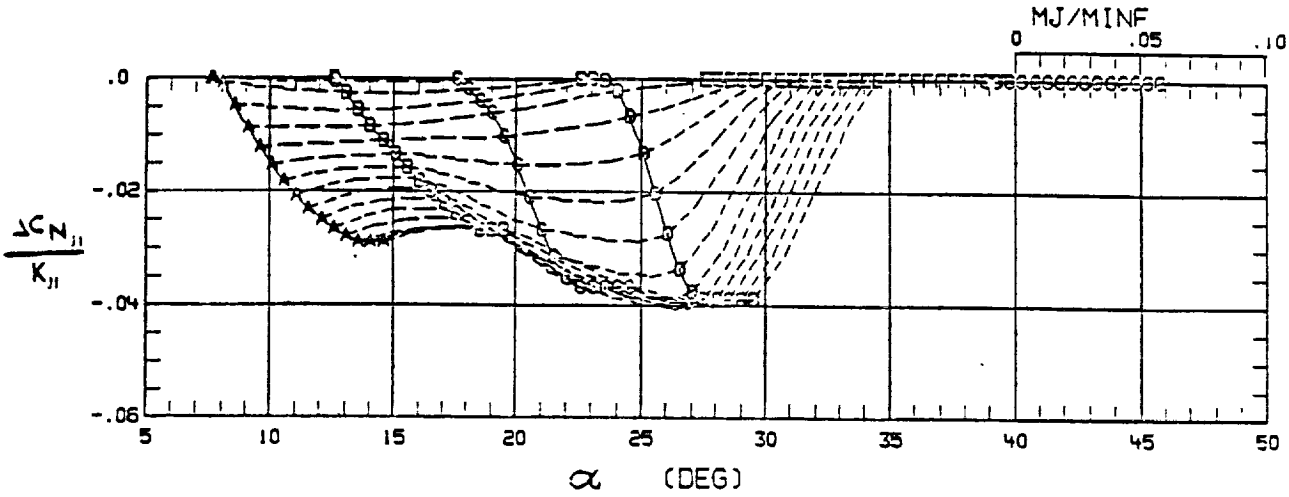
FIGURE 4.1.1.1-108
NORMAL FORCE JET INTERACTION. DOWN-FIRING



MJ/MINF - A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	39.750 G
	NORMAL FORCE JI,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00013	-0.00055	-0.00039	-0.00002	0.0	0.0	0.0
0.005	-0.00067	-0.00276	-0.00195	-0.00011	0.0	0.0	0.0
0.010	-0.00483	-0.00558	-0.00389	-0.00022	0.0	0.0	0.0
0.015	-0.00867	-0.00846	-0.00518	-0.00207	0.0	0.0	0.0
0.020	-0.01220	-0.01109	-0.01024	-0.00568	0.0	0.0	0.0
0.025	-0.01541	-0.01359	-0.01545	-0.01312	0.0	0.0	0.0
0.030	-0.01831	-0.01594	-0.02119	-0.02042	0.0	0.0	0.0
0.035	-0.02089	-0.01815	-0.02684	-0.02762	0.0	0.0	0.0
0.040	-0.02316	-0.02022	-0.03177	-0.03377	0.0	0.0	0.0
0.045	-0.02511	-0.02214	-0.03537	-0.03791	0.0	0.0	0.0
0.050	-0.02675	-0.02393	-0.03702	-0.03908	0.0	0.0	0.0
0.055	-0.02807	-0.02557	-0.03702	-0.03908	0.0	0.0	0.0
0.060	-0.02908	-0.02707	-0.03702	-0.03908	0.0	0.0	0.0
0.065	-0.02908	-0.02707	-0.03702	-0.03908	0.0	0.0	0.0
0.070	-0.02908	-0.02707	-0.03702	-0.03908	0.0	0.0	0.0

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{q_\infty}\right)$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{N_{JI}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003, MIN, MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	NORMAL FORCE JI,SF					
7.500	0.00380	-0.92590	6.29930	0.0	0.00500	0.06000
12.500	0.00030	-0.62650	2.83980	0.0	0.00500	0.06000
17.500	-0.00710	0.96400	-72.60001	827.00000	0.01000	0.05000
22.500	-0.00870	1.85000	-113.00000	1277.00000	0.01000	0.05000
27.500	0.0	0.0	0.0	0.0	0.00500	0.06000
32.500	0.0	0.0	0.0	0.0	0.00500	0.06000
38.750	0.0	0.0	0.0	0.0	0.00500	0.06000

$K_{JI} = 1.0$

Interpolate for α's not shown *after* calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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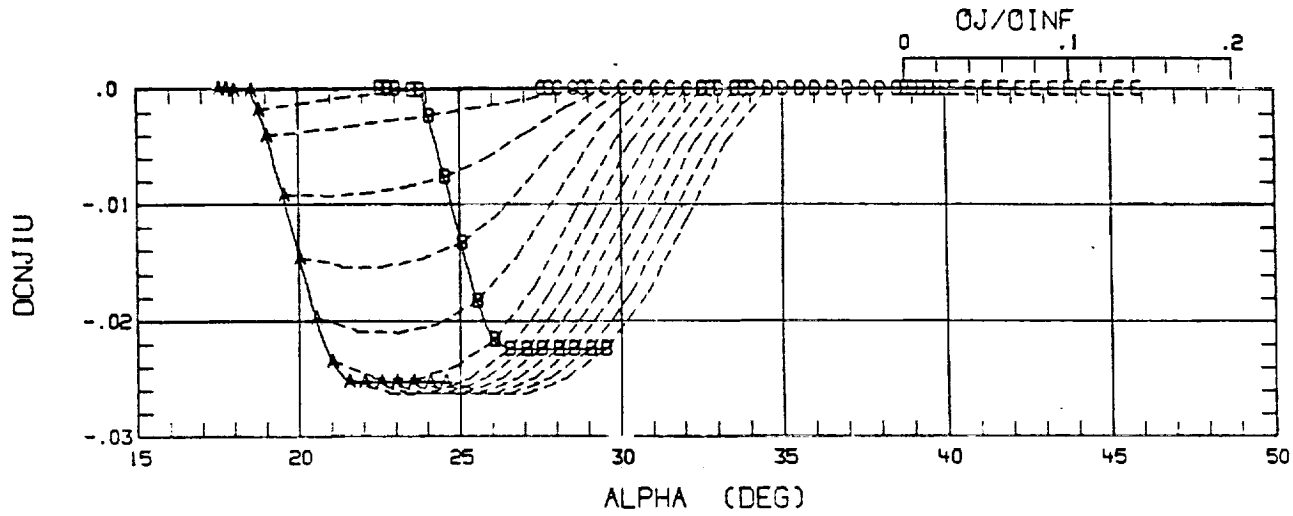
FIGURE 4.1.1.1-109
NORMAL FORCE JET INTERACTION, SIDE-FIRING



QJ/QINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	NORMAL FORCE JET UP				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00004	-0.00002	0.0	0.0	0.0
0.0100	-0.00009	-0.00005	0.0	0.0	0.0
0.0200	-0.00017	-0.00010	0.0	0.0	0.0
0.0250	-0.00191	-0.00012	0.0	0.0	0.0
0.0300	-0.00406	-0.00233	0.0	0.0	0.0
0.0400	-0.00920	-0.00764	0.0	0.0	0.0
0.0500	-0.01472	-0.01333	0.0	0.0	0.0
0.0600	-0.01980	-0.01835	0.0	0.0	0.0
0.0700	-0.02359	-0.02172	0.0	0.0	0.0
0.0800	-0.02523	-0.02241	0.0	0.0	0.0
0.0900	-0.02523	-0.02241	0.0	0.0	0.0
0.1000	-0.02523	-0.02241	0.0	0.0	0.0
0.1100	-0.02523	-0.02241	0.0	0.0	0.0
0.1200	-0.02523	-0.02241	0.0	0.0	0.0
0.1300	-0.02523	-0.02241	0.0	0.0	0.0
0.1400	-0.02523	-0.02241	0.0	0.0	0.0

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{N_{JI}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	NORMAL FORCE JET UP					
17.500	0.0005	0.2880	-18.9000	141.0000	0.0200	0.0800
22.500	0.0013	0.3900	-22.1000	169.0000	0.0250	0.0800
27.500	0.0	0.0	0.0	0.0	0.0050	0.1200
32.500	0.0	0.0	0.0	0.0	0.0050	0.1200
38.750	0.0	0.0	0.0	0.0	0.0050	0.1200

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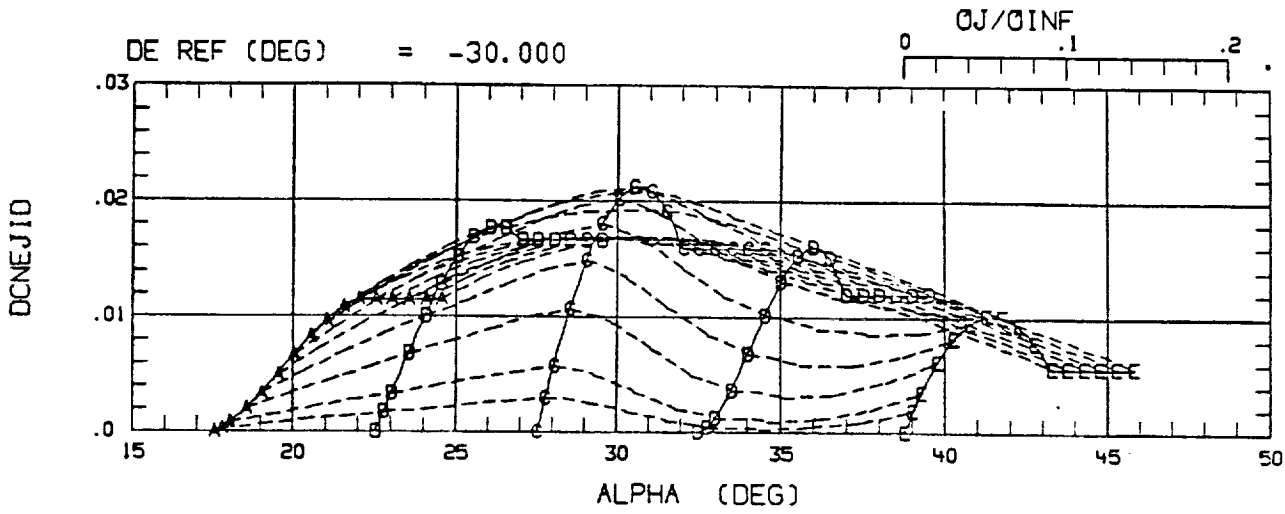
FIGURE 4.1.1.1-110
NORMAL FORCE JET INTERACTION, UP-FIRING



QJ/QINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE NORMAL FORCE JT.DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00033	0.00168	0.00291	0.00042	0.00179
0.0100	0.00077	0.00337	0.00586	0.00120	0.00340
0.0200	0.00192	0.00671	0.01062	0.00360	0.00611
0.0300	0.00335	0.00987	0.01476	0.00670	0.00812
0.0400	0.00494	0.01269	0.01796	0.00999	0.00943
0.0500	0.00658	0.01503	0.02011	0.01297	0.01005
0.0600	0.00816	0.01673	0.02109	0.01515	0.00997
0.0700	0.00955	0.01764	0.02077	0.01602	0.00920
0.0800	0.01066	0.01762	0.01905	0.01508	0.00773
0.0900	0.01137	0.01651	0.01580	0.01184	0.00556
0.1000	0.01137	0.01651	0.01580	0.01184	0.00556
0.1100	0.01137	0.01651	0.01580	0.01184	0.00556
0.1200	0.01137	0.01651	0.01580	0.01184	0.00555
0.1300	0.01137	0.01651	0.01580	0.01184	0.00556
0.1400	0.01137	0.01651	0.01580	0.01184	0.00555

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$$\left(\Delta C_N\right)_{\delta_{e_{REF}} = -30^\circ} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE NORMAL FORCE JT.DF					
17.500	0.0	0.0536	2.5000	-18.6000	0.0050	0.0900
22.500	0.0	0.3340	0.5860	-25.1000	0.0050	0.0900
27.500	0.0	0.5970	-2.9100	-19.7000	0.0050	0.0900
32.500	0.0	0.0439	8.4800	-83.4000	0.0050	0.0900
38.750	0.0	0.3750	-3.4800	0.0	0.0050	0.0900

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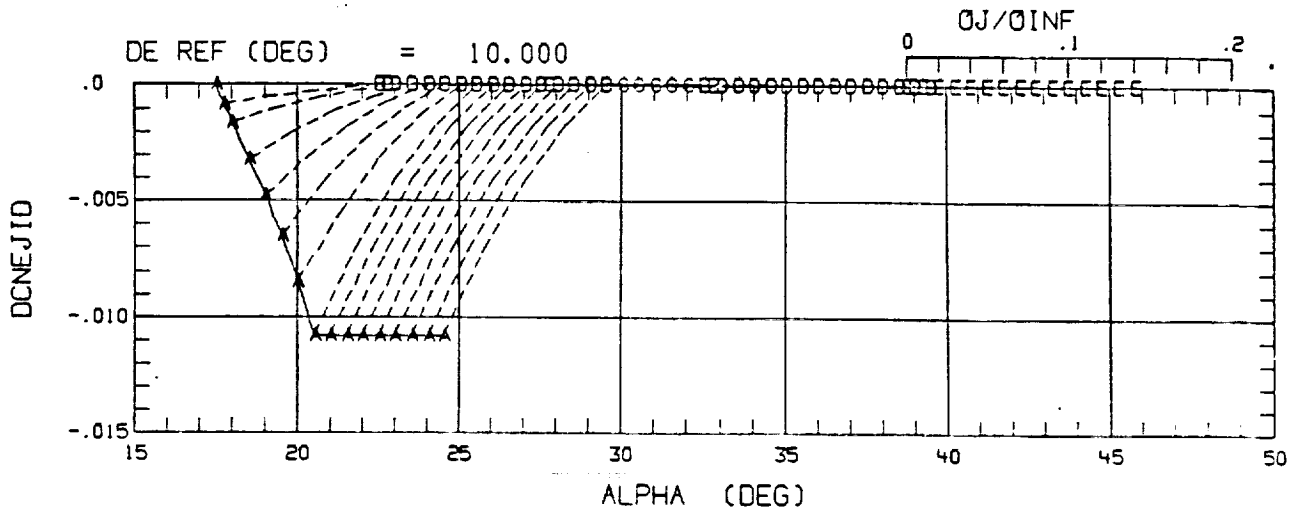
FIGURE 4.1.1.1-111
ELEVON NORMAL FORCE JET INTERACTION, DOWN-FIRING



DJ/DINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE NORMAL FORCE JET,DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00065	0.0	0.0	0.0	0.0
0.0100	-0.00166	0.0	0.0	0.0	0.0
0.0200	-0.00323	0.0	0.0	0.0	0.0
0.0300	-0.00482	0.0	0.0	0.0	0.0
0.0400	-0.00655	0.0	0.0	0.0	0.0
0.0500	-0.00852	0.0	0.0	0.0	0.0
0.0600	-0.01086	0.0	0.0	0.0	0.0
0.0700	-0.01086	0.0	0.0	0.0	0.0
0.0800	-0.01086	0.0	0.0	0.0	0.0
0.0900	-0.01086	0.0	0.0	0.0	0.0
0.1000	-0.01086	0.0	0.0	0.0	0.0
0.1100	-0.01086	0.0	0.0	0.0	0.0
0.1200	-0.01086	0.0	0.0	0.0	0.0
0.1300	-0.01086	0.0	0.0	0.0	0.0
0.1400	-0.01086	0.0	0.0	0.0	0.0

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\left(\Delta C_N\right)_{\delta_{e_{REF}} = +10^\circ} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE NORMAL FORCE JET,DF					
17.500	0.0	-0.1740	1.0100	-18.8000	0.0050	0.0600
22.500	0.0	0.0	0.0	0.0	0.0050	0.0600
27.500	0.0	0.0	0.0	0.0	0.0050	0.0600
32.500	0.0	0.0	0.0	0.0	0.0050	0.0600
38.750	0.0	0.0	0.0	0.0	0.0050	0.0600

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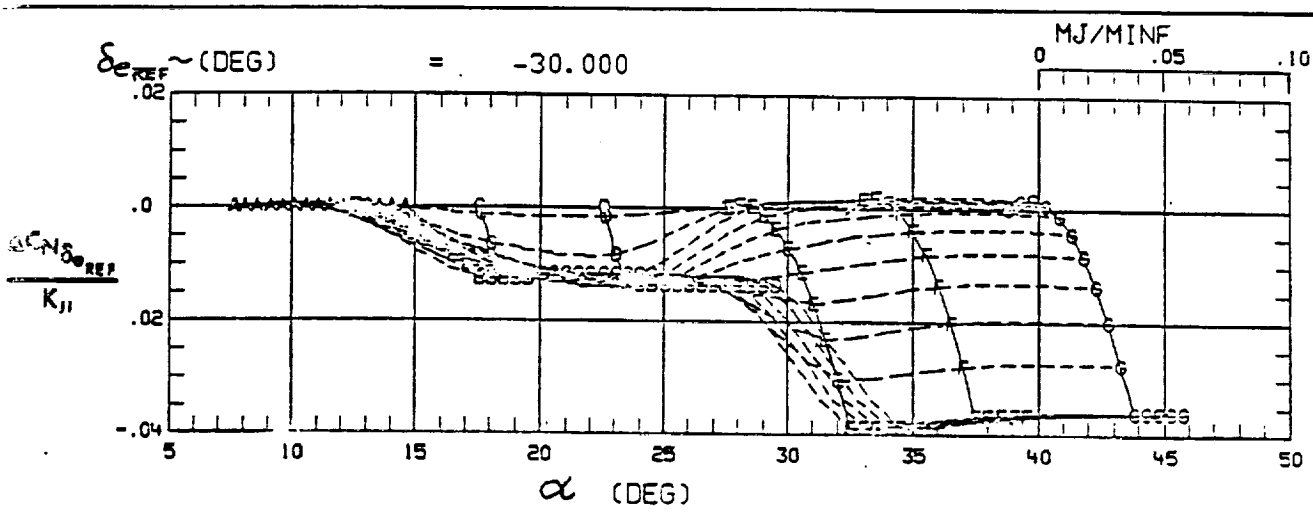
FIGURE 4.1.1.1-112
ELEVON NORMAL FORCE JET INTERACTION, DOWN-FIRING

SE[illegible]-SH-C[illegible]C IM



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE NORMAL FORCE J1,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.0	-0.00008	-0.00135	-0.00170	0.00011	0.00030	0.00026
0.005	0.0	-0.00041	-0.00679	-0.00851	0.00054	0.00148	0.00129
0.010	0.0	-0.00102	-0.01058	-0.01278	0.00010	0.00181	0.00147
0.015	0.0	-0.00182	-0.01198	-0.01376	-0.00133	0.00099	0.00057
0.020	0.0	-0.00281	-0.01198	-0.01376	-0.00374	-0.00093	-0.00142
0.025	0.0	-0.00399	-0.01198	-0.01376	-0.00714	-0.00410	-0.00450
0.030	0.0	-0.00536	-0.01198	-0.01376	-0.01152	-0.00837	-0.00857
0.035	0.0	-0.00693	-0.01198	-0.01376	-0.01689	-0.01379	-0.01393
0.040	0.0	-0.00868	-0.01198	-0.01376	-0.02324	-0.02035	-0.02023
0.045	0.0	-0.01063	-0.01198	-0.01376	-0.03058	-0.02803	-0.02772
0.050	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625
0.055	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625
0.060	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625
0.065	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625
0.070	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_{sc}}\right)\left(\frac{v_{sc}}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{a_\infty}\right)$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{N\delta_{e_{REF}}}}{K_{j1}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003, MIN, MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE NORMAL FORCE J1,SF					
7.500	0.0	0.0	0.0	0.0	0.00500	0.05000
12.500	0.0	-0.06370	-3.83510	0.0	0.00500	0.05000
17.500	0.0	-1.70000	72.50000	-827.00000	0.00500	0.01500
22.500	0.0	-2.19000	104.00000	-1277.00000	0.00500	0.01500
27.500	0.0	0.20700	-19.70000	0.0	0.00500	0.05000
32.500	0.0	0.41100	-23.00000	0.0	0.00500	0.05000
38.750	0.0	0.36500	-21.80000	0.0	0.00500	0.05000

$K_{j1} = 1.0$

Interpolate for α's not shown *after* calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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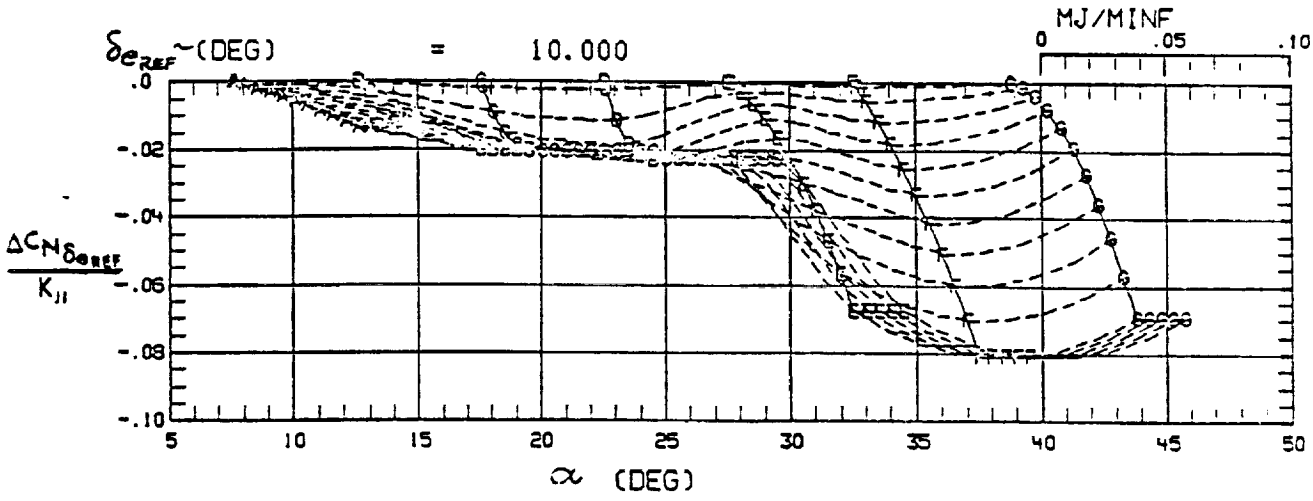
FIGURE 4.1.1.1-113
ELEVON NORMAL FORCE JET INTERACTION, SIDE-FIRING



	α (DEG)						
	7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
MJ/MINF A	DE NORMAL FORCE JI.SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00019	-0.00057	-0.00188	-0.00229	-0.00057	-0.00112	-0.00029
0.005	-0.00097	-0.00287	-0.00938	-0.01143	-0.00287	-0.00562	-0.00147
0.010	-0.00203	-0.00556	-0.01555	-0.01848	-0.00681	-0.01180	-0.00416
0.015	-0.00317	-0.00806	-0.01911	-0.02208	-0.01121	-0.01652	-0.00807
0.020	-0.00441	-0.01037	-0.02070	-0.02322	-0.01668	-0.02580	-0.01320
0.025	-0.00574	-0.01249	-0.02092	-0.02283	-0.02301	-0.03362	-0.01955
0.030	-0.00716	-0.01442	-0.02092	-0.02283	-0.03021	-0.04200	-0.02712
0.035	-0.00867	-0.01617	-0.02092	-0.02283	-0.03827	-0.05092	-0.03591
0.040	-0.01027	-0.01773	-0.02092	-0.02283	-0.04720	-0.06040	-0.04592
0.045	-0.01196	-0.01910	-0.02092	-0.02283	-0.05699	-0.07042	-0.05715
0.050	-0.01374	-0.02029	-0.02092	-0.02283	-0.06765	-0.08100	-0.06960
0.055	-0.01374	-0.02029	-0.02092	-0.02283	-0.06765	-0.08100	-0.06960
0.060	-0.01374	-0.02029	-0.02092	-0.02283	-0.06765	-0.08100	-0.06960
0.065	-0.01374	-0.02029	-0.02092	-0.02283	-0.06765	-0.08100	-0.06960
0.070	-0.01374	-0.02029	-0.02092	-0.02283	-0.06765	-0.08100	-0.06960

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{q_\infty}\right)$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{N_{JI}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

	A0C3, MIN, MAX					
	A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
ALPHA (DEG)	DE NORMAL FORCE JI.SF					
7.500	0.0	-0.18450	-1.80710	0.0	0.00500	0.05000
12.500	0.0	-0.59330	3.75160	0.0	0.00500	0.05000
17.500	0.0	-2.24000	76.80000	-827.00000	0.00500	0.02500
22.500	0.0	-2.79000	107.00000	-1277.00000	0.00500	0.02500
27.500	0.0	-0.48800	-17.30000	0.0	0.00500	0.05000
32.500	0.0	-1.07000	-11.00000	0.0	0.00500	0.05000
38.750	0.0	-0.17200	-24.39999	0.0	0.00500	0.05000

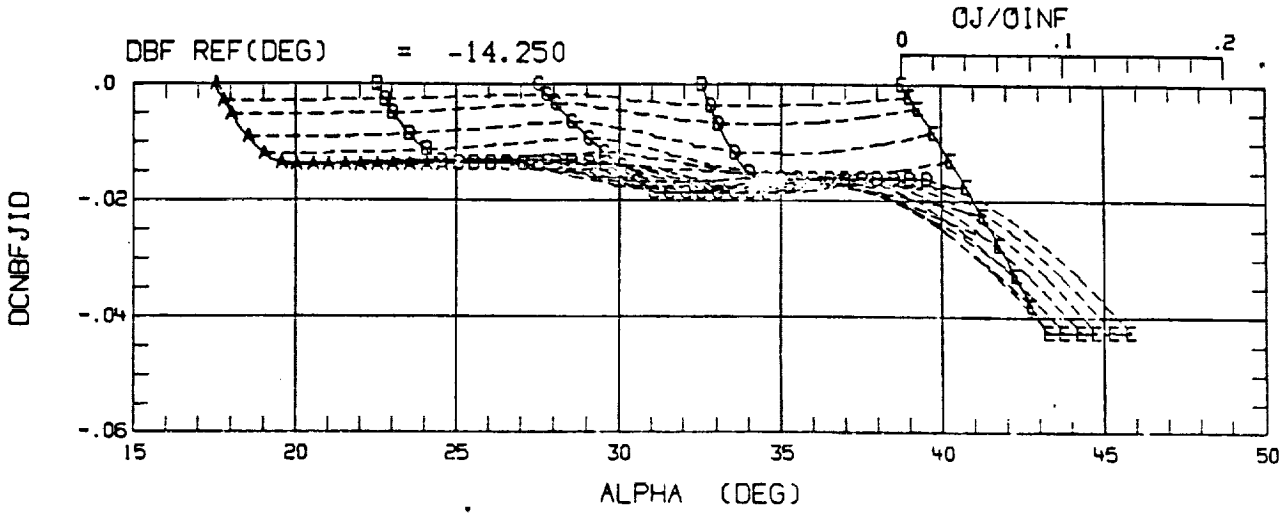
$K_{JI} = 1.0$

Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

ENGINEER HP
DATE 4/15/75

FIGURE 4.1.1.1-114
ELEVON NORMAL FORCE JET INTERACTION, SIDE-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DBF NORMAL FORCE J1.DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00282	-0.00233	-0.00184	-0.00374	-0.00208
0.0100	-0.00529	-0.00495	-0.00354	-0.00692	-0.00420
0.0200	-0.00529	-0.00873	-0.00664	-0.01191	-0.00857
0.0300	-0.01211	-0.01149	-0.00940	-0.01545	-0.01311
0.0400	-0.01386	-0.01339	-0.01194	-0.01634	-0.01783
0.0500	-0.01413	-0.01372	-0.01439	-0.01634	-0.02272
0.0600	-0.01413	-0.01372	-0.01666	-0.01634	-0.02778
0.0700	-0.01413	-0.01372	-0.01866	-0.01634	-0.03302
0.0800	-0.01413	-0.01372	-0.01866	-0.01634	-0.03844
0.0900	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1000	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1100	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1200	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1300	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1400	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$$\Delta C_{N_{\delta_{BF_{REF}}}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3 \quad @\ \delta_{BF_{REF}} = -14.25°$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DBF NORMAL FORCE J1.DF					
17.500	0.0	-0.5580	7.0400	-18.8000	0.0050	0.0424
22.500	0.0	-0.5580	6.5900	-25.2000	0.0050	0.0423
27.500	0.0	-0.3810	2.8500	-19.7000	0.0050	0.0670
32.500	0.0	-0.8060	12.2000	-83.4000	0.0050	0.0331
38.750	0.0	-0.4110	-0.8680	0.0	0.0050	0.0880

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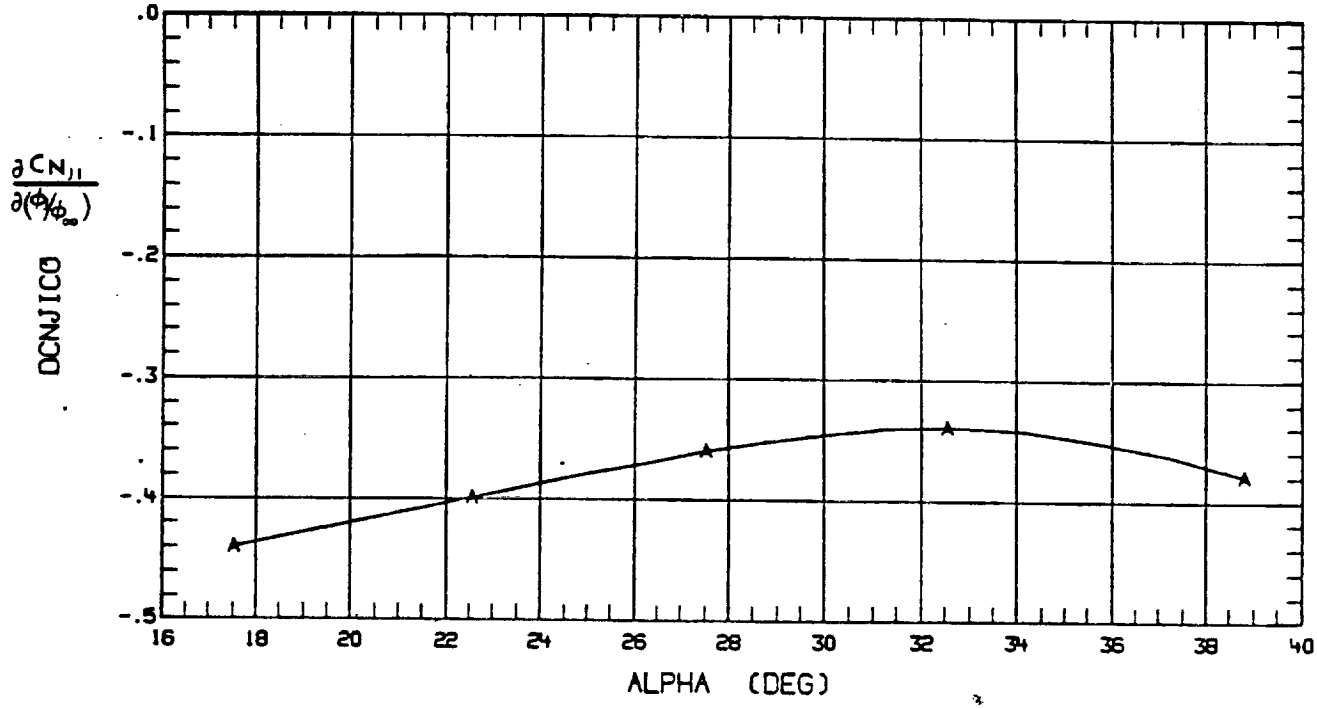
DATE 5/4/92

FIGURE 4.1.1.1-115
BODYFLAP NORMAL FORCE JET INTERACTION.DOWN-FIRING



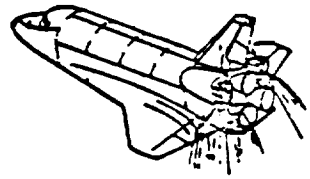
CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

$\frac{\partial C_{N_{JI}}}{\partial(\phi_J/\phi_\infty)} = 0$ if down firing jet group is inoperative on one side.

ALPHA (DEG)	$\frac{\partial C_{N_{JI}}}{\partial(\phi_J/\phi_\infty)}$ NORMAL FOR
17.500	-0.44000
22.500	-0.40000
27.500	-0.36000
32.500	-0.34000
38.750	-0.38000

$$\left(\frac{\overline{\phi_J}}{\phi_\infty}\right) = \frac{1}{2}\left[\left(\frac{\phi_J}{\phi_\infty}\right)_{LH_D} + \left(\frac{\phi_J}{\phi_\infty}\right)_{RH_D}\right]$$

$$0 < \left(\frac{\overline{\phi_J}}{\phi_\infty}\right) \leq 0.03$$



ENGINEER MLD
DATE 9/26/73

FIGURE 4.1.1.1-116
NORMAL FORCE JET INTERACTION CARRYOVER. DOWN-FIRING

4.1.1.2 AXIAL FORCE COEFFICIENT. The Orbiter Vehicle aerodynamic axial force coefficient is defined in this section. The basic aerodynamic axial force coefficient data are presented in three forms: 1) as a function of angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty'$) from 0.005 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet to 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.1.1.2[. Uncertainties associated with the axial force characteristics are available in Section 6.0.

The RCS flow field interaction data are presented as a contribution to the axial force (A) rather than the coefficient (C_A) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where the RCS is used in conjunction with the aerodynamic force (cf. Section 3.6); i.e., the aerodynamic coefficient must be converted to a dimensional force *before* adding the RCS flow field interaction effect (see also Appendix B).

The total axial force is:

$$A_{TOTAL} = \bar{q}\, S\, C_{A_{\substack{TOTAL \\ AERO}}} + A_{RCS}$$

*The total aerodynamic axial force coefficient is obtained by the following equation:

$$C_{A_{\substack{TOTAL \\ AERO}}} = C_{A_{BASIC}} + [\Delta C_{A_{ELEVATOR}} + \Delta C_{A_{AILERON}}]_{ELEVON} + \Delta C_{A_{\substack{BODY \\ FLAP}}} + \Delta C_{A_{RUDDER}} + \Delta C_{A_{\substack{SPEED \\ BRAKE}}} + \Delta C_{A_{FLEX}} + \Delta C_{A_{\substack{LANDING \\ GEAR}}} + \Delta C_{A_{\substack{GROUND \\ EFFECT}}} + \Delta C_{A_{\substack{SILTS \\ POD}}}$$

where,

$C_{A_{BASIC}}$ = Basic, full-scale, freestream, rigid body axial force coefficient (Figures 4.1.1.2-1 through -6)

NOTE: 1) All control surfaces neutral *except* $\delta_{SB} = 25°$.

$\Delta C_{A_{ELEVATOR}}$ = Change in axial force coefficient due to elevon (elevator) deflection, δ_e. (Figures 4.1.1.2-7 through -36)

*Refer to Appendix D when using digitized data.

$\Delta C_{A_{AILERON}}$ = Change in axial force coefficient due to aileron deflection, δ_a.

$= \frac{1}{2}(\Delta C_{A_{e_{\delta_e-\delta_{e_L}}}} + \Delta C_{A_{e_{\delta_e-\delta_{e_R}}}}) - \Delta C_{A_{e_{\delta_e-\delta_{e_{TRIM}}}}}$

$\Delta C_{A_{BODY\ FLAP}}$ = Change in axial force coefficient due to body flap deflection, δ_{BF}. (Figures 4.1.1.2-37 through -65)

$\Delta C_{A_{RUDDER}}$ = Change in axial force coefficient due to rudder deflection, δ_r. (Assume zero)

$\Delta C_{A_{SPEED\ BRAKE}}$ = Change in axial force coefficient due to speed brake deflection, δ_{SB}. (Figures 4.1.1.2-66 through -92)

$\Delta C_{A_{FLEX}}$ = Change in axial force coefficient due to aeroelastic deformation.

$= \Delta C_{D_{FLEX}} \cos \alpha - \Delta C_{L_{FLEX}} \sin \alpha$

where, $\Delta C_{L_{FLEX}}$ = flexible lift increment (cf. Section 4.1.2.1)

$\Delta C_{D_{FLEX}}$ = flexible drag increment (cf. Section 4.1.2.2)

$\Delta C_{A_{LANDING\ GEAR}}$ = Change in axial force coefficient due to fully extended landing gear. (Figure 4.1.1.2-93)

NOTE: 1. See Section 4.1.2.2 for landing gear drag during deployment.

$\Delta C_{A_{GROUND\ EFFECT}}$ = Change in axial force coefficient due to proximity of ground, f(h/b) (Figures 4.1.1.2-94 through -103)

NOTE: 1. See Section 3.4 for ground clearance and scrape attitude.

$\Delta C_{A_{SILTS\ POD}}$ = Change in axial force coefficient due to addition of SILTS pod.

$= \Delta C_{D_{SILTS\ POD}} \cos \alpha - \Delta C_{L_{SILTS\ POD}} \sin \alpha$ ... ($\Delta C_{L_{SILTS}}$ - cf Section 4.1.2.1) ($\Delta C_{D_{SILTS}}$ - cf Section 4.1.2.2)

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

The effect of the RCS may be described as a dimensional axial force (pounds) in terms of the significant contributing elements by:

$$A_{RCS} = A_{JT} + [A_{SURF} + \Delta A_{ELEVON} + \Delta A_{\substack{BODY \\ FLAP}}]_{IMP} + \bar{q} S [\Delta C_A + \Delta C_{A_{ELEVON}} + \Delta C_{A_{\substack{BODY \\ FLAP}}} + \Delta C_{A_{\substack{DOWN \\ FIRING \\ CARRYOVER \\ 2\ SIDES}}}]_{JI}$$

where,

A_{JT} = Axial force resulting from number (n) of jets being fired (Reference data only). (cf. Appendix B)

$$= \sum_{OJG} [A_{JET}; n] \sim lb$$

NOTE: 1. OJG - operating jet group

2. Values given in Figure B-1 are for reference only.

$A_{\substack{SURF \\ IMP}}$ = Axial force resulting from jet impingement on Orbiter Vehicle surface(s). (Figure 4.1.1.2-104)

$$= \sum_{OJG} [A_{\substack{SURF \\ IMP}} \cdot n] \sim lb$$

$A_{\substack{ELEVON \\ IMP}}$ = Change in axial force due to effect of impingement on elevon effectiveness. (Figure 4.1.1.2-105)

$$= \sum_{OJG} [\frac{\partial A}{\partial \delta_e} \delta_e \cdot n] \sim lb$$

$A_{\substack{BODY \\ FLAP \\ IMP}}$ = Change in axial force due to effect of impingement on body flap effectiveness. (Figure 4.1.1.2-106)

$$= \sum_{OJG} [\frac{\partial A}{\partial \delta_{BF}} \delta_{BF} \cdot n] \sim lb$$

$\Delta C_{A_{JI}}$ = Change in axial force coefficient due to jet interaction. (Figures 4.1.1.2-107 through -109)

$$= \sum_{OJG} [\Delta C_{A_{JI}}]$$

$\Delta C_{A_{\substack{\text{ELEVON} \\ JI}}}$ = Change in axial force coefficient due to jet interaction effect on elevon effectiveness.

$$= \sum_{OJG}\left[(\Delta C_A)_{\delta_{e_{REF}}}\left(\frac{\delta_e}{\delta_{e_{REF}}}\right)^{0.75}\right]$$

NOTE: 1. Down-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.2-110)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (No effect)

2. Side-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.2-111)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.2-112)

3. Up-firing jets (No effect)

$\Delta C_{A_{\substack{\text{BODY} \\ \text{FLAP} \\ JI}}}$ = Change in axial force coefficient due to jet interaction effect on body flap effectiveness. (No effect)

$$= \sum_{OJG}\left[(\Delta C_A)_{\delta_{BF_{REF}}}\left(\frac{\delta_{BF}}{\delta_{BF_{REF}}}\right)^{0.75}\right]$$

$\Delta C_{A_{\substack{\text{DOWN} \\ \text{FIRING} \\ \text{CARRYOVER} \\ JI \\ \text{2 SIDES}}}}$ = Effect of carry-over between left- and right-down-firing jet groups due to jet interaction. (Figure 4.1.1.2-113)

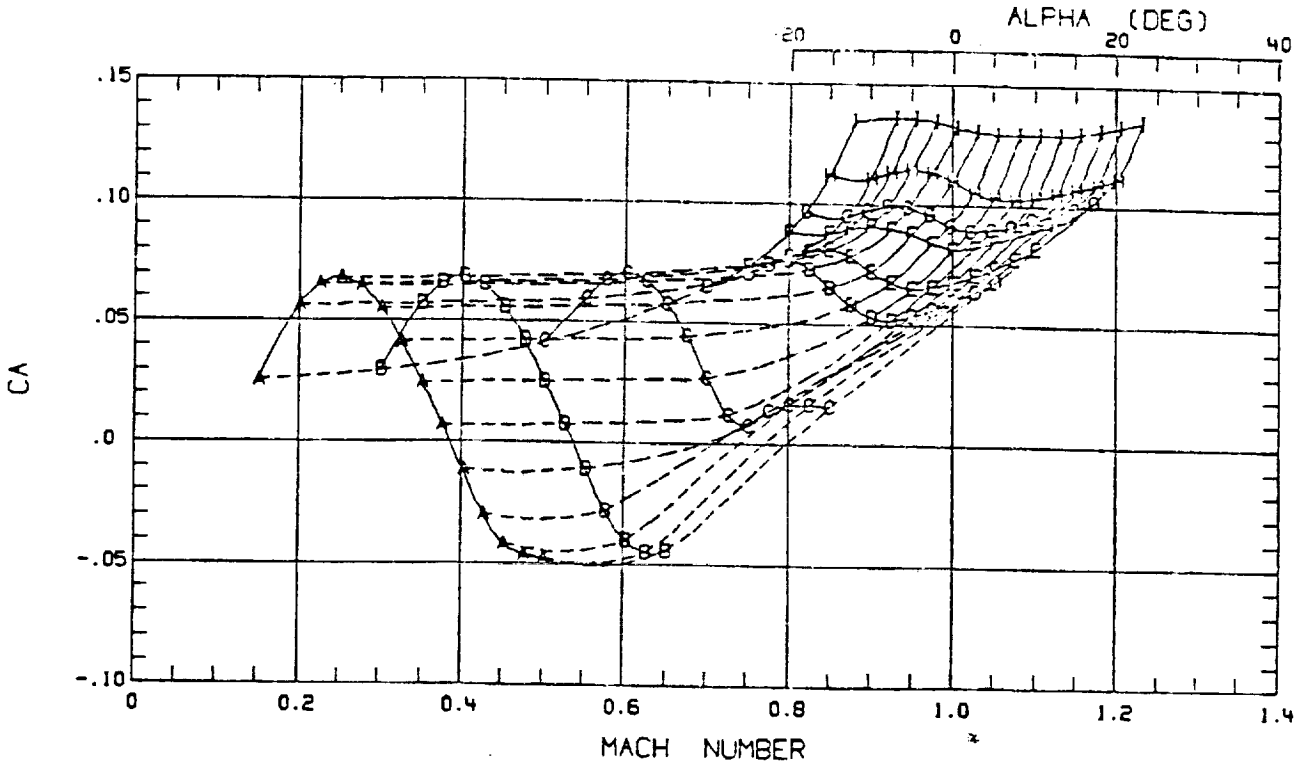
$$= \left[\frac{\partial\ C_{A_{JI}}}{\partial(\phi_j/\phi_\infty)}\right]\left[(\overline{\phi_j/\phi_\infty})\right]$$

NOTE: 1. $\phi_j/\phi_\infty = (0.1543/\overline{q}_\infty)^n$

2. This term is zero when down-firing jet group is inoperative on one side.

3. $(\overline{\phi_j/\phi_\infty}) = \frac{1}{2}\left[(\phi_j/\phi_\infty)_{LD} + (\phi_j/\phi_\infty)_{RD}\right]$

where: $0 < (\overline{\phi_j/\phi_\infty}) < 0.03$



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	0.250 A	0.400 B	0.600 C	0.800 D	0.850 E	0.900 F	0.920 G	0.950 H	0.980 I
ALPHA (DEG)	AXIAL FORCE COEFFICIENT								
-10.000	0.02520	0.02520	0.04120	0.06490	0.07400	0.08810	0.09640	0.11200	0.13450
-5.000	0.05610	0.05700	0.05940	0.07060	0.07780	0.08770	0.09450	0.11040	0.13600
-2.500	0.06500	0.06550	0.06760	0.07480	0.08010	0.08980	0.09760	0.11320	0.13580
0.0	0.06740	0.06810	0.07020	0.07630	0.08100	0.09070	0.09900	0.11450	0.13460
2.500	0.06410	0.06470	0.06690	0.07280	0.07820	0.08990	0.09840	0.11320	0.13220
5.000	0.05490	0.05550	0.05760	0.06500	0.07200	0.08760	0.09590	0.10990	0.13070
7.500	0.04110	0.04200	0.04390	0.05780	0.06740	0.08410	0.09120	0.10500	0.12980
10.000	0.02430	0.02520	0.02720	0.05290	0.06500	0.08170	0.08930	0.10280	0.12960
12.500	0.00670	0.00730	0.01180	0.05180	0.06590	0.08240	0.08990	0.10240	0.12950
15.000	-0.01210	-0.01100	0.00730	0.05350	0.06780	0.08460	0.09120	0.10320	0.12960
17.500	-0.03000	-0.02820	0.01340	0.05630	0.07040	0.08710	0.09400	0.10470	0.13030
20.000	-0.04230	-0.04030	0.01620	0.05970	0.07370	0.08990	0.09620	0.10670	0.13160
22.500	-0.04650	-0.04530	0.01620	0.06370	0.07760	0.09270	0.09890	0.10900	0.13340
25.000	-0.04780	-0.04500	0.01520	0.06800	0.08190	0.09570	0.10180	0.11150	0.13510
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

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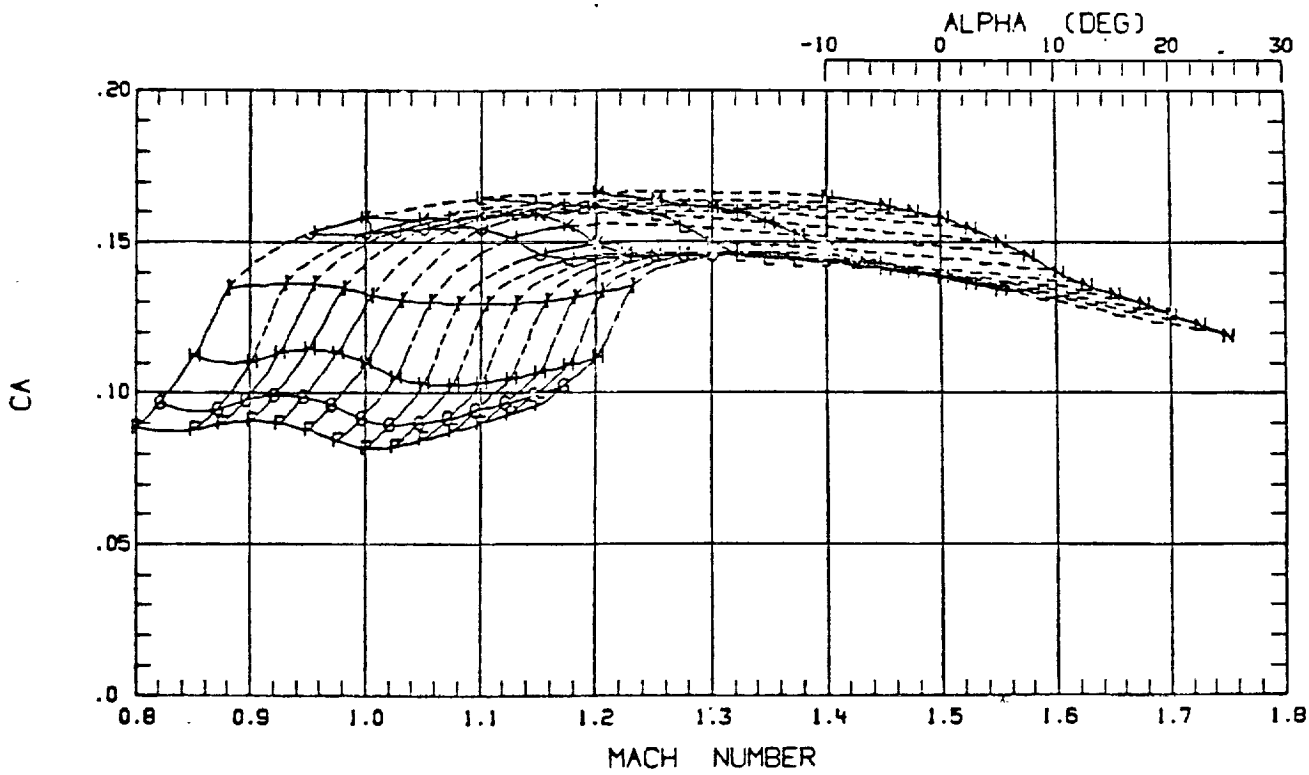
FIGURE 4.1.1.2 -1
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	0.900 F	0.920 G	0.950 H	0.980 I	1.050 J	1.100 K	1.200 L	1.300 M	1.500 N
ALPHA (DEG)	AXIAL FORCE COEFFICIENT								
-10.000	0.08810	0.09640	0.11200	0.13450	0.15270	0.15790	0.16440	0.16610	0.16460
-5.000	0.08770	0.09450	0.11040	0.13600	0.15260	0.15760	0.16270	0.16340	0.16180
-2.500	0.08980	0.09750	0.11320	0.13580	0.15350	0.15790	0.16200	0.16210	0.15990
0.0	0.09070	0.09900	0.11450	0.13460	0.15410	0.15840	0.16140	0.16110	0.15770
2.500	0.08990	0.09840	0.11320	0.13220	0.15470	0.15890	0.16030	0.15930	0.15430
5.000	0.08760	0.09590	0.10990	0.13070	0.15430	0.15880	0.15890	0.15600	0.14990
7.500	0.08410	0.09120	0.10500	0.12980	0.15110	0.15510	0.15490	0.15200	0.14520
10.000	0.08170	0.08930	0.10280	0.12960	0.14580	0.14900	0.14940	0.14720	0.13980
12.500	0.08240	0.08990	0.10240	0.12950	0.14410	0.14580	0.14530	0.14270	0.13540
15.000	0.08460	0.09120	0.10320	0.12960	0.14400	0.14520	0.14440	0.14070	0.13240
17.500	0.08710	0.09400	0.10470	0.13030	0.14450	0.14560	0.14390	0.13940	0.12950
20.000	0.08990	0.09620	0.10670	0.13160	0.14500	0.14590	0.14360	0.13800	0.12600
22.500	0.09270	0.09890	0.10900	0.13340	0.14510	0.14610	0.14310	0.13610	0.12250
25.000	0.09570	0.10180	0.11150	0.13510	0.14510	0.14620	0.14250	0.13390	0.11880
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

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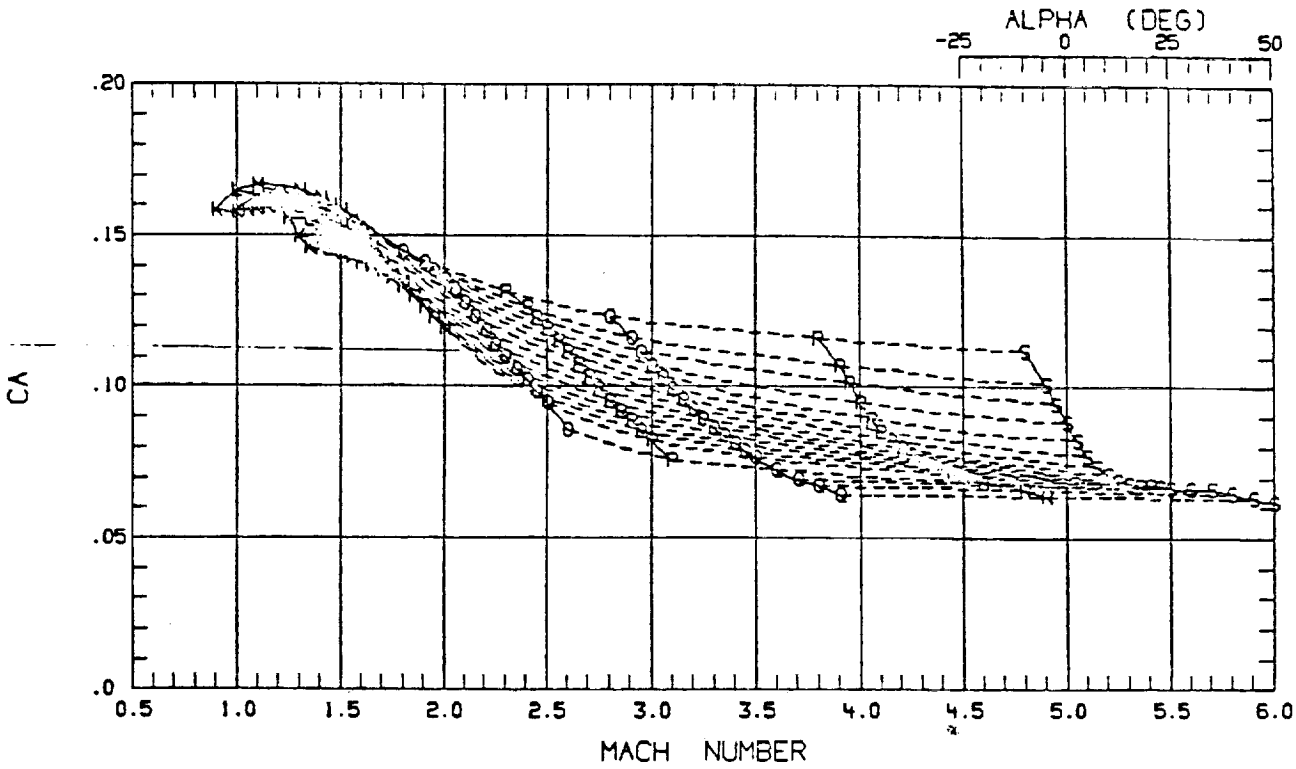
FIGURE 4.1.1.2 -2
BASIC AXIAL FORCE COEFFICIENT

SLTL-3R-0[illegible] IM



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	1.100	1.200	1.300	1.500	2.000	2.500	3.000	4.000	5.000
	K	L	M	N	O	P	Q	R	S
ALPHA (DEG)	AXIAL FORCE COEFFICIENT								
-10.000	0.15790	0.16440	0.16610	0.16460	0.14440	0.13100	0.12270	0.11570	0.11170
-5.000	0.15760	0.16270	0.16340	0.16180	0.14060	0.12590	0.11580	0.10680	0.10040
-2.500	0.15790	0.16200	0.16210	0.15890	0.13800	0.12230	0.11130	0.10090	0.09390
0.0	0.15840	0.16140	0.16110	0.15770	0.13490	0.11860	0.10680	0.09430	0.08760
2.500	0.15890	0.16030	0.15930	0.15430	0.13120	0.11490	0.10300	0.08880	0.08190
5.000	0.15880	0.15890	0.15600	0.14990	0.12730	0.11110	0.09910	0.08490	0.07690
7.500	0.15510	0.15490	0.15200	0.14520	0.12290	0.10720	0.09540	0.08180	0.07300
10.000	0.14900	0.14940	0.14720	0.13980	0.11830	0.10300	0.09210	0.07910	0.07060
12.500	0.14580	0.14530	0.14270	0.13540	0.11380	0.09900	0.08890	0.07710	0.06860
15.000	0.14520	0.14440	0.14070	0.13240	0.10940	0.09490	0.08600	0.07530	0.06770
17.500	0.14560	0.14390	0.13940	0.12950	0.10570	0.09140	0.08330	0.07380	0.06720
20.000	0.14580	0.14360	0.13800	0.12600	0.10190	0.08820	0.08060	0.07260	0.06680
22.500	0.14610	0.14310	0.13610	0.12250	0.09800	0.08500	0.07830	0.07150	0.06650
25.000	0.14620	0.14250	0.13390	0.11880	0.09430	0.08160	0.07600	0.07030	0.06620
30.000	.....	.....	.....	.....	0.08540	0.07520	0.07190	0.06790	0.06600
35.000	.....	.....	.....	.....	.....	.....	0.06880	0.06730	0.06590
40.000	.....	.....	.....	.....	.....	.....	0.06700	0.06560	0.06450
45.000	.....	.....	.....	.....	.....	.....	0.06410	0.06350	0.06270
50.000	.....	.....	.....	.....	.....	.....	.....	.....	0.06130

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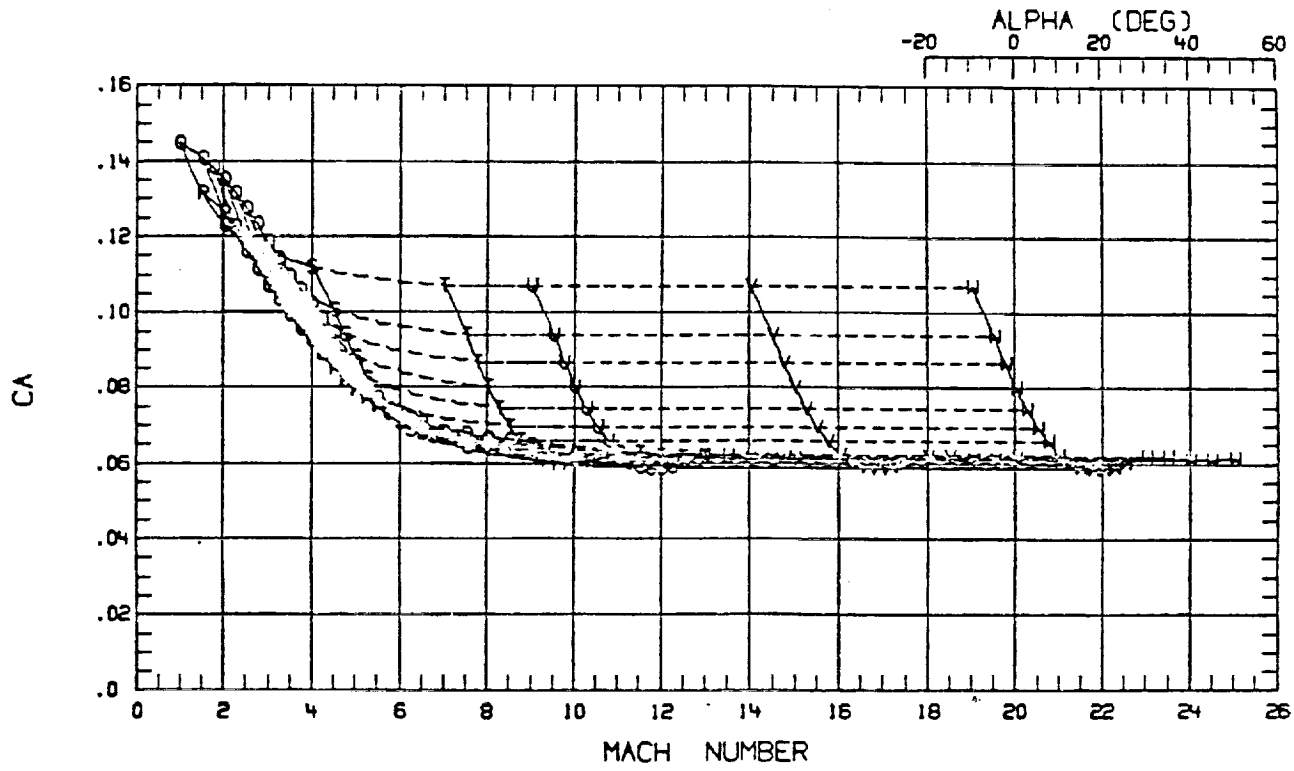
FIGURE 4.1.1.2 - 3
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	2.000	2.500	3.000	4.000	5.000	8.000	10.000	15.000	20.000
ALPHA (DEG)	Q	P	Q	R	S	T	U	V	W
	AXIAL FORCE COEFFICIENT								
-10.000	0.14440	0.13100	0.12270	0.11570	0.11170	0.10670	0.10670	0.10670	0.10670
-5.000	0.14060	0.12590	0.11580	0.10680	0.10040	0.09380	0.09380	0.09380	0.09380
-2.500	0.13800	0.12230	0.11130	0.10090	0.09390	0.08670	0.08670	0.08670	0.08670
0.0	0.13490	0.11860	0.10680	0.09430	0.08760	0.08000	0.08000	0.08000	0.08000
2.500	0.13120	0.11490	0.10300	0.08880	0.08190	0.07440	0.07440	0.07440	0.07440
5.000	0.12730	0.11110	0.09910	0.08490	0.07690	0.06960	0.06960	0.06960	0.06960
7.500	0.12290	0.10720	0.09540	0.08180	0.07300	0.06560	0.06560	0.06560	0.06560
10.000	0.11830	0.10300	0.09210	0.07910	0.07060	0.06250	0.06200	0.06200	0.06200
12.500	0.11380	0.09900	0.08890	0.07710	0.06860	0.06060	0.06000	0.06000	0.06000
15.000	0.10940	0.09490	0.08600	0.07530	0.06770	0.05970	0.05900	0.05900	0.05900
17.500	0.10570	0.09140	0.08330	0.07380	0.06720	0.05950	0.05860	0.05860	0.05860
20.000	0.10190	0.08820	0.08060	0.07260	0.06680	0.05950	0.05850	0.05850	0.05850
22.500	0.09800	0.08500	0.07830	0.07150	0.06650	0.06010	0.05900	0.05900	0.05900
25.000	0.09430	0.08160	0.07600	0.07030	0.06620	0.06090	0.06000	0.06000	0.06000
30.000	0.08540	0.07520	0.07190	0.06790	0.06600	0.06250	0.06170	0.06170	0.06170
35.000	**********	**********	0.06880	0.06730	0.06590	0.06260	0.06160	0.06160	0.06160
40.000	**********	**********	0.06700	0.06560	0.06450	0.06180	0.06080	0.06080	0.06080
45.000	**********	**********	0.06410	0.06350	0.06270	0.06150	0.06100	0.06100	0.06100
50.000	**********	**********	**********	**********	0.06130	0.06130	0.06130	0.06130	0.06130

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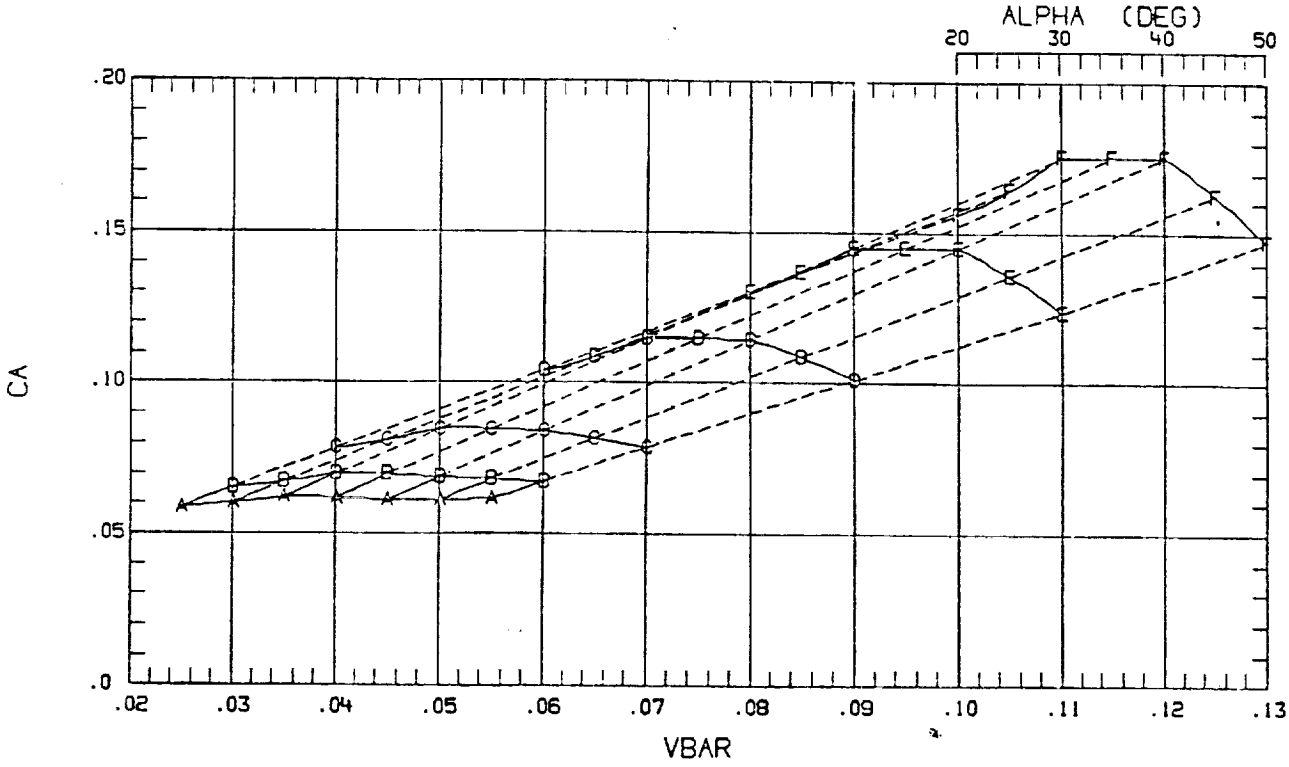
FIGURE 4.1.1.2 -4
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005	0.010	0.020	0.040	0.060	0.080
	A	B	C	D	E	F
ALPHA (DEG)	VISCOUS AXIAL FORCE COEFFICIENT					
20.000	0.05850	0.06500	0.07800	0.10400	0.13000	0.15600
25.000	0.06000	0.06690	0.08080	0.10850	0.13630	0.16400
30.000	0.06170	0.06930	0.08440	0.11460	0.14480	0.17500
35.000	0.06160	0.06930	0.08440	0.11460	0.14480	0.17500
40.000	0.06080	0.06840	0.08360	0.11410	0.14450	0.17500
45.000	0.06100	0.06780	0.08130	0.10840	0.13540	0.16250
50.000	0.06130	0.06690	0.07830	0.10100	0.12360	0.14700

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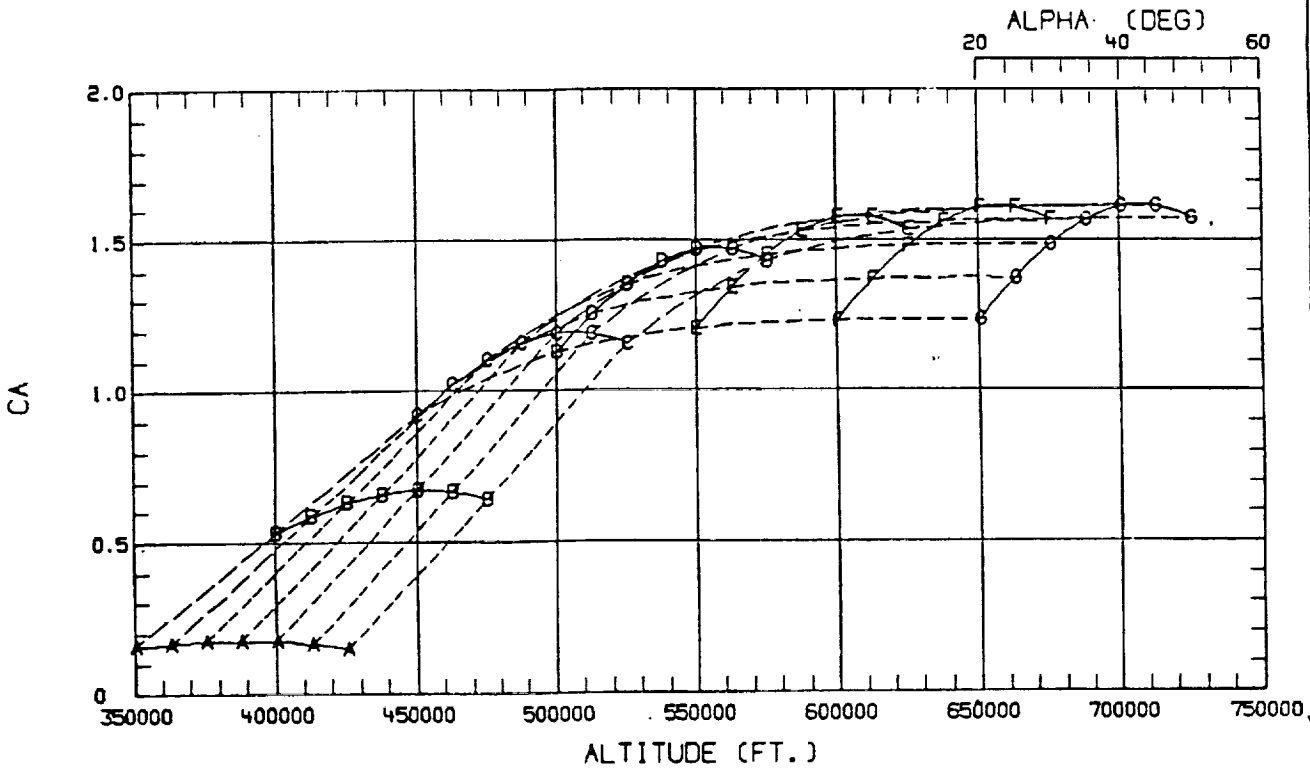
FIGURE 4.1.1.2-5
BASIC AXIAL FORCE COEFFICIENT

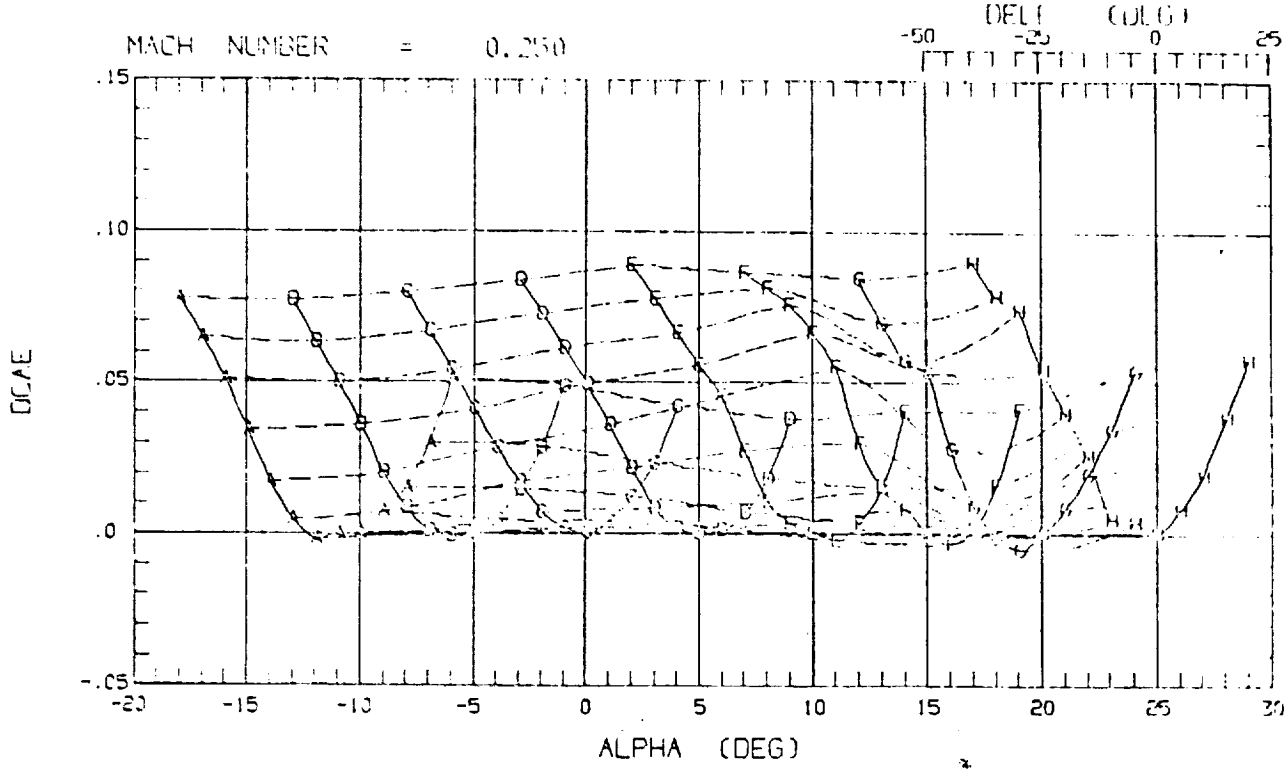


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE AXIAL FORCE						
20.000	0.15600	0.52910	0.91800	1.12600	1.20470	1.22960	1.23350
25.000	0.16400	0.58230	1.01830	1.25150	1.33980	1.36770	1.37200
30.000	0.17500	0.62780	1.09990	1.35230	1.44780	1.47810	1.48270
35.000	0.17500	0.65570	1.15690	1.42490	1.52630	1.55840	1.56340
40.000	0.17500	0.67170	1.18950	1.46650	1.57120	1.60440	1.60950
45.000	0.16250	0.66380	1.18640	1.46600	1.57170	1.60520	1.61040
50.000	0.14700	0.63930	1.15250	1.42700	1.53080	1.56370	1.56880

ENGINEER NASA
DATE

FIGURE 4.1.1.2-6
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.07752	0.07697	0.07960	0.08361	0.08835	0.08598	0.08381	0.08947
-35.000	0.06460	0.06320	0.06700	0.07258	0.07751	0.08083	0.06949	0.07835
-30.000	0.05126	0.05009	0.05400	0.06127	0.06610	0.07541	0.05696	0.07373
-25.000	0.03426	0.03589	0.04100	0.04936	0.05567	0.06625	0.05295	0.05393
-20.000	0.01710	0.01997	0.02800	0.03575	0.04536	0.05495	0.02752	0.03976
-15.000	0.00461	0.00916	0.01700	0.02164	0.02724	0.02959	0.00911	0.02568
-10.000	-0.00197	0.00090	0.00700	0.00629	0.01057	0.01395	-0.00066	0.00507
-5.000	-0.00033	-0.00057	0.00200	0.00157	0.00323	0.00798	-0.00555	0.00333
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00731	0.00412	0.00400	0.00130	-0.00248	-0.00346	0.00823	0.00791
10.000	0.01488	0.01448	0.01200	0.00688	0.00350	0.00164	0.01942	0.01917
15.000	0.02962	0.02839	0.02300	0.01787	0.01527	0.01576	0.03446	0.03644
20.000	0.05095	0.04824	0.04200	0.03757	0.04031	0.04069	0.05373	0.05768

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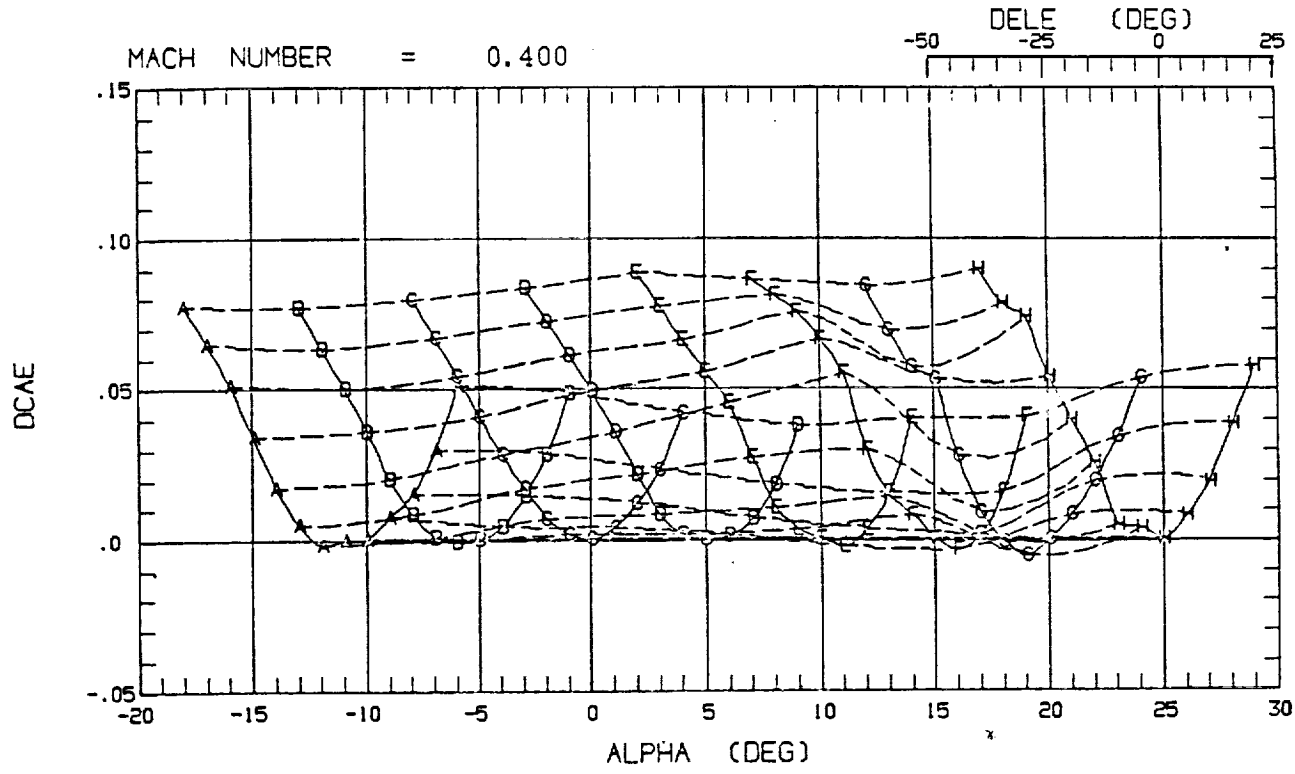
DATE 10-4-78

FIGURE 4.1.1.2-7
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.07752	0.07697	0.07960	0.08361	0.08835	0.08598	0.08381	0.08947
-35.000	0.06460	0.06320	0.06700	0.07258	0.07751	0.08083	0.06949	0.07835
-30.000	0.05126	0.05009	0.05400	0.06127	0.06610	0.07541	0.05696	0.07373
-25.000	0.03426	0.03589	0.04100	0.04936	0.05567	0.06625	0.05295	0.05393
-20.000	0.01710	0.01997	0.02800	0.03575	0.04536	0.05495	0.02752	0.03976
-15.000	0.00461	0.00816	0.01700	0.02164	0.02724	0.02959	0.00911	0.02568
-10.000	-0.00197	0.00080	0.00700	0.00829	0.01057	0.01395	-0.00066	0.00507
-5.000	-0.00033	-0.00057	0.00200	0.00157	0.00323	0.00798	-0.00555	0.00393
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00731	0.00412	0.00400	0.00130	-0.00248	-0.00346	0.00823	0.00791
10.000	0.01488	0.01448	0.01200	0.00688	0.00350	0.00164	0.01942	0.01917
15.000	0.02962	0.02839	0.02300	0.01787	0.01527	0.01576	0.03446	0.03844
20.000	0.05095	0.04824	0.04200	0.03757	0.04031	0.04069	0.05373	0.05768

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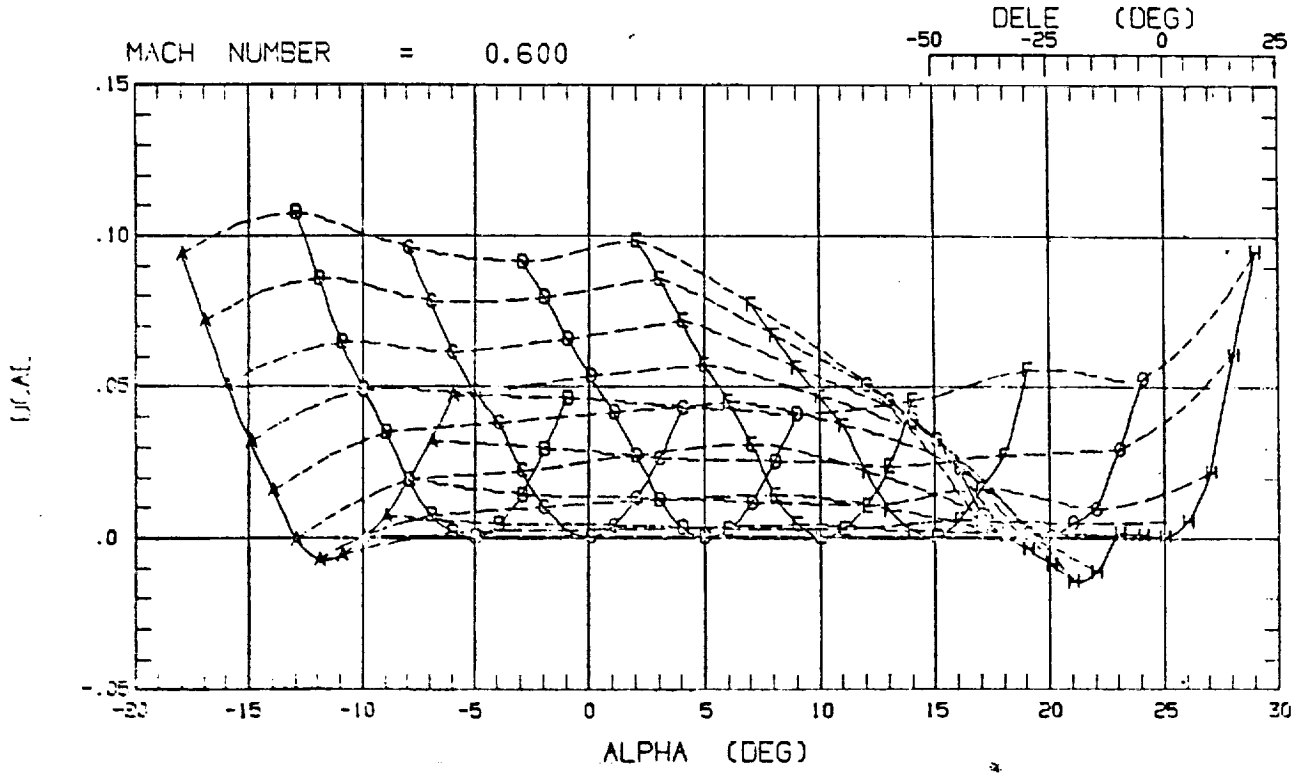
FIGURE 4.1.1.2-8
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.09355	0.10724	0.09560	0.09127	0.09808	0.07674	0.05061	0.00333
-35.000	0.07159	0.08656	0.07800	0.07949	0.08563	0.06680	0.04565	0.00072
-30.000	0.05076	0.06461	0.06100	0.06593	0.07161	0.05618	0.03907	-0.00399
-25.000	0.03169	0.04889	0.04800	0.05343	0.05704	0.04633	0.03215	-0.00865
-20.000	0.01540	0.03475	0.03800	0.04140	0.04468	0.03687	0.02274	-0.01443
-15.000	-0.00023	0.01892	0.02200	0.02732	0.03095	0.02162	0.00734	-0.01125
-10.000	-0.00727	0.00735	0.01000	0.01266	0.01417	0.00909	0.00108	0.00104
-5.000	-0.00584	0.00160	0.00250	0.00321	0.00422	0.00204	0.00122	0.00094
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00673	0.00430	0.00400	0.00285	0.00303	0.00561	0.00459	0.00558
10.000	0.01906	0.01387	0.01300	0.01160	0.01057	0.01620	0.00960	0.02161
15.000	0.03185	0.02925	0.02600	0.02534	0.02345	0.02730	0.02931	0.06065
20.000	0.04682	0.04501	0.04300	0.04070	0.04541	0.05574	0.05279	0.09489

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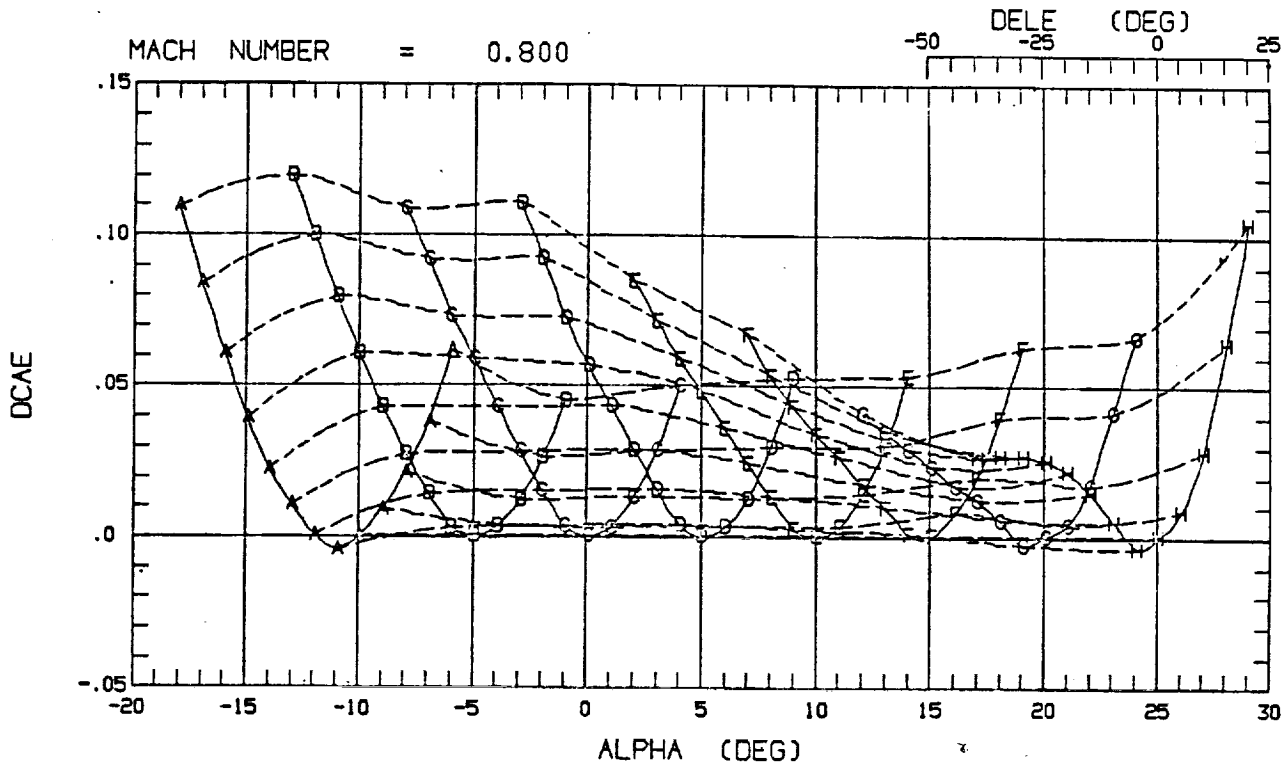
FIGURE 4.1.1.2-9
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.10920	0.11966	0.10850	0.11017	0.08464	0.06655	0.04064	0.02615
-35.000	0.08417	0.09951	0.09150	0.09191	0.07138	0.05320	0.03454	0.02681
-30.000	0.06078	0.07933	0.07300	0.07221	0.05864	0.04313	0.02891	0.02663
-25.000	0.03949	0.06063	0.05850	0.05638	0.04778	0.03360	0.02328	0.02517
-20.000	0.02195	0.04290	0.04300	0.04319	0.03559	0.02601	0.01649	0.02161
-15.000	0.01016	0.02740	0.02800	0.02892	0.02393	0.01678	0.01197	0.01463
-10.000	0.00040	0.01420	0.01500	0.01525	0.01290	0.00957	0.00536	0.00506
-5.000	-0.00418	0.00289	0.00350	0.00382	0.00239	0.00075	-0.00301	-0.00374
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00872	0.00330	0.00300	0.00333	0.00343	0.00762	0.00399	0.00827
10.000	0.02105	0.01170	0.01300	0.01245	0.01416	0.01942	0.01717	0.02810
15.000	0.03774	0.02610	0.02850	0.02948	0.03004	0.03919	0.04135	0.06421
20.000	0.06171	0.04495	0.05000	0.05244	0.05322	0.06245	0.06642	0.10421

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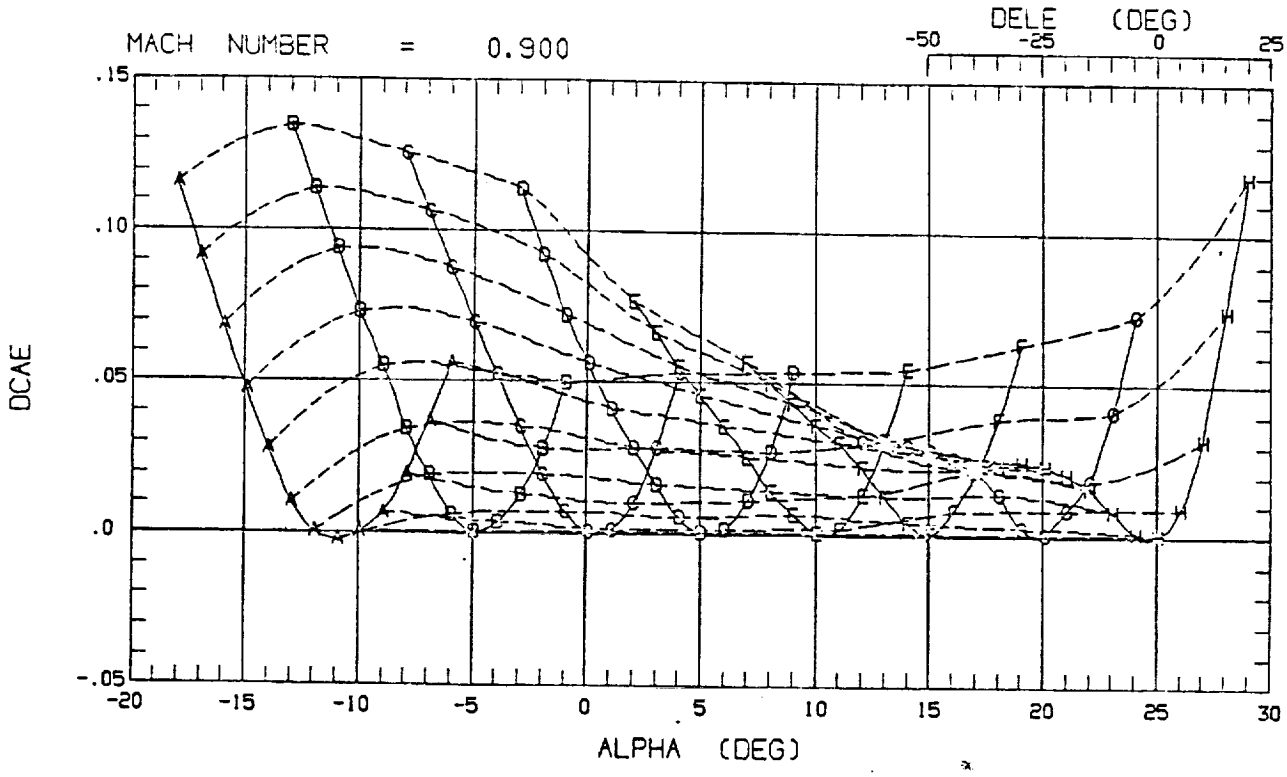
DATE 10-4-78

FIGURE 4.1.1.2-10
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.11562	0.13437	0.12500	0.11356	0.07616	0.05639	0.03051	0.02099
-35.000	0.09135	0.11335	0.10600	0.09152	0.06615	0.04967	0.03058	0.02310
-30.000	0.06823	0.09367	0.08700	0.07195	0.05483	0.04296	0.02907	0.02391
-25.000	0.04728	0.07305	0.06950	0.05616	0.04533	0.03555	0.02748	0.02303
-20.000	0.02774	0.05509	0.05200	0.04084	0.03547	0.03006	0.02499	0.02016
-15.000	0.00979	0.03442	0.03500	0.02817	0.02536	0.02209	0.02100	0.01560
-10.000	0.00007	0.01899	0.01900	0.01588	0.01403	0.01231	0.01335	0.00809
-5.000	-0.00244	0.00602	0.00700	0.00512	0.00645	0.00356	0.00244	0.00058
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00639	0.00329	0.00100	0.00136	0.00187	0.00769	0.00856	0.00890
10.000	0.01914	0.01229	0.00970	0.01103	0.01283	0.02091	0.01790	0.03160
15.000	0.03677	0.02748	0.02800	0.02695	0.03115	0.03822	0.04086	0.07444
20.000	0.05633	0.04956	0.05300	0.05349	0.05473	0.06304	0.07262	0.11885

ENGINEER DCO
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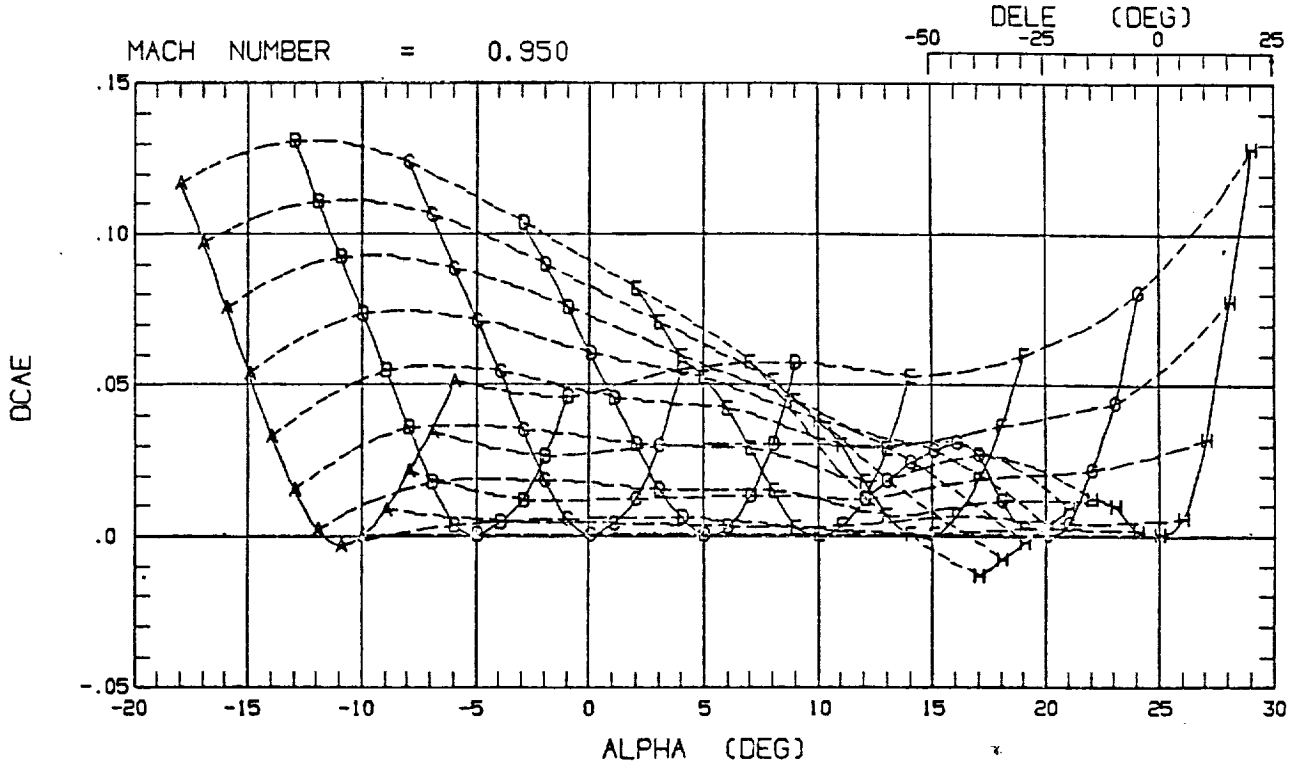
FIGURE 4.1.1.2-11
EFFECT OF ELEVON

SD72-SH-0[illegible] C IM



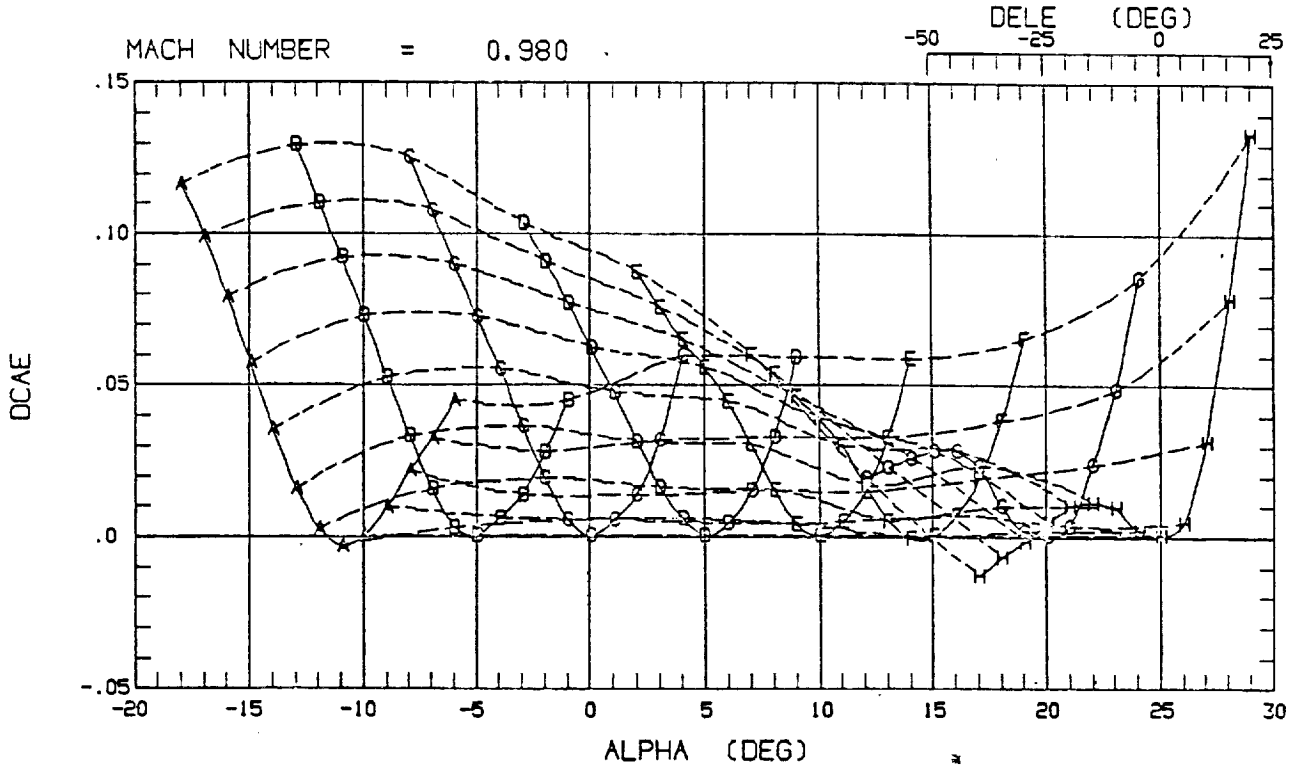
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.11633	0.13052	0.12350	0.10315	0.08155	0.05717	0.01180	-0.01357
-35.000	0.09661	0.11062	0.10600	0.08945	0.07029	0.05111	0.01824	-0.00787
-30.000	0.07533	0.09209	0.08800	0.07530	0.05908	0.04440	0.02399	-0.00252
-25.000	0.05355	0.07320	0.07100	0.06005	0.05193	0.03788	0.02804	0.00297
-20.000	0.03290	0.05459	0.05400	0.04545	0.04174	0.02984	0.03059	0.00874
-15.000	0.01480	0.03569	0.03500	0.03000	0.02859	0.01774	0.02643	0.01179
-10.000	0.00188	0.01751	0.01800	0.01510	0.01450	0.00612	0.01145	0.00933
-5.000	-0.00314	0.00353	0.00550	0.00567	0.00251	0.00026	0.00215	0.00110
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00822	0.00453	0.00400	0.00289	0.00308	0.00622	0.00381	0.00537
10.000	0.02089	0.01153	0.01200	0.01309	0.01202	0.01849	0.02173	0.03169
15.000	0.03433	0.02631	0.02950	0.03020	0.02883	0.03614	0.04394	0.07749
20.000	0.05114	0.04595	0.05500	0.05710	0.05270	0.05978	0.08041	0.12804

ENGINEER DCO
DATE 10-4-28

FIGURE 4.1.1.2-12
EFFECT OF ELEVON



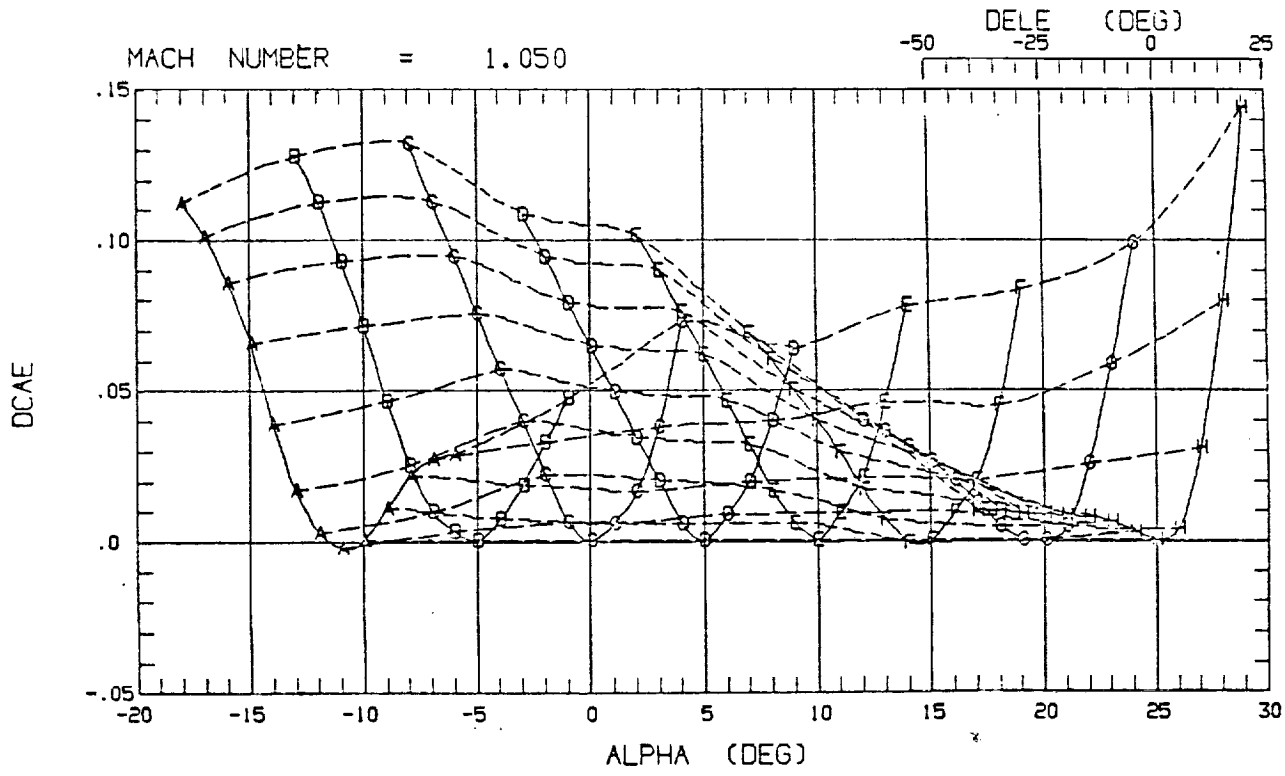
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.11608	0.12903	0.12514	0.10324	0.08688	0.05967	0.01881	-0.01295
-35.000	0.09890	0.11013	0.10748	0.09045	0.07558	0.05332	0.02264	-0.00685
-30.000	0.07908	0.09189	0.08950	0.07702	0.06450	0.04586	0.02581	-0.00164
-25.000	0.05732	0.07267	0.07223	0.06221	0.05567	0.03858	0.02836	0.00429
-20.000	0.03522	0.05245	0.05509	0.04733	0.04437	0.02969	0.02795	0.00990
-15.000	0.01571	0.03312	0.03615	0.03135	0.02999	0.01652	0.02289	0.01111
-10.000	0.00243	0.01569	0.01882	0.01602	0.01493	0.00502	0.00965	0.00919
-5.000	-0.00315	0.00294	0.00536	0.00592	0.00357	-0.00062	0.00154	0.00159
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00914	0.00606	0.00511	0.00437	0.00478	0.00684	0.00308	0.00449
10.000	0.02132	0.01346	0.01337	0.01475	0.01433	0.01879	0.02340	0.03142
15.000	0.03231	0.02789	0.03170	0.03281	0.03282	0.03810	0.04837	0.07849
20.000	0.04490	0.04498	0.05948	0.05923	0.05842	0.06510	0.08572	0.13301

ENGINEER DCO
DATE 10-7-78

FIGURE 4.1.1.2-13
EFFECT OF ELEVON



CONFIGURATION

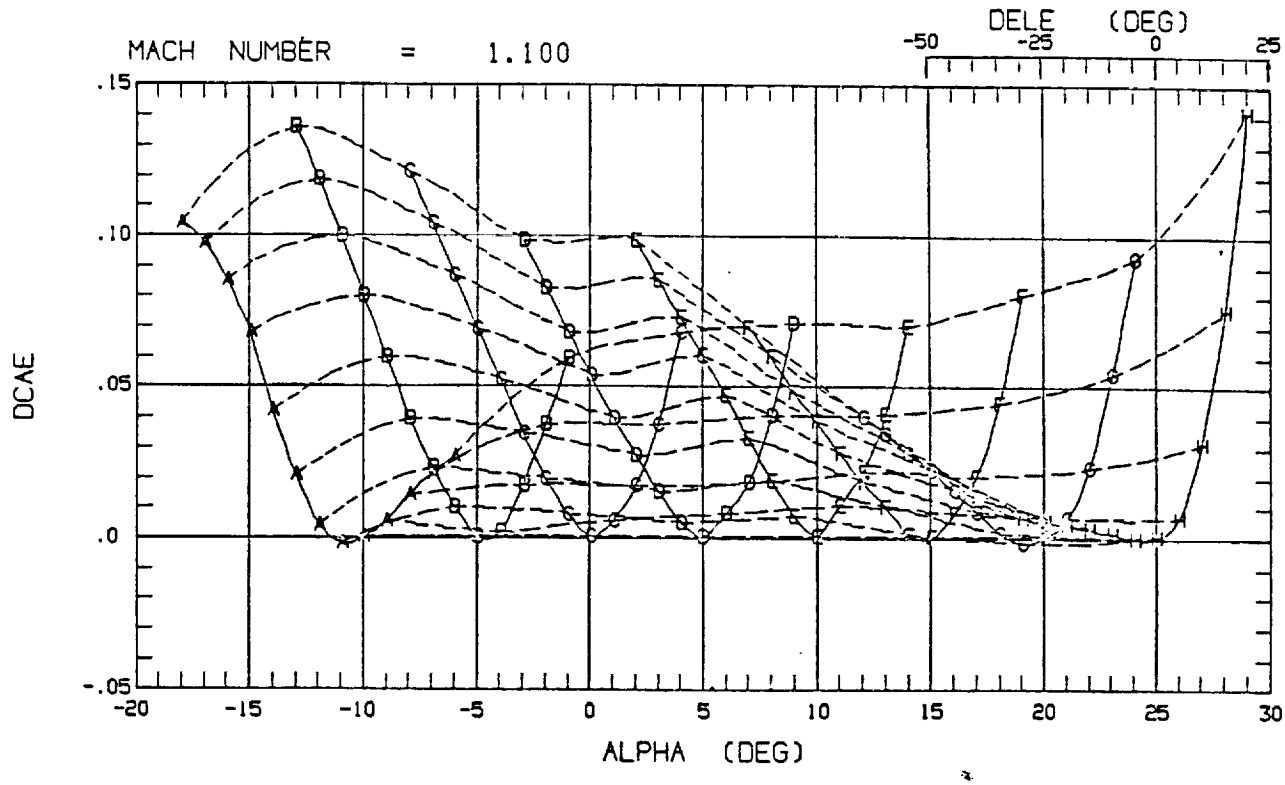
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.11175	0.12779	0.13150	0.10838	0.10139	0.06886	0.03978	0.00985
-35.000	0.10092	0.11241	0.11250	0.09417	0.08957	0.06037	0.03627	0.01003
-30.000	0.08551	0.09277	0.09400	0.07886	0.07568	0.04992	0.03104	0.00695
-25.000	0.06576	0.07134	0.07550	0.06492	0.06177	0.03966	0.02619	0.00880
-20.000	0.03902	0.04641	0.05700	0.04930	0.04660	0.02939	0.02007	0.00829
-15.000	0.01686	0.02528	0.04000	0.03425	0.03169	0.01688	0.01258	0.00791
-10.000	0.00287	0.00984	0.02200	0.02003	0.01655	0.00701	0.00492	0.00634
-5.000	-0.00240	0.00309	0.00630	0.00567	0.00598	-0.00058	0.00033	0.00288
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01079	0.00722	0.00600	0.00872	0.00951	0.00952	0.00458	0.00401
10.000	0.02176	0.01852	0.01650	0.01968	0.02093	0.02015	0.02540	0.03048
15.000	0.02712	0.03287	0.03800	0.03978	0.04597	0.04483	0.05859	0.07952
20.000	0.02853	0.04733	0.07300	0.06393	0.07784	0.08325	0.09884	0.14411

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-14
EFFECT OF ELEVON

SV 72-81 0060 IM



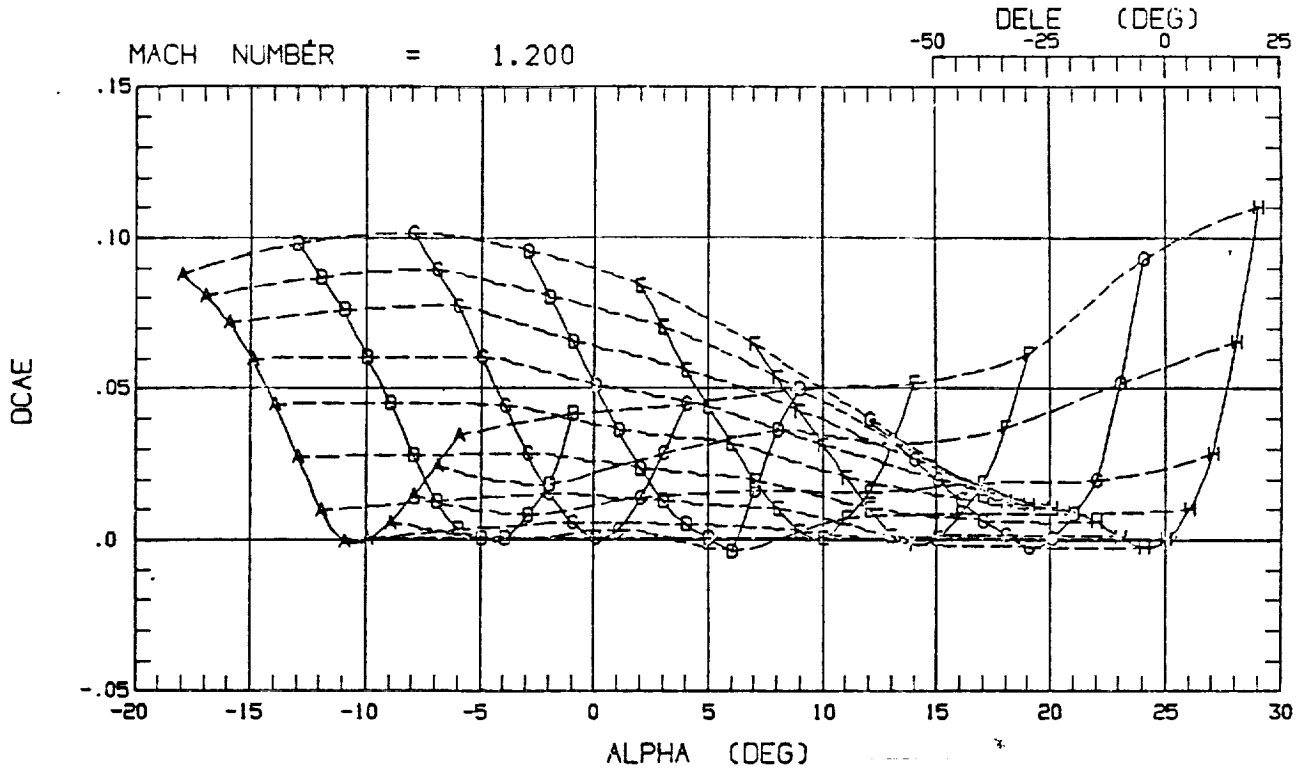
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.10382	0.13586	0.12100	0.09837	0.09803	0.06940	0.03986	0.01211
-35.000	0.09732	0.11869	0.10400	0.08274	0.08523	0.05965	0.03426	0.00867
-30.000	0.08503	0.09992	0.08630	0.06770	0.07275	0.04809	0.02772	0.00614
-25.000	0.06760	0.07969	0.06900	0.05372	0.06004	0.03808	0.02213	0.00509
-20.000	0.04180	0.05981	0.05200	0.03936	0.04675	0.02749	0.01529	0.00419
-15.000	0.02031	0.03920	0.03450	0.02701	0.03271	0.01809	0.00846	0.00281
-10.000	0.00399	0.02304	0.01900	0.01520	0.01858	0.00981	0.00142	0.00118
-5.000	-0.00200	0.01015	0.00750	0.00497	0.00671	0.00083	-0.00172	-0.00047
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00546	0.00172	0.00550	0.00798	0.01055	0.00798	0.00630	0.00630
10.000	0.01412	0.01723	0.01700	0.01782	0.02151	0.02014	0.02286	0.03099
15.000	0.02123	0.03742	0.03750	0.04031	0.04076	0.04457	0.05384	0.07550
20.000	0.02668	0.05927	0.06800	0.07086	0.07002	0.08022	0.09251	0.14124

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-15
EFFECT OF ELEVON



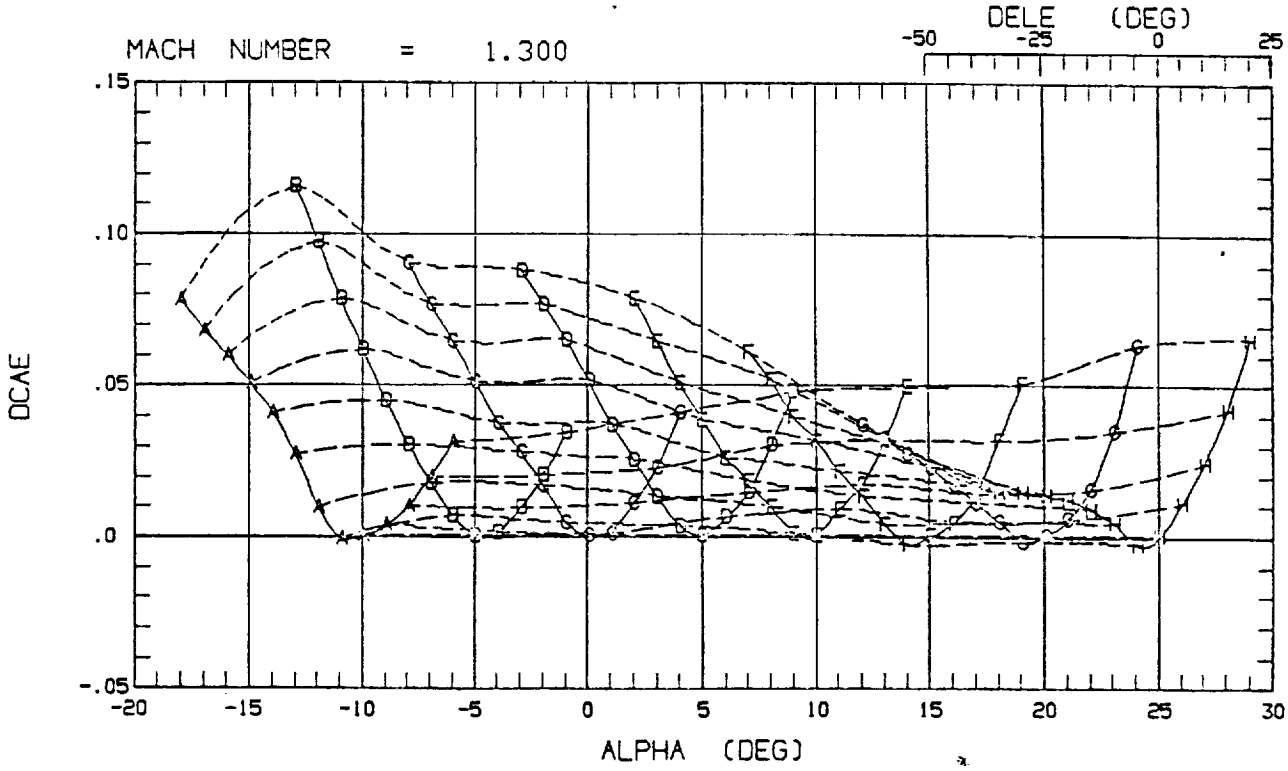
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.08780	0.09795	0.10150	0.09523	0.08358	0.06401	0.03929	0.01441
-35.000	0.08026	0.08680	0.08900	0.07984	0.06977	0.05313	0.03235	0.01227
-30.000	0.07165	0.07581	0.07700	0.06527	0.05576	0.04209	0.02593	0.01128
-25.000	0.05986	0.06011	0.06000	0.05070	0.04336	0.03079	0.01944	0.01035
-20.000	0.04466	0.04511	0.04400	0.03570	0.03126	0.02019	0.01294	0.00902
-15.000	0.02713	0.02781	0.02800	0.02325	0.01927	0.01005	0.00601	0.00601
-10.000	0.00957	0.01259	0.01500	0.01226	0.00989	0.00080	0.00148	0.00091
-5.000	-0.00057	0.00306	0.00550	0.00458	0.00243	-0.00169	-0.00255	-0.00282
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00553	0.00002	0.00300	-0.00418	0.00702	0.00831	0.00844	0.00998
10.000	0.01429	0.00772	0.01350	0.01575	0.01560	0.01856	0.01952	0.02803
15.000	0.02414	0.01800	0.02800	0.03560	0.03113	0.03659	0.05156	0.06534
20.000	0.03446	0.04115	0.04450	0.04963	0.05136	0.06132	0.09239	0.10981

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-16
EFFECT OF ELEVON



CONFIGURATION

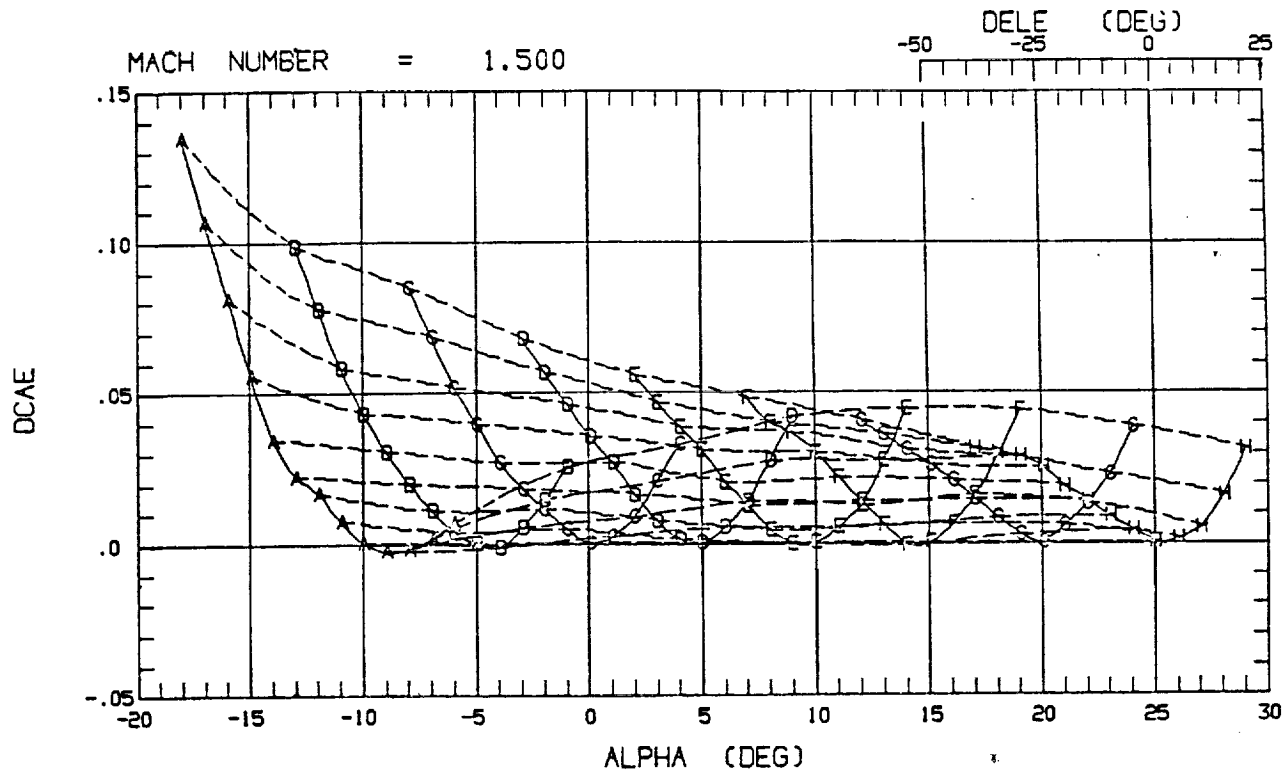
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.07811	0.11546	0.09000	0.08774	0.07846	0.06046	0.03666	0.01587
-35.000	0.06799	0.09698	0.07650	0.07627	0.06416	0.05165	0.03199	0.01454
-30.000	0.05955	0.07827	0.06400	0.06456	0.05049	0.03948	0.02734	0.01436
-25.000	0.05050	0.06148	0.05100	0.05131	0.03827	0.03147	0.02237	0.01337
-20.000	0.04072	0.04496	0.03750	0.03701	0.02573	0.02121	0.01684	0.01199
-15.000	0.02707	0.03045	0.02750	0.02529	0.01794	0.01303	0.01110	0.00894
-10.000	0.00924	0.01767	0.01650	0.01301	0.00926	0.00378	0.00481	0.00420
-5.000	-0.00069	0.00665	0.00450	0.00331	0.00069	-0.00302	-0.00167	-0.00294
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00370	0.00115	0.00100	0.00628	0.00885	0.00452	0.00566	0.01095
10.000	0.00992	0.00914	0.01100	0.01451	0.01679	0.01389	0.01567	0.02419
15.000	0.01961	0.01995	0.02250	0.02999	0.03179	0.03148	0.03467	0.04202
20.000	0.03099	0.03437	0.04100	0.04776	0.04939	0.05026	0.06301	0.06525

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-17
EFFECT OF ELEVON

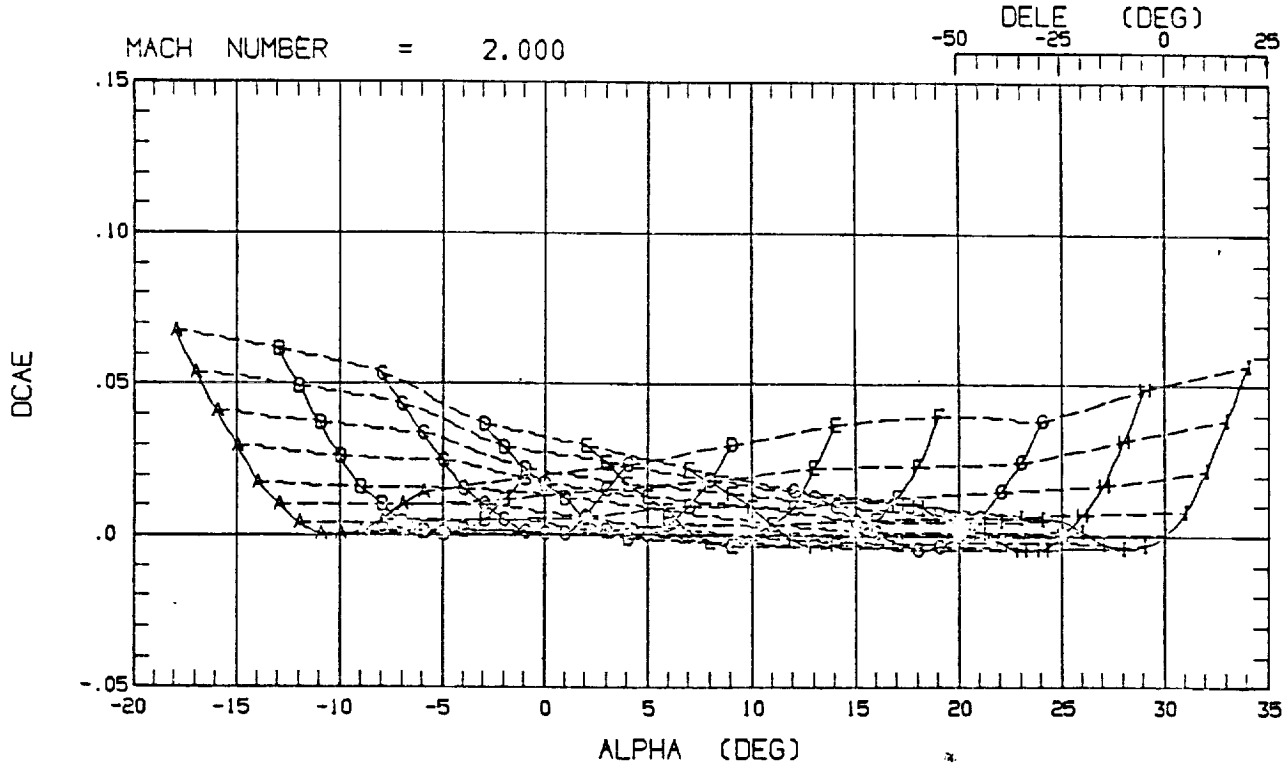


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.13433	0.09823	0.08467	0.06758	0.05549	0.04815	0.04014	0.03121
-35.000	0.10613	0.07731	0.06803	0.05644	0.04669	0.03982	0.03568	0.02983
-30.000	0.08115	0.05822	0.05140	0.04577	0.03852	0.03647	0.03061	0.02857
-25.000	0.05566	0.04313	0.03948	0.03534	0.03075	0.02962	0.02578	0.02518
-20.000	0.03432	0.03018	0.02660	0.02655	0.02014	0.02144	0.02064	0.01877
-15.000	0.02210	0.01968	0.01814	0.01619	0.01263	0.01375	0.01448	0.01413
-10.000	0.01669	0.01069	0.01123	0.00740	0.00448	0.00577	0.00838	0.00864
-5.000	0.00718	0.00370	0.00470	0.00111	-0.00017	-0.00076	0.00291	0.00434
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00246	-0.00108	0.00249	0.00549	0.00544	0.00645	0.00586	0.00118
10.000	-0.00164	0.00513	0.00913	0.01415	0.01264	0.01576	0.01308	0.00498
15.000	0.00191	0.01466	0.02046	0.02731	0.02700	0.02857	0.02272	0.01548
20.000	0.00693	0.02538	0.03274	0.04179	0.04467	0.04386	0.03830	0.03092

ENGINEER DCO
DATE 10-7-78

FIGURE 4.1.1.2-18
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

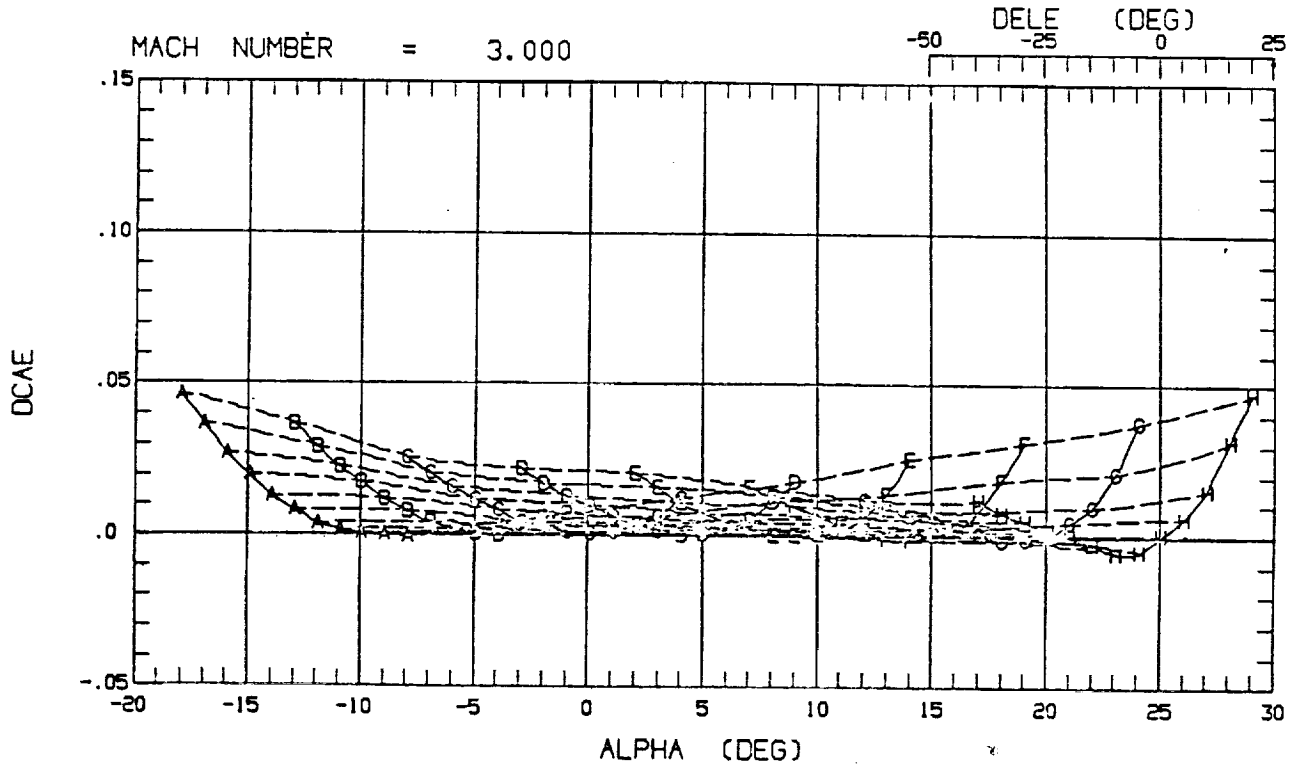
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

REFERENCE DIMENSIONS

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT								
-40.000	0.06742	0.06107	0.05310	0.03605	0.02918	0.02157	0.01430	0.01048	0.00487
-35.000	0.05361	0.04875	0.04300	0.02870	0.02371	0.01764	0.01268	0.00933	0.00570
-30.000	0.04068	0.03659	0.03300	0.02153	0.01673	0.01363	0.00926	0.00641	0.00553
-25.000	0.02925	0.02542	0.02400	0.01667	0.01221	0.00892	0.00447	0.00417	0.00486
-20.000	0.01719	0.01550	0.01500	0.01208	0.00770	0.00311	0.00062	0.00070	0.00132
-15.000	0.00998	0.01001	0.01000	0.00512	0.00115	-0.00200	-0.00263	-0.00243	-0.00271
-10.000	0.00356	0.00387	0.00500	0.00106	-0.00244	-0.00395	-0.00494	-0.00469	-0.00415
-5.000	0.00026	0.00090	0.00100	-0.00125	-0.00359	-0.00352	-0.00384	-0.00466	-0.00349
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00123	0.00133	0.0	0.00333	0.00342	0.00493	0.00563	0.00702	0.00805
10.000	0.00480	0.00476	0.00600	0.00955	0.00910	0.01231	0.01442	0.01639	0.02153
15.000	0.00985	0.01149	0.01500	0.01777	0.02191	0.02278	0.02407	0.03120	0.03848
20.000	0.01374	0.01875	0.02300	0.02971	0.03610	0.03949	0.03790	0.04837	0.05652

ENGINEER DCo
DATE 10-4-28

FIGURE 4.1.1.2-19
EFFECT OF ELEVON



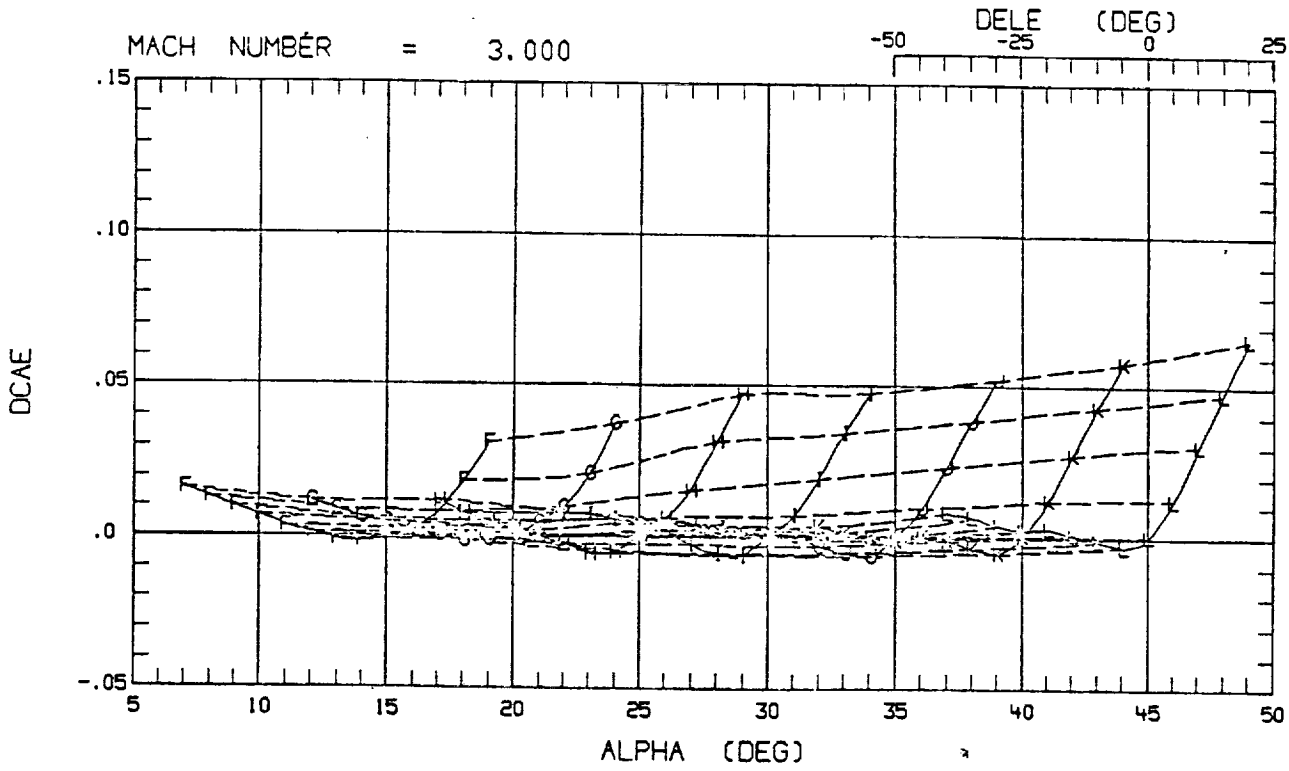
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04594	0.03652	0.02500	0.02143	0.02027	0.01567	0.01124	0.01133
-35.000	0.03632	0.02889	0.02000	0.01675	0.01546	0.01263	0.00856	0.00750
-30.000	0.02663	0.02205	0.01550	0.01265	0.01030	0.00934	0.00591	0.00457
-25.000	0.01931	0.01677	0.01150	0.00964	0.00695	0.00630	0.00420	0.00165
-20.000	0.01241	0.01158	0.00800	0.00604	0.00411	0.00300	0.00181	-0.00038
-15.000	0.00782	0.00747	0.00400	0.00318	0.00173	0.00074	0.00001	-0.00279
-10.000	0.00349	0.00362	0.00300	0.00148	-0.00047	-0.00133	-0.00187	-0.00563
-5.000	0.00143	0.00177	0.00100	-0.00012	-0.00006	-0.00172	-0.00119	-0.00532
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00011	-0.00021	0.00100	0.00162	0.00151	0.00191	0.00427	0.00599
10.000	-0.00065	0.00174	0.00300	0.00506	0.00585	0.00795	0.00964	0.01512
15.000	0.00106	0.00517	0.00600	0.01081	0.01339	0.01823	0.02066	0.03132
20.000	0.00208	0.00677	0.01200	0.01738	0.02503	0.03070	0.03731	0.04685

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-20
EFFECT OF ELEVON

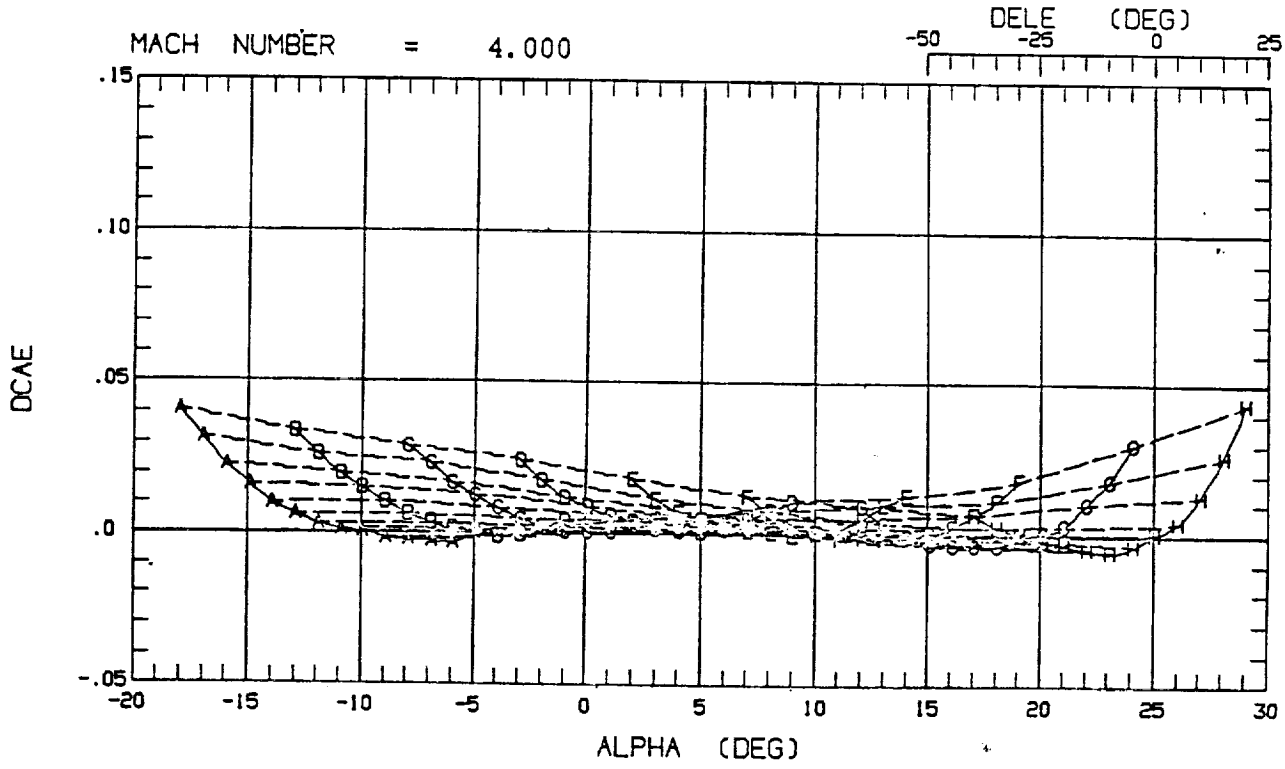


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.01567	0.01124	0.01133	0.00731	0.00391	0.00323	0.00788
-35.000	0.01263	0.00856	0.00750	0.00702	0.00288	0.00149	0.00624
-30.000	0.00934	0.00591	0.00457	0.00535	0.00116	-0.00026	0.00371
-25.000	0.00630	0.00420	0.00165	0.00402	0.00006	-0.00146	0.00241
-20.000	0.00300	0.00181	-0.00038	0.00175	0.00030	0.00040	0.00284
-15.000	0.00074	0.00001	-0.00279	-0.00302	-0.00315	-0.00103	0.00097
-10.000	-0.00133	-0.00187	-0.00563	-0.00605	-0.00554	-0.00379	-0.00141
-5.000	-0.00172	-0.00119	-0.00532	-0.00649	-0.00626	-0.00516	-0.00332
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00191	0.00427	0.00599	0.00682	0.00926	0.01186	0.01208
10.000	0.00795	0.00964	0.01512	0.01884	0.02299	0.02732	0.03035
15.000	0.01823	0.02066	0.03132	0.03423	0.03835	0.04289	0.04740
20.000	0.03070	0.03731	0.04685	0.04740	0.05224	0.05774	0.06573

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-21
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

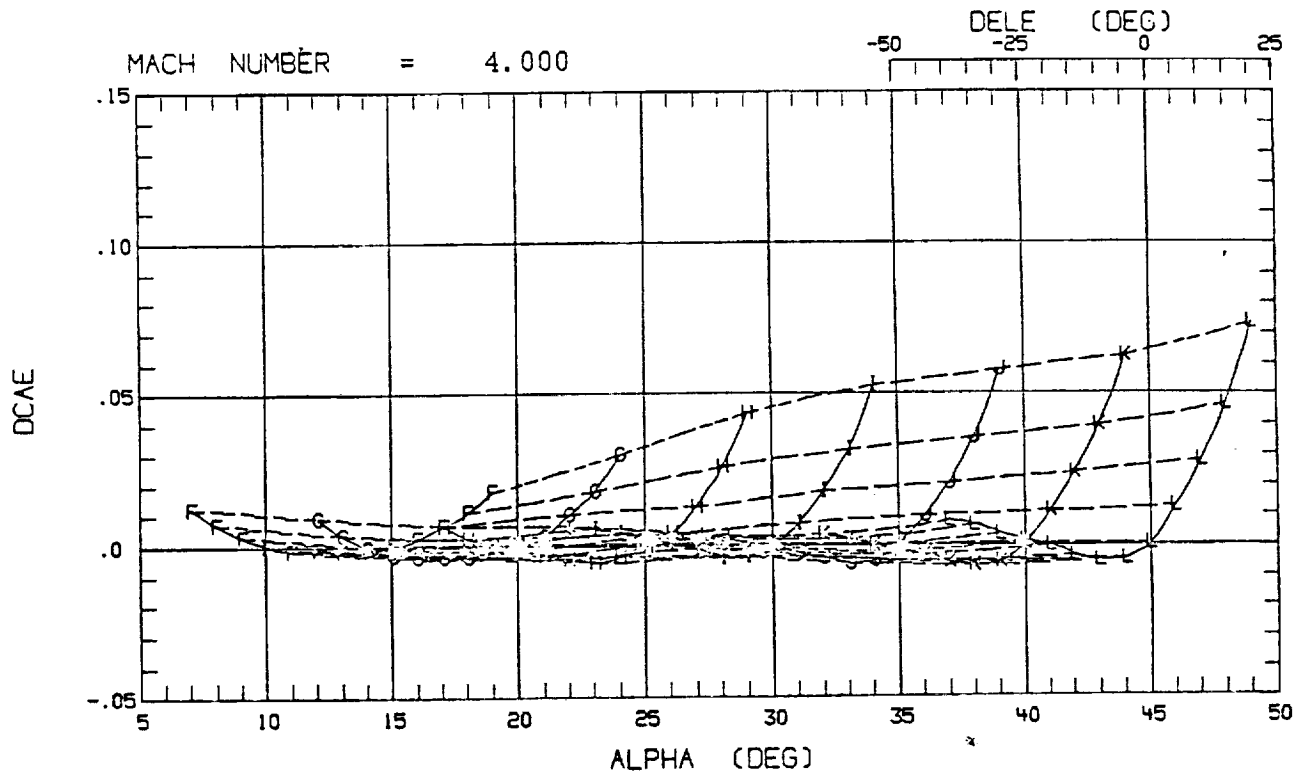
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04019	0.03349	0.02840	0.02377	0.01741	0.01216	0.00880	0.00651
-35.000	0.03103	0.02563	0.02270	0.01687	0.01101	0.00675	0.00317	0.00246
-30.000	0.02223	0.01926	0.01600	0.01146	0.00709	0.00278	-0.00056	0.00017
-25.000	0.01571	0.01440	0.01200	0.00844	0.00425	-0.00003	-0.00324	-0.00161
-20.000	0.00938	0.01002	0.00800	0.00552	0.00255	-0.00177	-0.00401	-0.00339
-15.000	0.00577	0.00580	0.00450	0.00392	0.00101	-0.00140	-0.00405	-0.00478
-10.000	0.00269	0.00298	0.00200	0.00122	0.00014	-0.00172	-0.00376	-0.00590
-5.000	0.00096	0.00103	0.00050	0.00061	-0.00058	-0.00134	-0.00205	-0.00405
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00176	-0.00138	0.0	0.00112	0.00136	0.00217	0.00273	0.00375
10.000	-0.00242	-0.00077	0.00200	0.00435	0.00504	0.00640	0.01004	0.01249
15.000	-0.00301	0.00174	0.00500	0.00741	0.00938	0.01072	0.01771	0.02546
20.000	-0.00319	0.00376	0.00400	0.01049	0.01250	0.01775	0.02984	0.04353

ENGINEER D Co
DATE 10-4-78

FIGURE 4.1.1.2-22
EFFECT OF ELEVON



CONFIGURATION

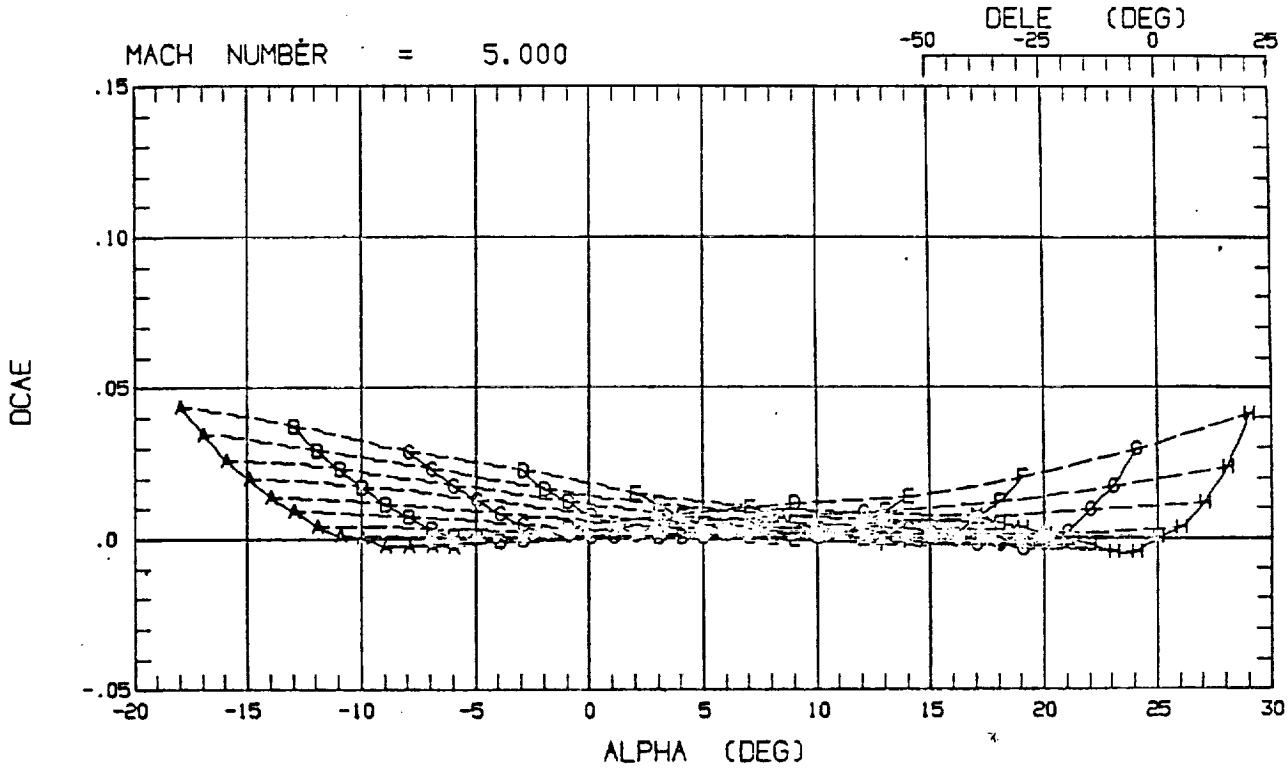
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.01216	0.00880	0.00651	0.00599	0.00325	0.00313	0.00764
-35.000	0.00675	0.00317	0.00246	0.00539	0.00222	0.00189	0.00630
-30.000	0.00278	-0.00056	0.00017	0.00395	0.00046	-0.00031	0.00349
-25.000	-0.00003	-0.00324	-0.00161	0.00238	-0.00134	-0.00239	0.00117
-20.000	-0.00177	-0.00401	-0.00339	0.00037	-0.00265	-0.00327	-0.00047
-15.000	-0.00140	-0.00405	-0.00478	-0.00129	-0.00450	-0.00567	-0.00356
-10.000	-0.00172	-0.00376	-0.00590	-0.00415	-0.00622	-0.00701	-0.00519
-5.000	-0.00134	-0.00205	-0.00405	-0.00376	-0.00510	-0.00567	-0.00468
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00217	0.00273	0.00375	0.00695	0.00936	0.01077	0.01220
10.000	0.00640	0.01004	0.01249	0.01726	0.02030	0.02344	0.02782
15.000	0.01072	0.01771	0.02546	0.03109	0.03532	0.03954	0.04622
20.000	0.01775	0.02984	0.04353	0.05229	0.05742	0.06243	0.07330

ENGINEER DCO
DATE 12-4-78

FIGURE 4.1.1.2-23
EFFECT OF ELEVON

SL 72-SH-0000 IM



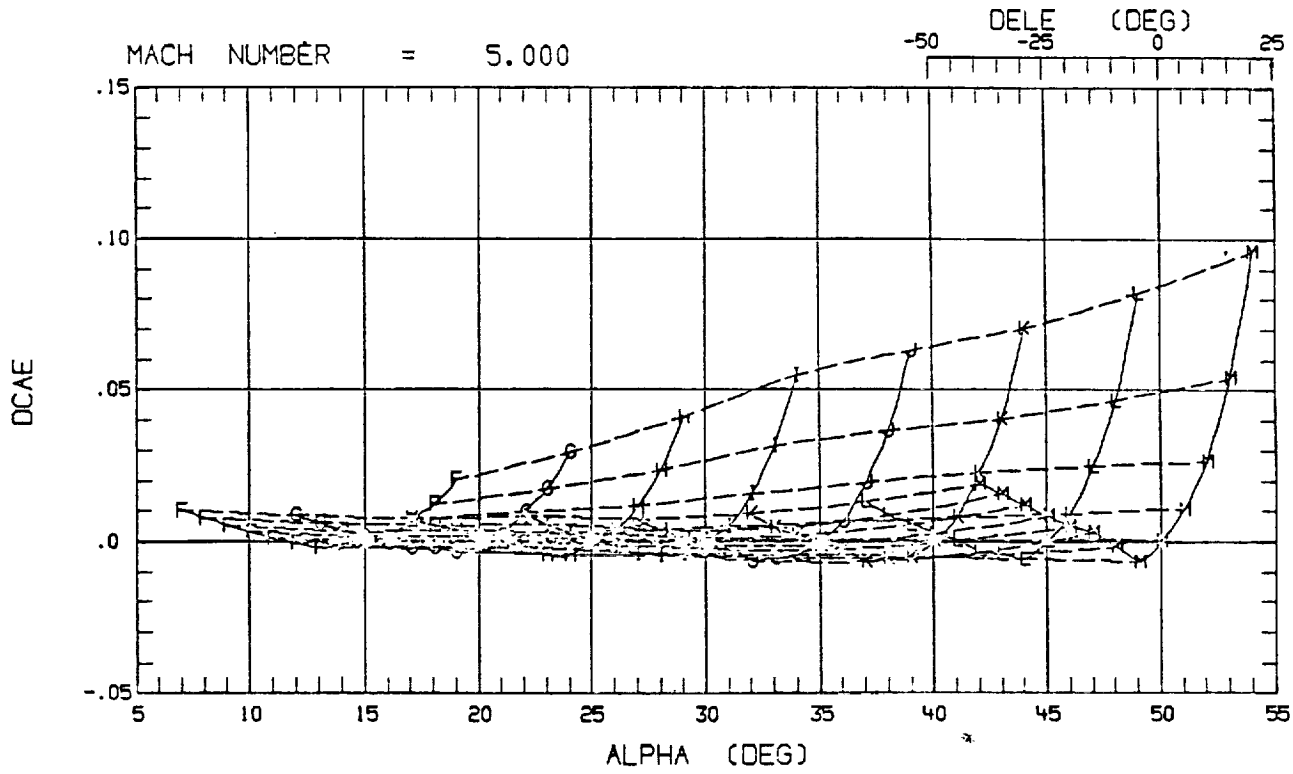
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04347	0.03677	0.02830	0.02219	0.01462	0.00997	0.00816	0.00720
-35.000	0.03447	0.02863	0.02270	0.01576	0.01093	0.00739	0.00560	0.00494
-30.000	0.02573	0.02248	0.01710	0.01173	0.00671	0.00480	0.00304	0.00319
-25.000	0.01949	0.01674	0.01250	0.00751	0.00442	0.00271	0.00105	0.00120
-20.000	0.01324	0.01108	0.00790	0.00437	0.00205	0.00061	-0.00094	-0.00046
-15.000	0.00897	0.00700	0.00420	0.00156	0.0	-0.00094	-0.00233	-0.00239
-10.000	0.00391	0.00300	0.00120	0.00014	-0.00027	-0.00250	-0.00236	-0.00493
-5.000	0.00089	0.00021	0.00060	0.00002	-0.00093	-0.00125	-0.00359	-0.00478
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00258	-0.00147	0.00040	0.00131	0.00154	0.00098	0.00170	0.00309
10.000	-0.00287	-0.00095	0.00070	0.00262	0.00465	0.00657	0.00950	0.01157
15.000	-0.00272	0.00113	0.00440	0.00694	0.00904	0.01172	0.01711	0.02310
20.000	-0.00349	0.00321	0.00810	0.01134	0.01340	0.02013	0.02926	0.04099

ENGINEER 10-4-78
DATE DEC

FIGURE 4.1.1.2-24
EFFECT OF ELEVON



CONFIGURATION

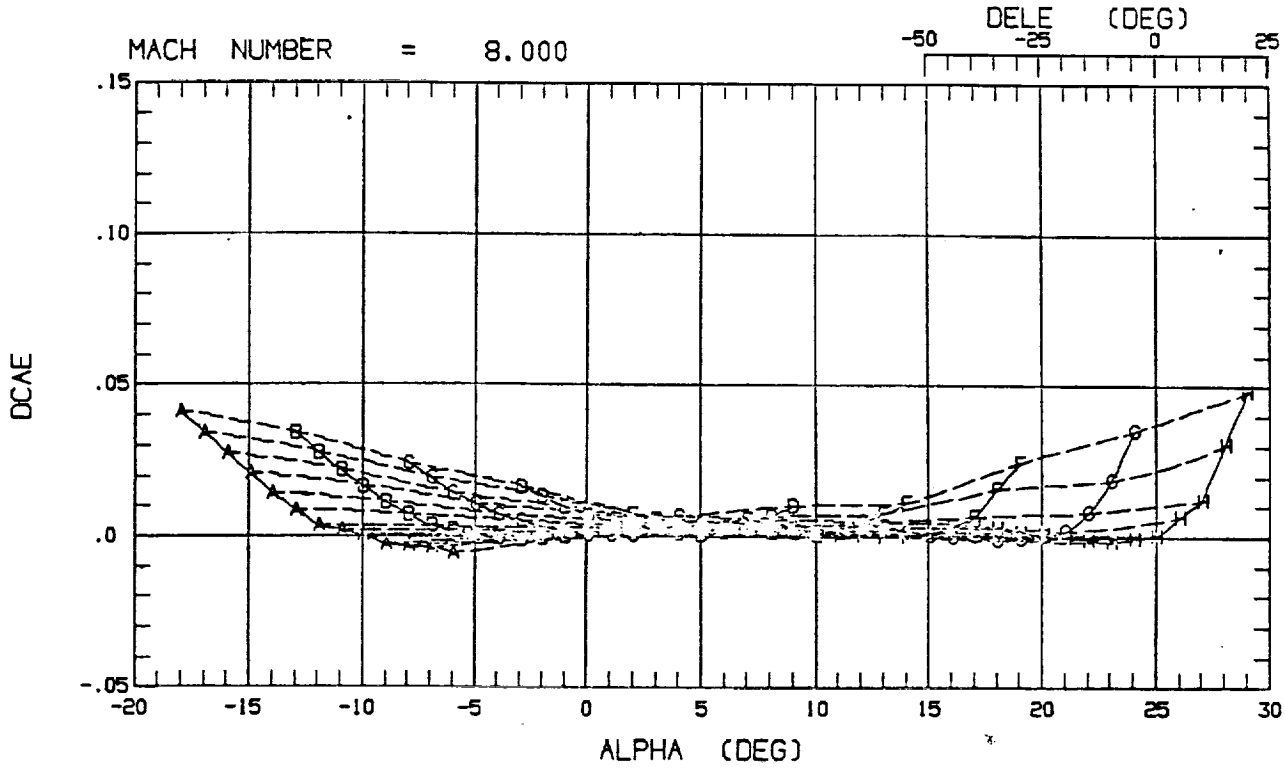
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00997	0.00816	0.00720	0.00799	0.00698	0.00990	0.01280	0.01869
-35.000	0.00739	0.00560	0.00494	0.00525	0.00336	0.00417	0.00827	0.01524
-30.000	0.00480	0.00304	0.00319	0.00251	0.00075	0.00185	0.00554	0.01168
-25.000	0.00271	0.00105	0.00120	0.00022	-0.00187	-0.00112	0.00237	0.00825
-20.000	0.00061	-0.00094	-0.00046	-0.00156	-0.00343	-0.00274	0.00004	0.00477
-15.000	-0.00094	-0.00233	-0.00239	-0.00414	-0.00667	-0.00696	-0.00361	0.00265
-10.000	-0.00250	-0.00236	-0.00493	-0.00463	-0.00584	-0.00592	-0.00445	-0.00177
-5.000	-0.00125	-0.00359	-0.00478	-0.00450	-0.00475	-0.00528	-0.00600	-0.00710
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00098	0.00170	0.00309	0.00459	0.00615	0.00769	0.00910	0.01064
10.000	0.00657	0.00950	0.01157	0.01525	0.01917	0.02239	0.02456	0.02622
15.000	0.01172	0.01711	0.02310	0.03135	0.03619	0.04058	0.04658	0.05399
20.000	0.02013	0.02926	0.04099	0.05479	0.06293	0.07045	0.08204	0.09570

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-25
EFFECT OF ELEVON

SD72-SH-0000 IM



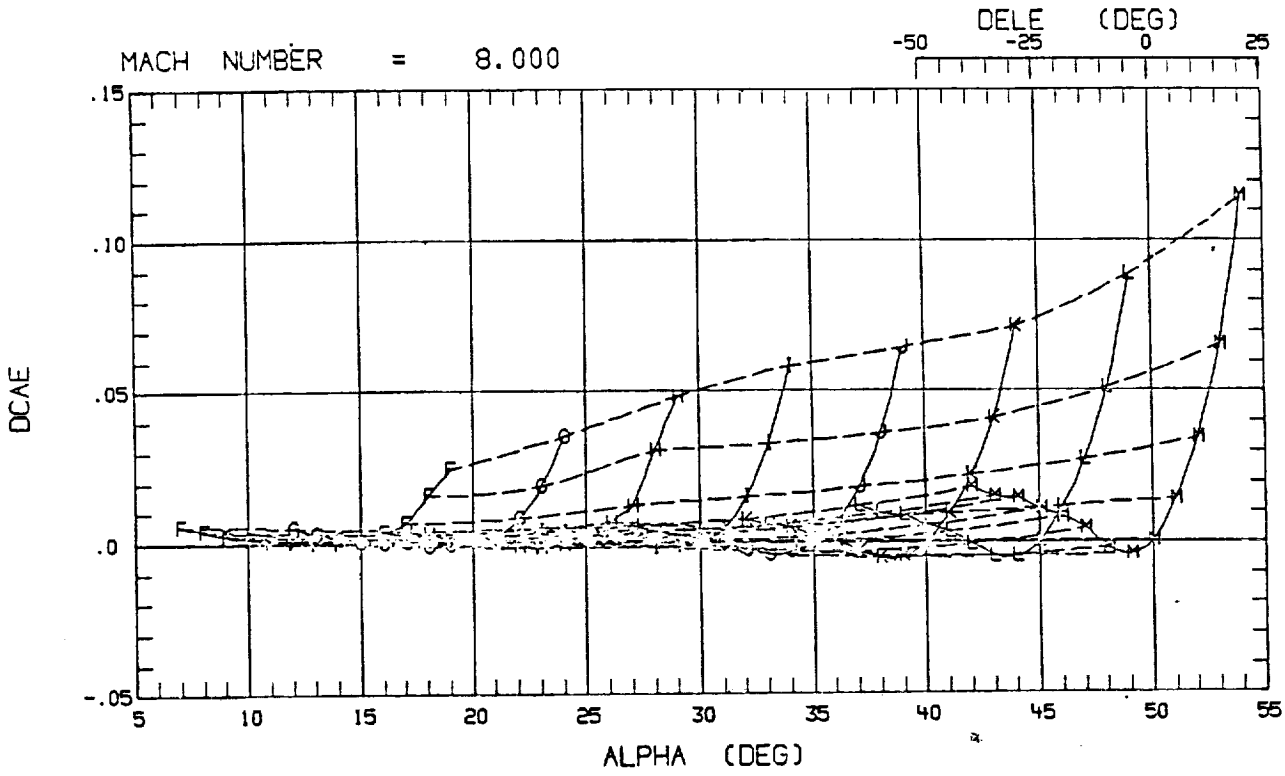
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04061	0.03366	0.02380	0.01613	0.00710	0.00554	0.00477	0.00346
-35.000	0.03385	0.02740	0.01890	0.01276	0.00555	0.00377	0.00296	0.00261
-30.000	0.02709	0.02132	0.01390	0.00931	0.00407	0.00226	0.00149	0.00126
-25.000	0.02061	0.01615	0.01050	0.00706	0.00313	0.00135	0.00027	0.00053
-20.000	0.01402	0.01100	0.00700	0.00471	0.00209	0.00045	-0.00038	-0.00028
-15.000	0.00861	0.00704	0.00490	0.00326	0.00175	0.00015	0.00010	-0.00113
-10.000	0.00321	0.00306	0.00280	0.00200	0.00123	-0.00014	-0.00127	-0.00197
-5.000	0.00164	0.00158	0.00140	0.00091	0.00105	-0.00015	-0.00059	-0.00082
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00278	-0.00076	0.00030	0.00138	0.00139	0.00317	0.00179	0.00623
10.000	-0.00348	-0.00152	0.00050	0.00266	0.00434	0.00635	0.00790	0.01213
15.000	-0.00388	-0.00082	0.00250	0.00635	0.00745	0.01544	0.01835	0.03011
20.000	-0.00607	-0.00004	0.00610	0.01002	0.01082	0.02417	0.03497	0.04809

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-26
EFFECT OF ELEVON



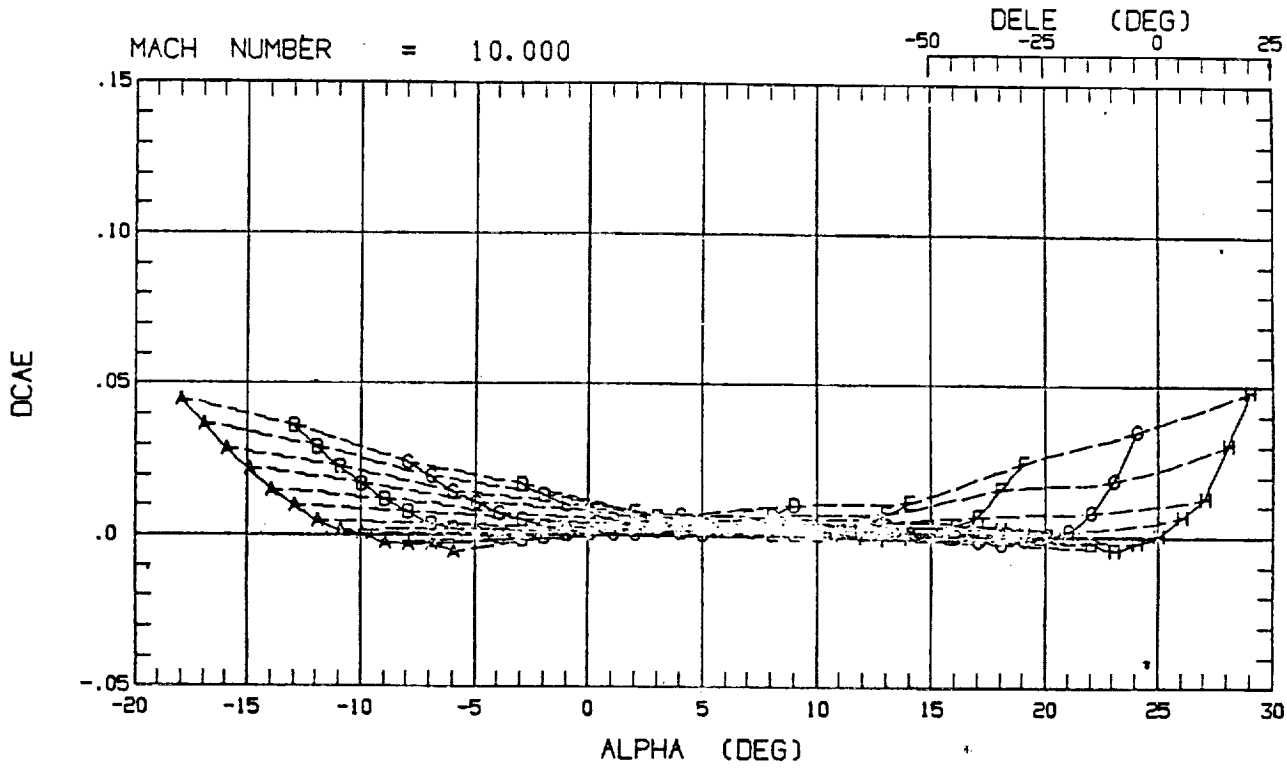
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00554	0.00477	0.00346	0.00448	0.00511	0.00756	0.01182	0.01794
-35.000	0.00377	0.00296	0.00261	0.00385	0.00340	0.00556	0.00937	0.01495
-30.000	0.00226	0.00149	0.00126	0.00322	0.00247	0.00470	0.00865	0.01433
-25.000	0.00135	0.00027	0.00053	0.00243	0.00066	0.00166	0.00517	0.01078
-20.000	0.00045	-0.00038	-0.00028	0.00164	-0.00028	0.00022	0.00308	0.00805
-15.000	0.00015	0.00010	-0.00113	0.00003	-0.00257	-0.00325	-0.00087	0.00413
-10.000	-0.00014	-0.00127	-0.00197	-0.00159	-0.00413	-0.00545	-0.00470	-0.00214
-5.000	-0.00015	-0.00059	-0.00082	-0.00146	-0.00348	-0.00490	-0.00499	-0.00409
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00317	0.00179	0.00623	0.00422	0.00651	0.00936	0.01162	0.01415
10.000	0.00635	0.00790	0.01213	0.01475	0.01785	0.02198	0.02712	0.03420
15.000	0.01544	0.01835	0.03011	0.03235	0.03557	0.04110	0.05091	0.06498
20.000	0.02417	0.03497	0.04809	0.05801	0.06437	0.07117	0.08878	0.11449

ENGINEER DCo
DATE 12-4-78

FIGURE 4.1.1.2-27
EFFECT OF ELEVON



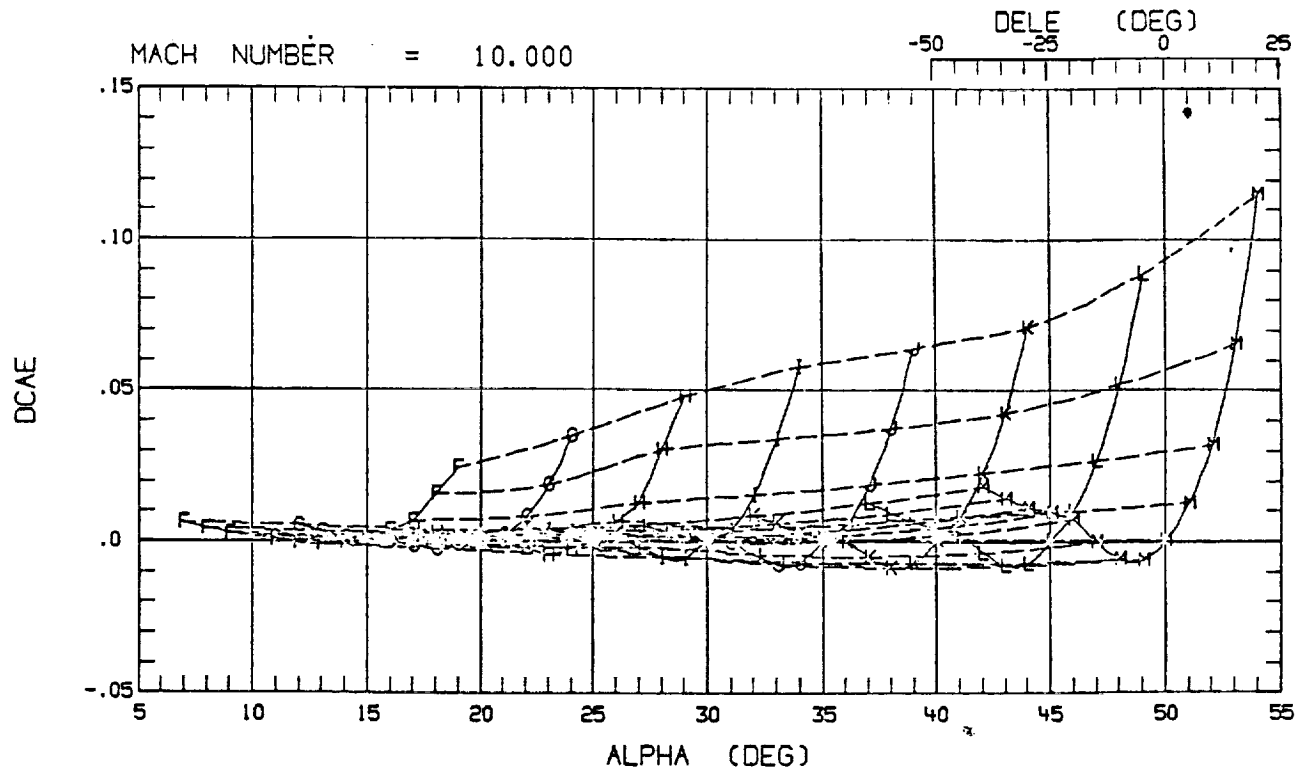
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04427	0.03556	0.02380	0.01632	0.00739	0.00583	0.00486	0.00346
-35.000	0.03634	0.02879	0.01890	0.01298	0.00604	0.00406	0.00296	0.00219
-30.000	0.02813	0.02193	0.01400	0.00973	0.00451	0.00229	0.00096	0.00092
-25.000	0.02139	0.01665	0.01060	0.00727	0.00328	0.00138	0.00037	0.00020
-20.000	0.01466	0.01118	0.00710	0.00482	0.00204	0.00048	-0.00032	-0.00019
-15.000	0.00938	0.00741	0.00480	0.00310	0.00125	-0.00069	-0.00168	-0.00230
-10.000	0.00436	0.00355	0.00250	0.00147	0.00028	-0.00150	-0.00279	-0.00484
-5.000	0.00125	0.00177	0.00120	0.00073	0.00028	-0.00083	-0.00152	-0.00242
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00275	-0.00085	0.0	0.00108	0.00127	0.00324	0.00179	0.00623
10.000	-0.00316	-0.00161	0.0	0.00225	0.00374	0.00657	0.00790	0.01237
15.000	-0.00319	-0.00072	0.00250	0.00623	0.00722	0.01541	0.01835	0.03026
20.000	-0.00587	0.00016	0.00630	0.01011	0.01080	0.02424	0.03469	0.04773

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-28
EFFECT OF ELEVON



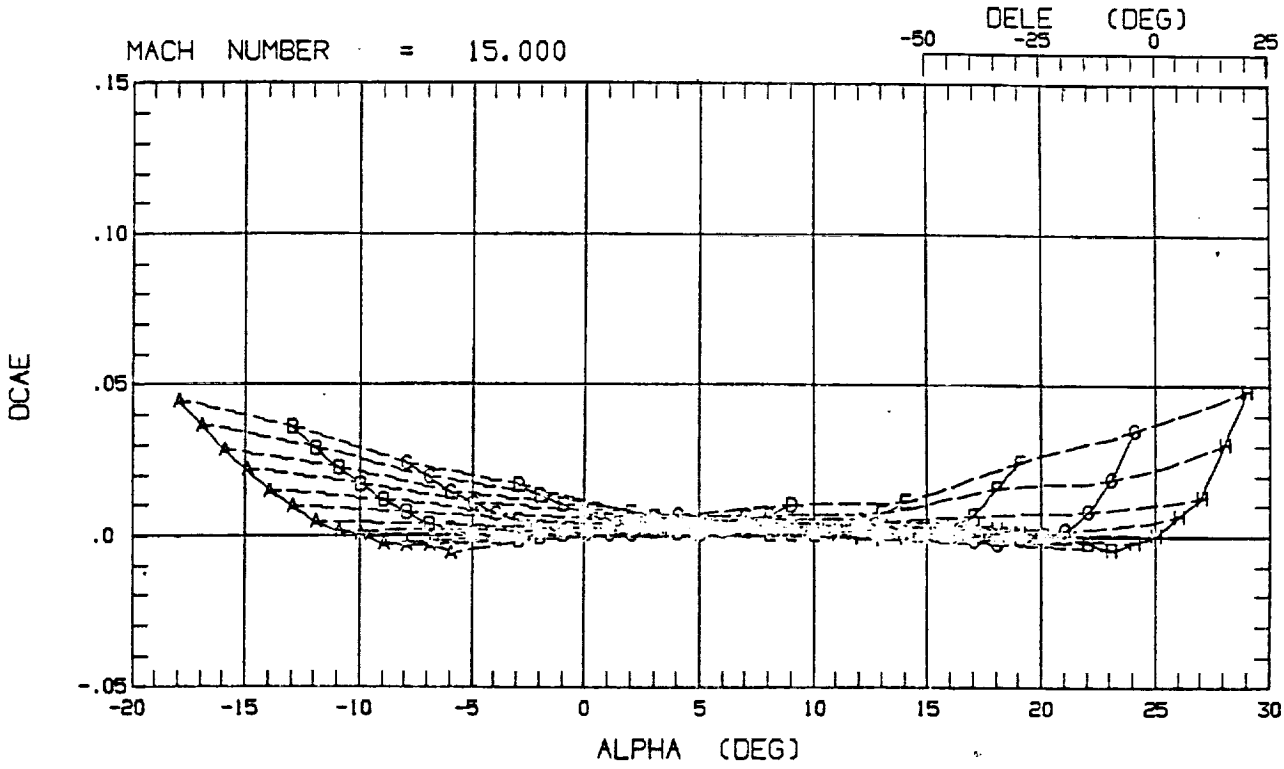
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00583	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00406	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00229	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00138	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	0.00048	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00069	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00150	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00083	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00324	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00657	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01541	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.02424	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-29
EFFECT OF ELEVON



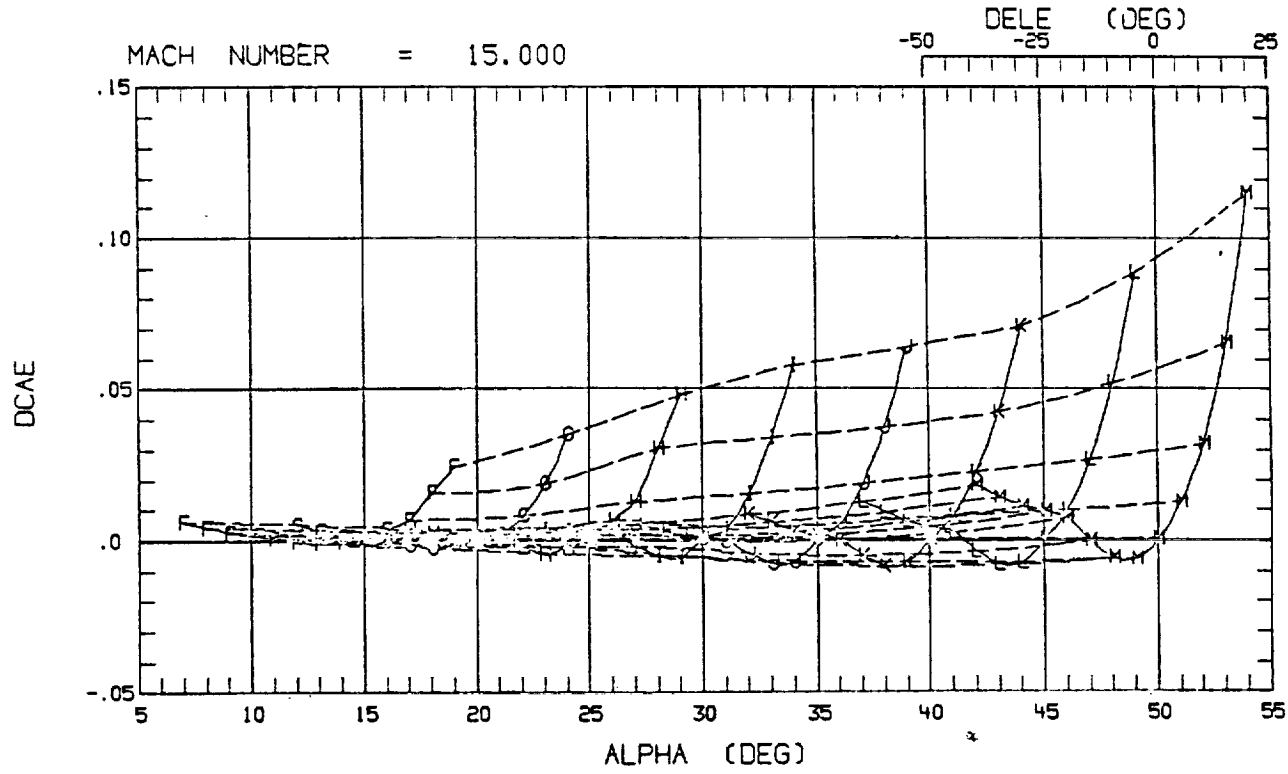
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04427	0.03556	0.02380	0.01632	0.00739	0.00583	0.00486	0.00346
-35.000	0.03634	0.02879	0.01890	0.01298	0.00604	0.00406	0.00296	0.00219
-30.000	0.02813	0.02193	0.01400	0.00973	0.00451	0.00229	0.00096	0.00092
-25.000	0.02139	0.01665	0.01060	0.00727	0.00328	0.00138	0.00037	0.00020
-20.000	0.01466	0.01118	0.00710	0.00482	0.00204	0.00048	-0.00032	-0.00019
-15.000	0.00938	0.00741	0.00480	0.00310	0.00125	-0.00069	-0.00168	-0.00230
-10.000	0.00436	0.00355	0.00250	0.00147	0.00028	-0.00150	-0.00279	-0.00484
-5.000	0.00125	0.00177	0.00120	0.00073	0.00028	-0.00083	-0.00152	-0.00242
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00275	-0.00085	0.0	0.00108	0.00127	0.00324	0.00179	0.00623
10.000	-0.00316	-0.00161	0.0	0.00225	0.00374	0.00657	0.00790	0.01237
15.000	-0.00319	-0.00072	0.00250	0.00623	0.00722	0.01541	0.01835	0.03026
20.000	-0.00587	0.00016	0.00630	0.01011	0.01080	0.02424	0.03469	0.04773

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-30
EFFECT OF ELEVON



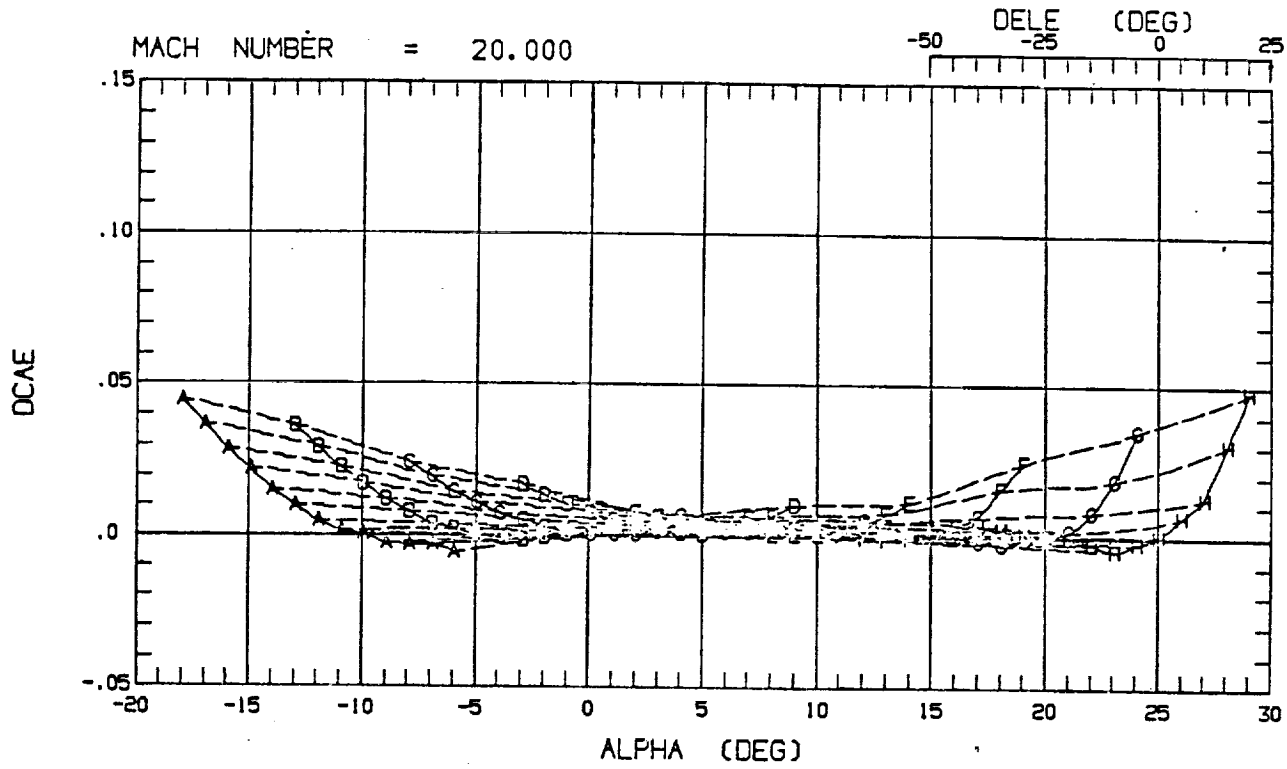
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00583	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00406	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00229	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00138	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	0.00048	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00069	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00150	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00083	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00324	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00657	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01541	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.02424	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-31
EFFECT OF ELEVON

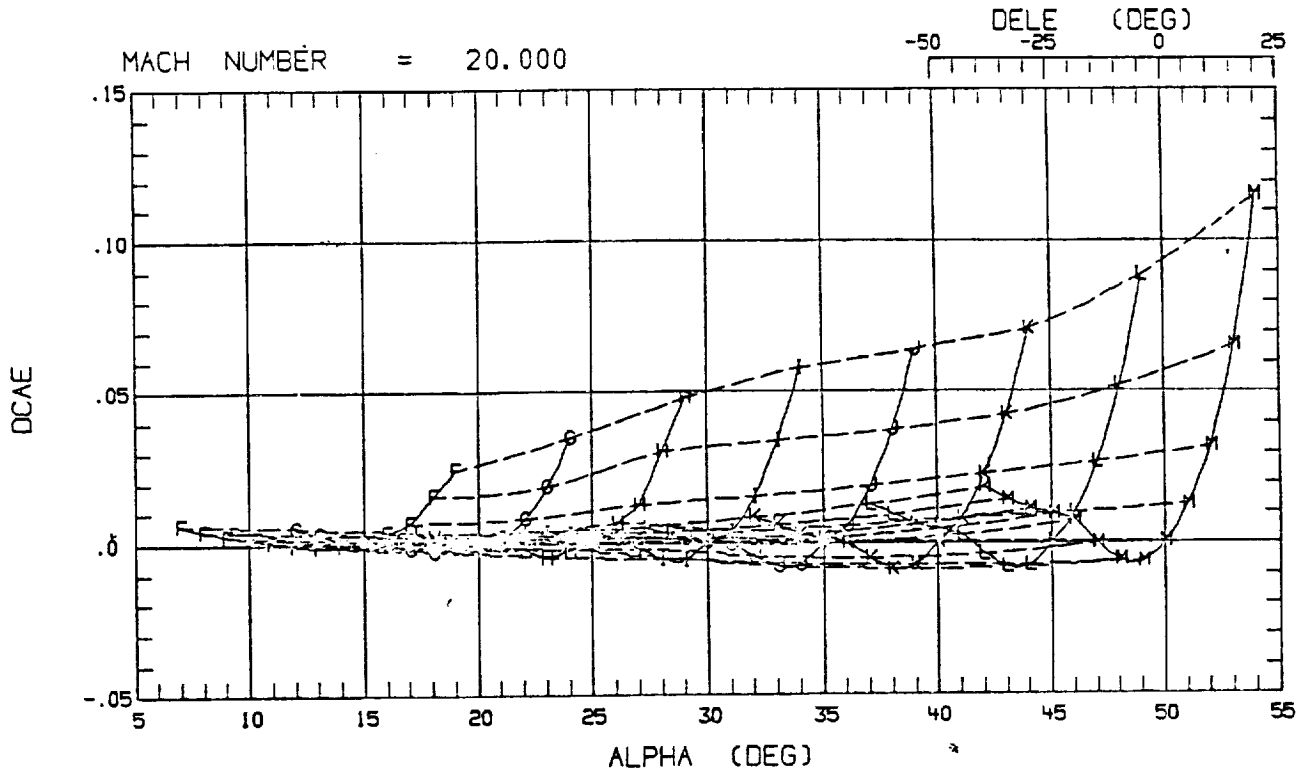


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04427	0.03566	0.02380	0.01632	0.00739	0.00583	0.00486	0.00346
-35.000	0.03634	0.02879	0.01890	0.01298	0.00604	0.00406	0.00296	0.00219
-30.000	0.02813	0.02193	0.01400	0.00973	0.00451	0.00229	0.00096	0.00092
-25.000	0.02139	0.01665	0.01060	0.00727	0.00328	0.00138	0.00037	0.00020
-20.000	0.01466	0.01118	0.00710	0.00482	0.00204	0.00048	-0.00032	-0.00019
-15.000	0.00938	0.00741	0.00480	0.00310	0.00125	-0.00069	-0.00168	-0.00230
-10.000	0.00436	0.00355	0.00250	0.00147	0.00028	-0.00150	-0.00279	-0.00484
-5.000	0.00125	0.00177	0.00120	0.00073	0.00028	-0.00083	-0.00152	-0.00242
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00275	-0.00085	0.0	0.00108	0.00127	0.00324	0.00179	0.00623
10.000	-0.00316	-0.00161	0.0	0.00225	0.00374	0.00657	0.00790	0.01237
15.000	-0.00319	-0.00072	0.00250	0.00623	0.00722	0.01541	0.01835	0.03026
20.000	-0.00587	0.00016	0.00630	0.01011	0.01080	0.02424	0.03469	0.04773

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2- 32
EFFECT OF ELEVON



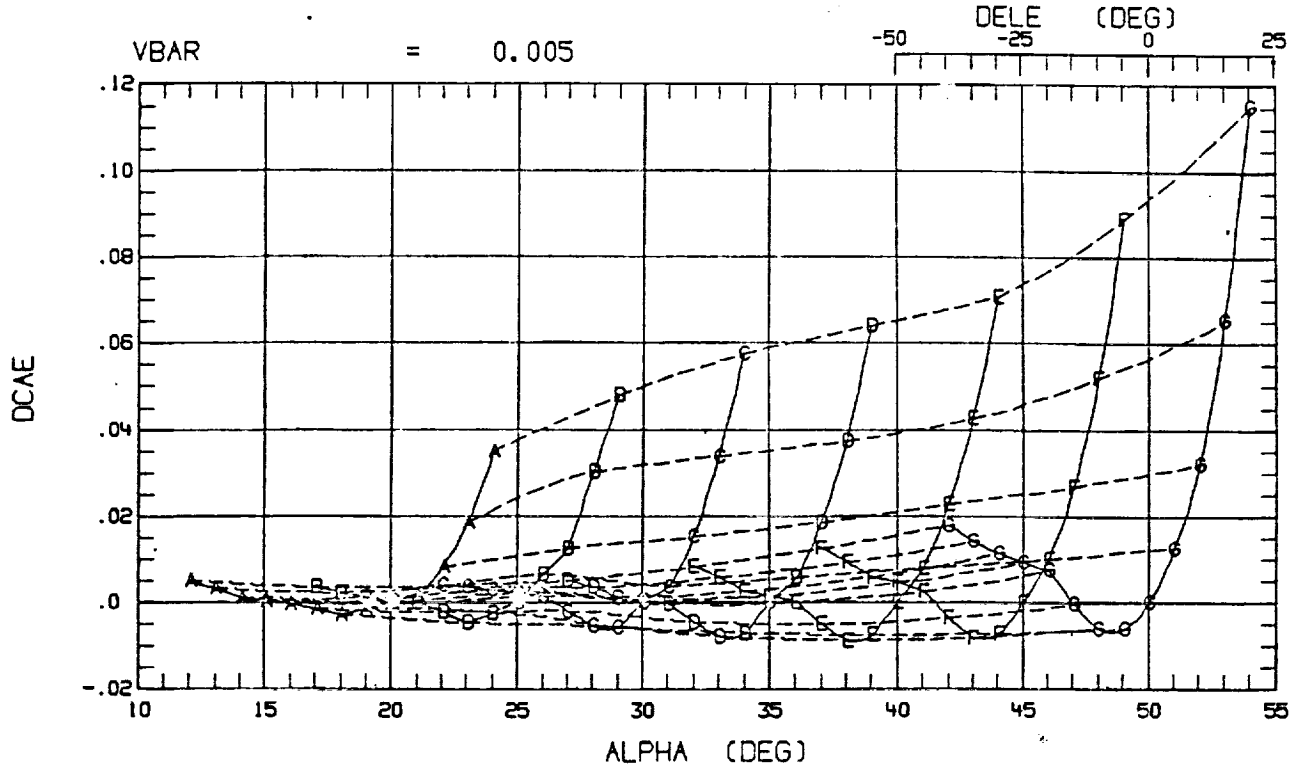
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00583	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00406	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00229	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00138	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	0.00048	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00069	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00150	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00083	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00625
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00324	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00657	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01541	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.02424	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2- 33
EFFECT OF ELEVON



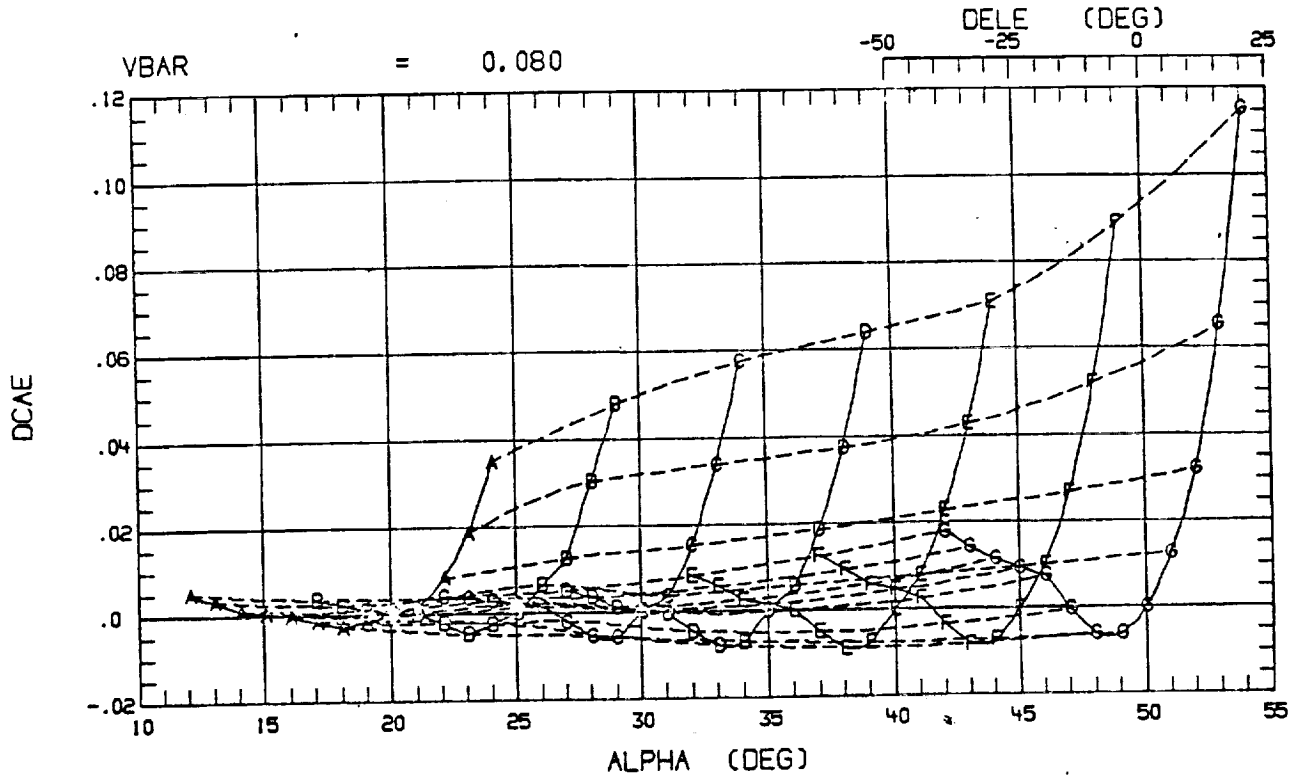
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER NASA
DATE

FIGURE 4.1.1.2-34
EFFECT OF ELEVON



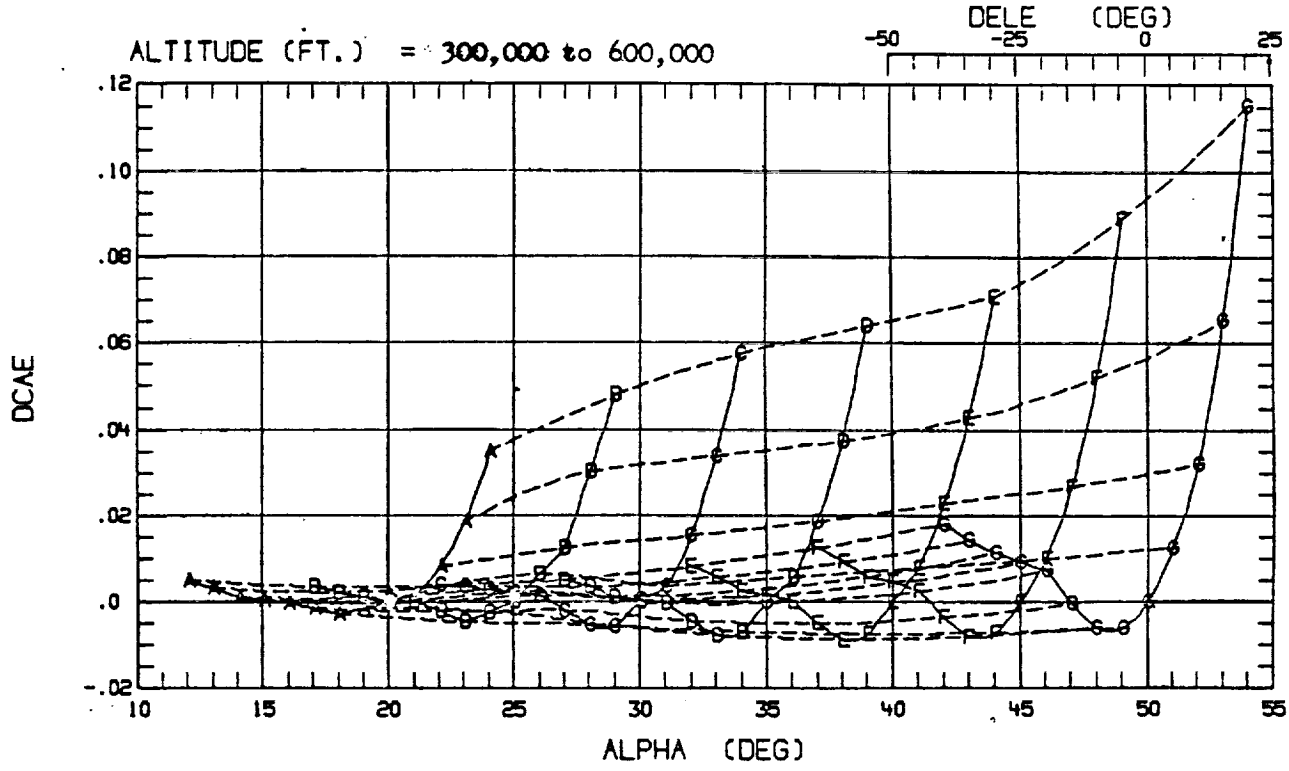
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER NASA
DATE

FIGURE 4.1.1.2-35
EFFECT OF ELEVON



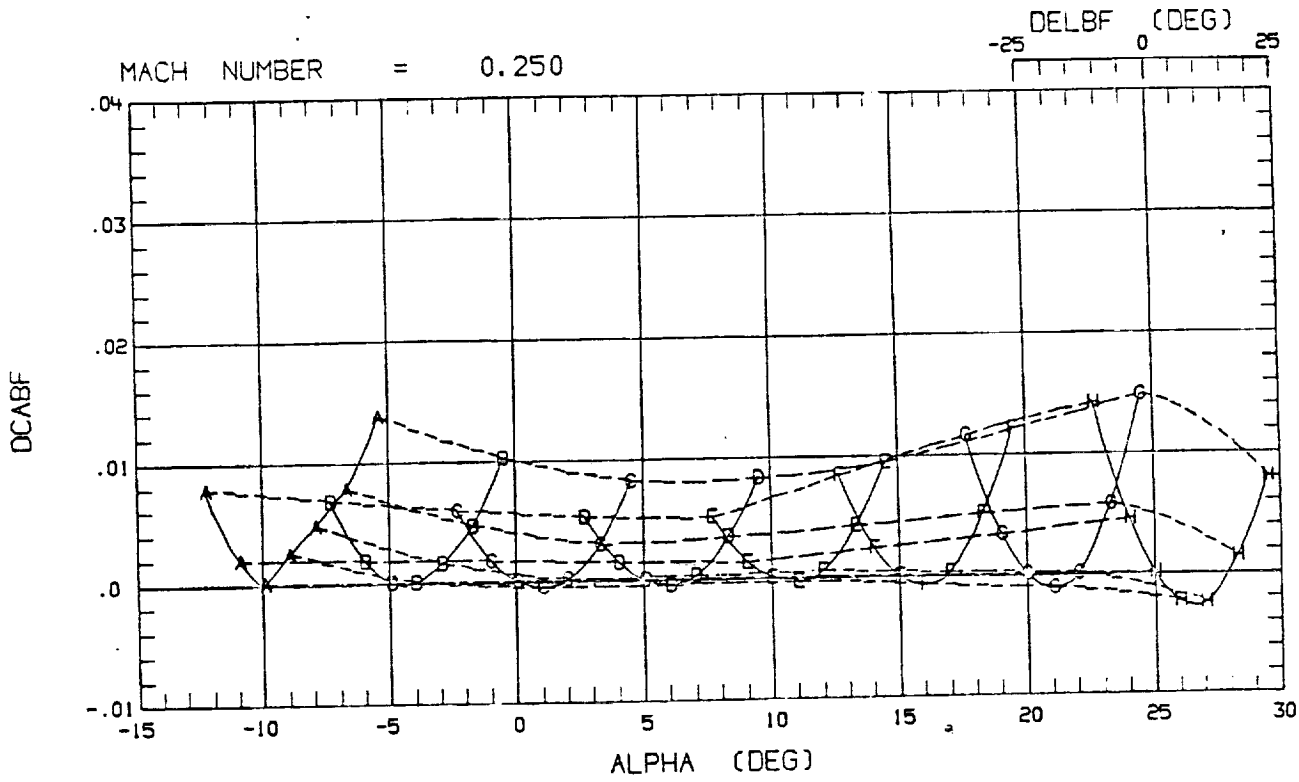
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER NASA
DATE

FIGURE 4.1.1.2-36
EFFECT OF ELEVON

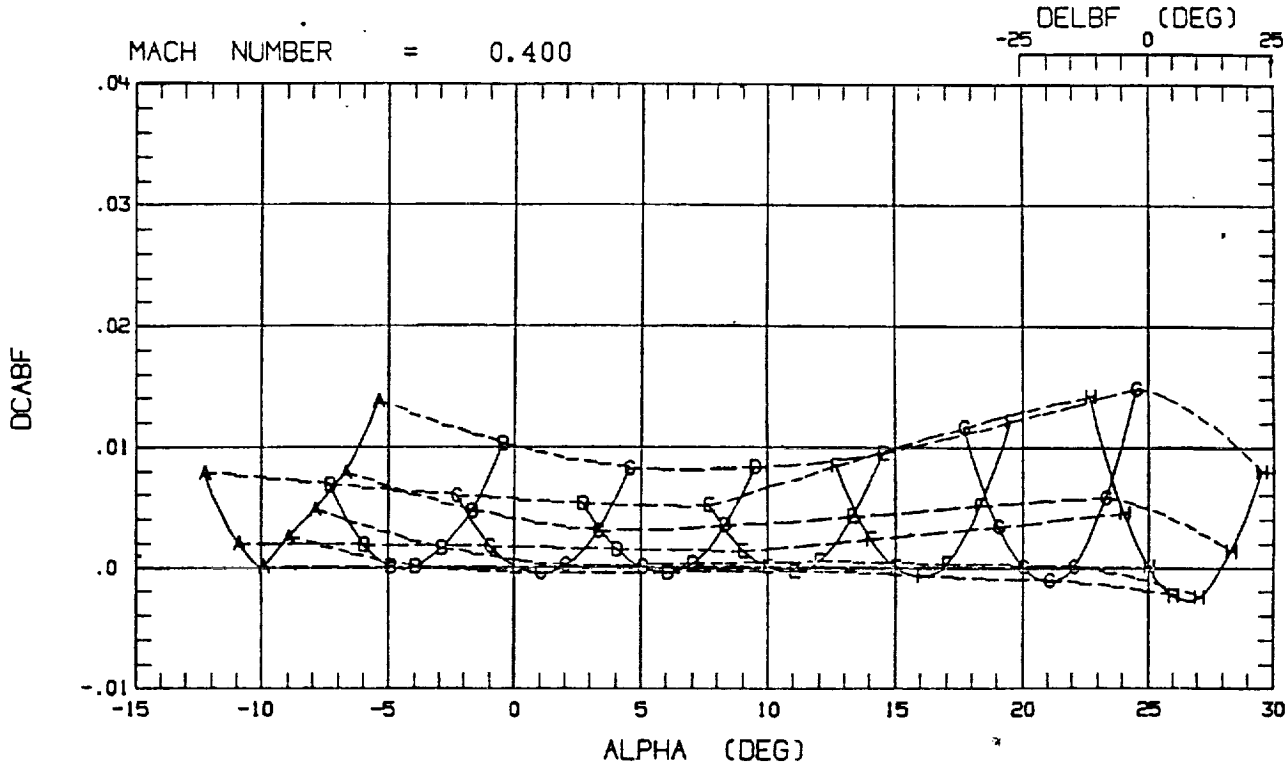


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00780	0.00675	0.00590	0.00522	0.00510	0.00838	0.01158	0.01415
-5.000	0.00197	0.00185	0.00170	0.00145	0.00135	0.00235	0.00334	0.00450
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00238	0.00004	-0.00054	-0.00042	-0.00032	-0.00073	-0.00116	-0.00240
10.000	0.00475	0.00157	0.00013	0.00026	0.00048	0.00028	-0.00001	-0.00257
16.300	0.00774	0.00464	0.00300	0.00340	0.00417	0.00506	0.00568	0.00129
22.500	0.01372	0.01014	0.00820	0.00825	0.00943	0.01203	0.01474	0.00732

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-37
EFFECT OF BODY FLAP



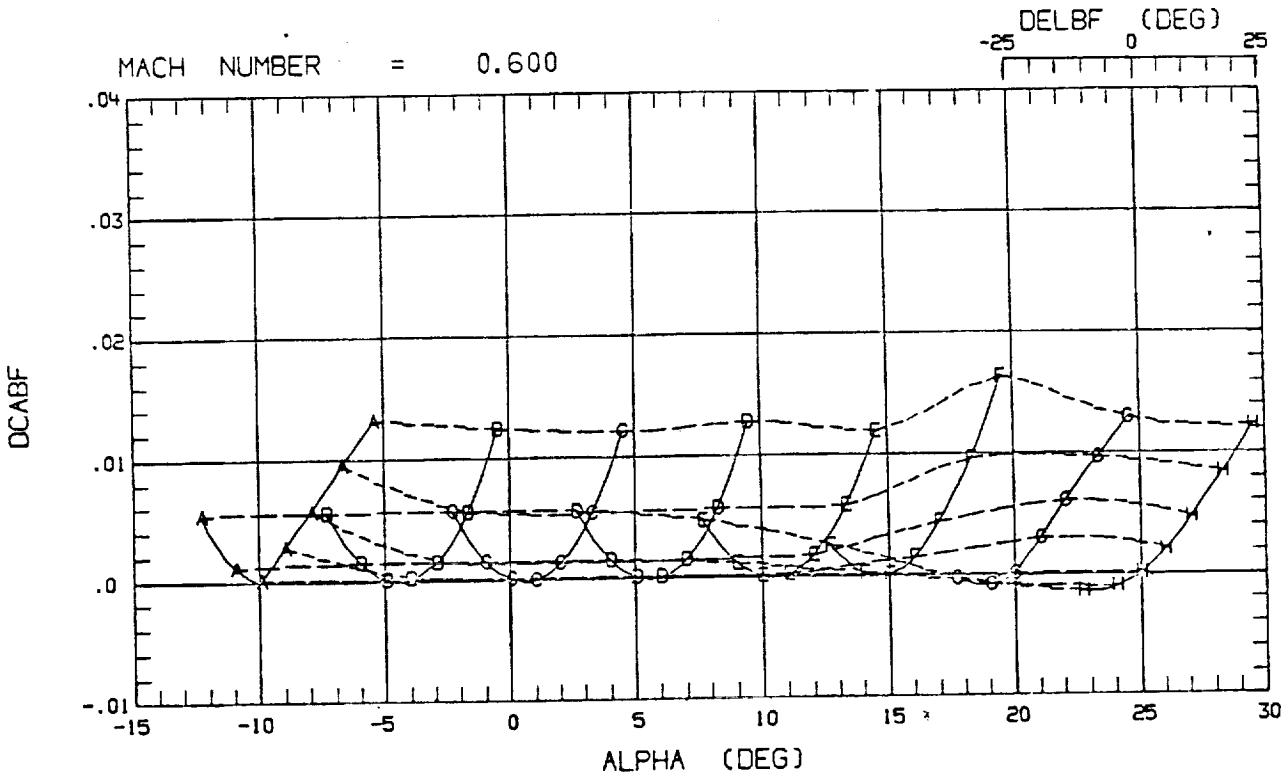
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00780	0.00675	0.00590	0.00522	0.00510	0.00838	0.01158	0.01415
-5.000	0.00197	0.00185	0.00170	0.00145	0.00135	0.00235	0.00334	0.00450
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00238	0.00004	-0.00054	-0.00042	-0.00032	-0.00073	-0.00116	-0.00240
10.000	0.00475	0.00157	0.00013	0.00026	0.00048	0.00028	-0.00001	-0.00257
16.300	0.00774	0.00464	0.00300	0.00340	0.00417	0.00506	0.00568	0.00129
22.500	0.01372	0.01014	0.00820	0.00825	0.00943	0.01203	0.01474	0.00792

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-38
EFFECT OF BODY FLAP



CONFIGURATION

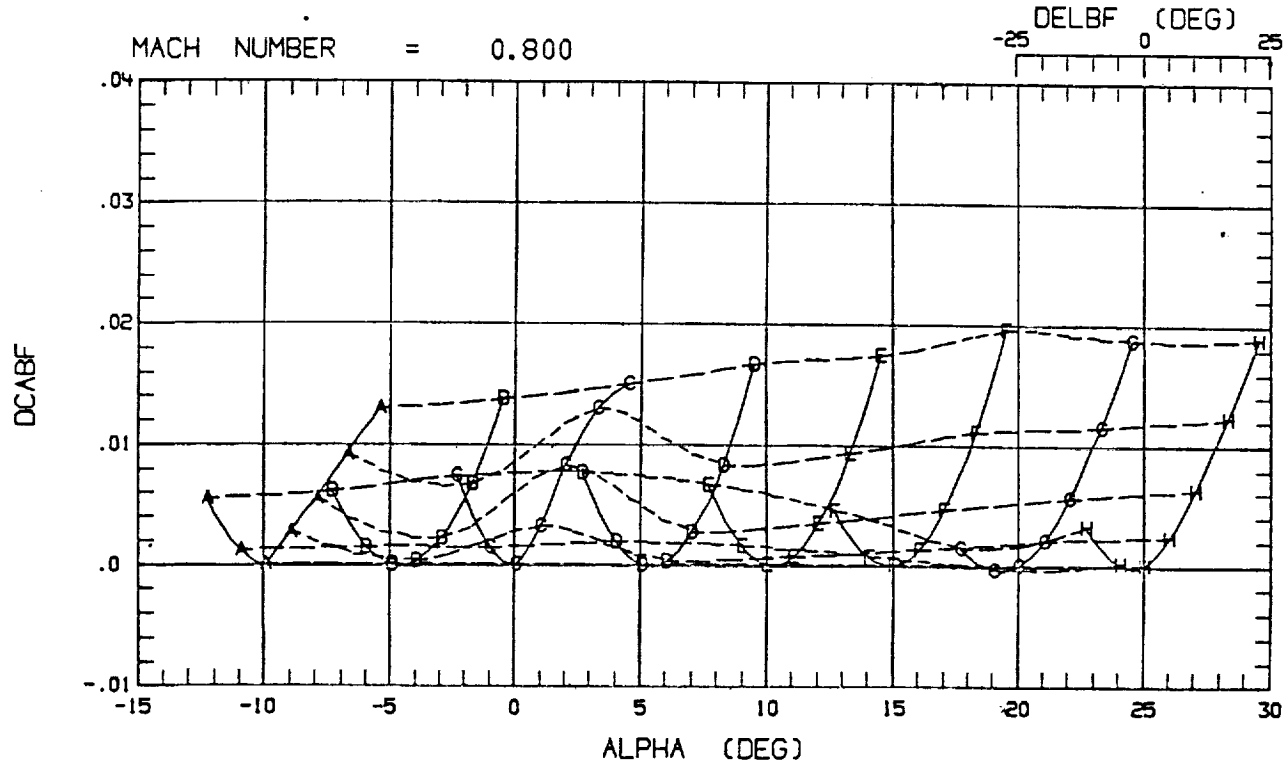
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00541	0.00548	0.00563	0.00552	0.00456	0.00250	-0.00038	-0.00155
-5.000	0.00107	0.00138	0.00144	0.00138	0.00106	0.00011	-0.00082	-0.00111
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00273	0.00010	-0.00008	-0.00003	0.00015	0.00146	0.00294	0.00196
10.000	0.00566	0.00147	0.00126	0.00138	0.00172	0.00437	0.00595	0.00455
16.300	0.00938	0.00548	0.00530	0.00561	0.00573	0.00959	0.00949	0.00822
22.500	0.01308	0.01234	0.01202	0.01266	0.01184	0.01625	0.01281	0.01223

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-39
EFFECT OF BODY FLAP

SD 7? -SH-0000 IM

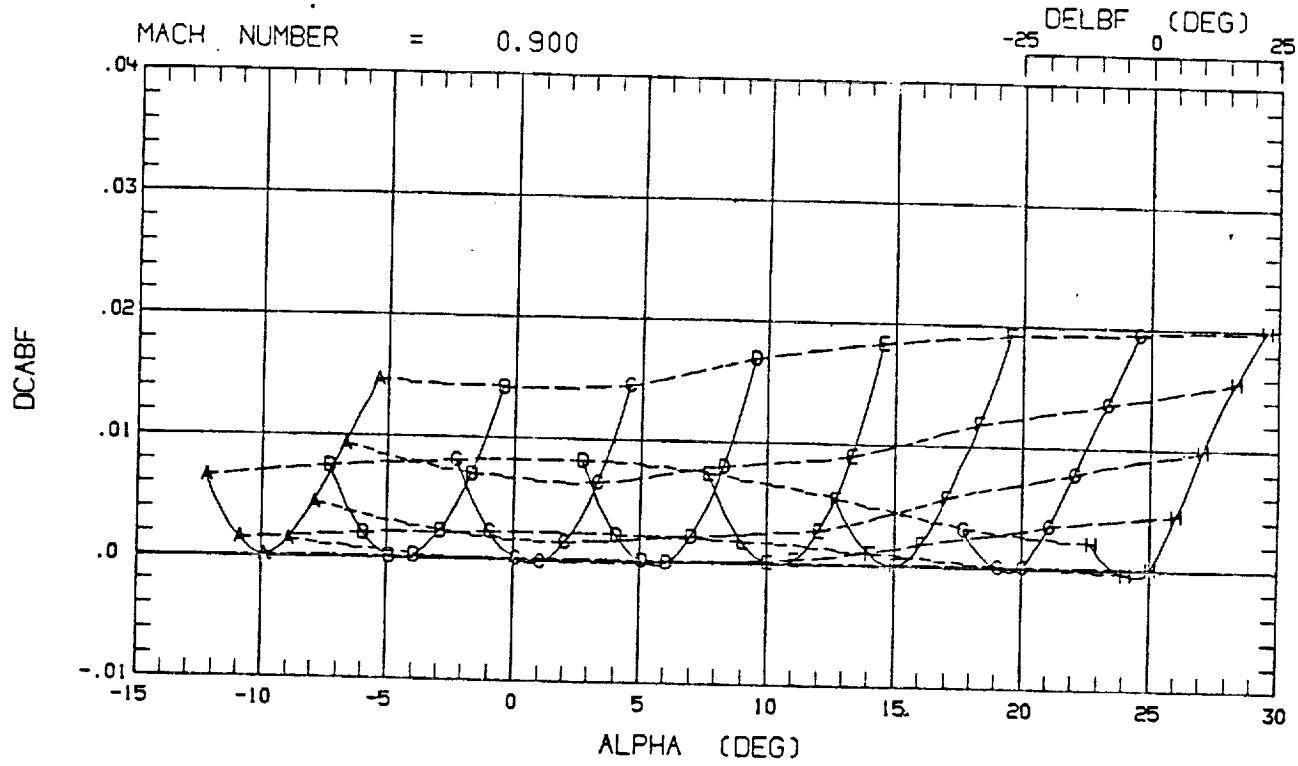


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00551	0.00608	0.00735	0.00767	0.00664	0.00453	0.00146	0.00319
-5.000	0.00111	0.00148	0.00144	0.00189	0.00149	0.00066	-0.00037	0.00014
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00265	0.00028	0.00319	0.00028	0.00068	0.00128	0.00201	0.00234
10.000	0.00553	0.00217	0.00830	0.00266	0.00341	0.00459	0.00558	0.00629
16.300	0.00922	0.00675	0.01291	0.00832	0.00923	0.01102	0.01151	0.01216
22.500	0.01294	0.01367	0.01494	0.01664	0.01735	0.01954	0.01868	0.01876

ENGINEER Wimz
DATE 9-21-78

FIGURE 4.1.1.2-40
EFFECT OF BODY FLAP



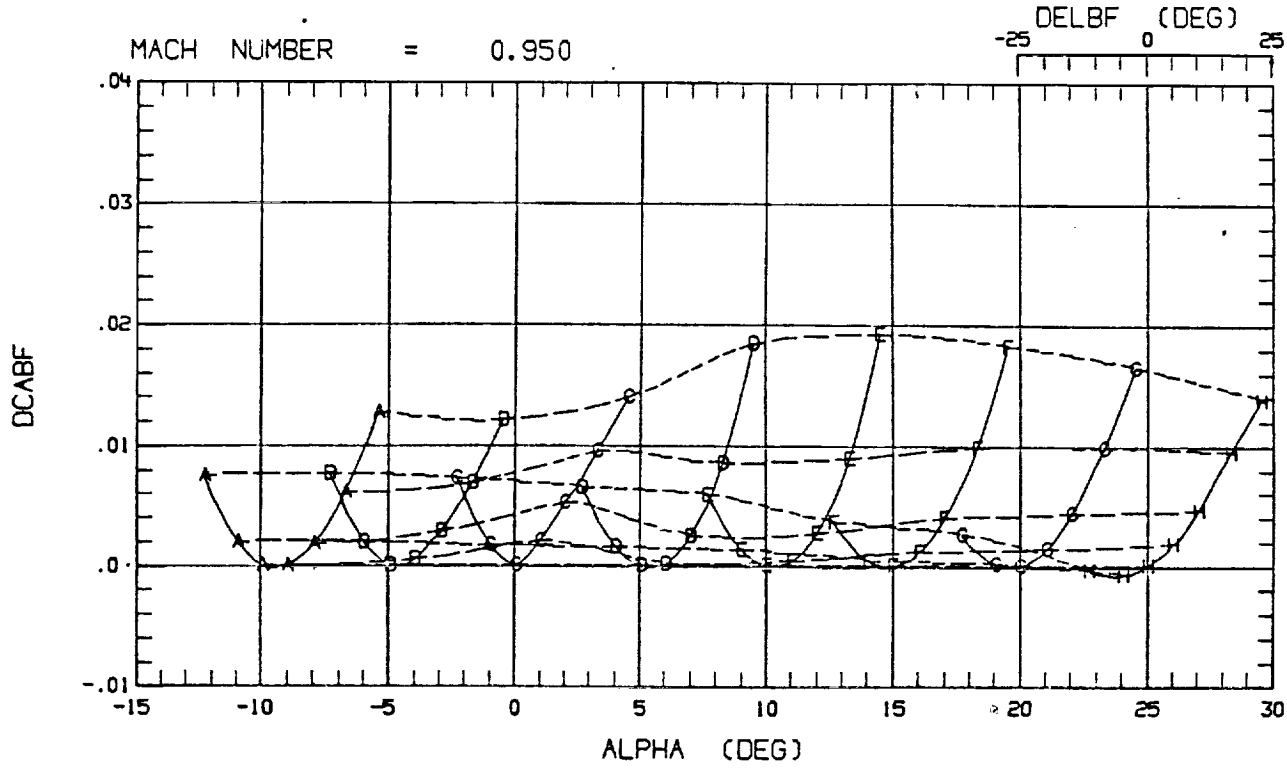
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00645	0.00742	0.00804	0.00816	0.00720	0.00532	0.00308	0.00205
-5.000	0.00143	0.00191	0.00215	0.00208	0.00168	0.00087	0.0	-0.00048
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00127	0.00021	-0.00027	-0.00013	0.00027	0.00174	0.00340	0.00444
10.000	0.00436	0.00215	0.00136	0.00208	0.00269	0.00558	0.00782	0.00983
16.300	0.00914	0.00689	0.00632	0.00791	0.00888	0.01178	0.01356	0.01549
22.500	0.01459	0.01414	0.01443	0.01689	0.01835	0.01914	0.01945	0.01985

ENGINEER WM3
DATE 9-21-78

FIGURE 4.1.1.2-41
EFFECT OF BODY FLAP

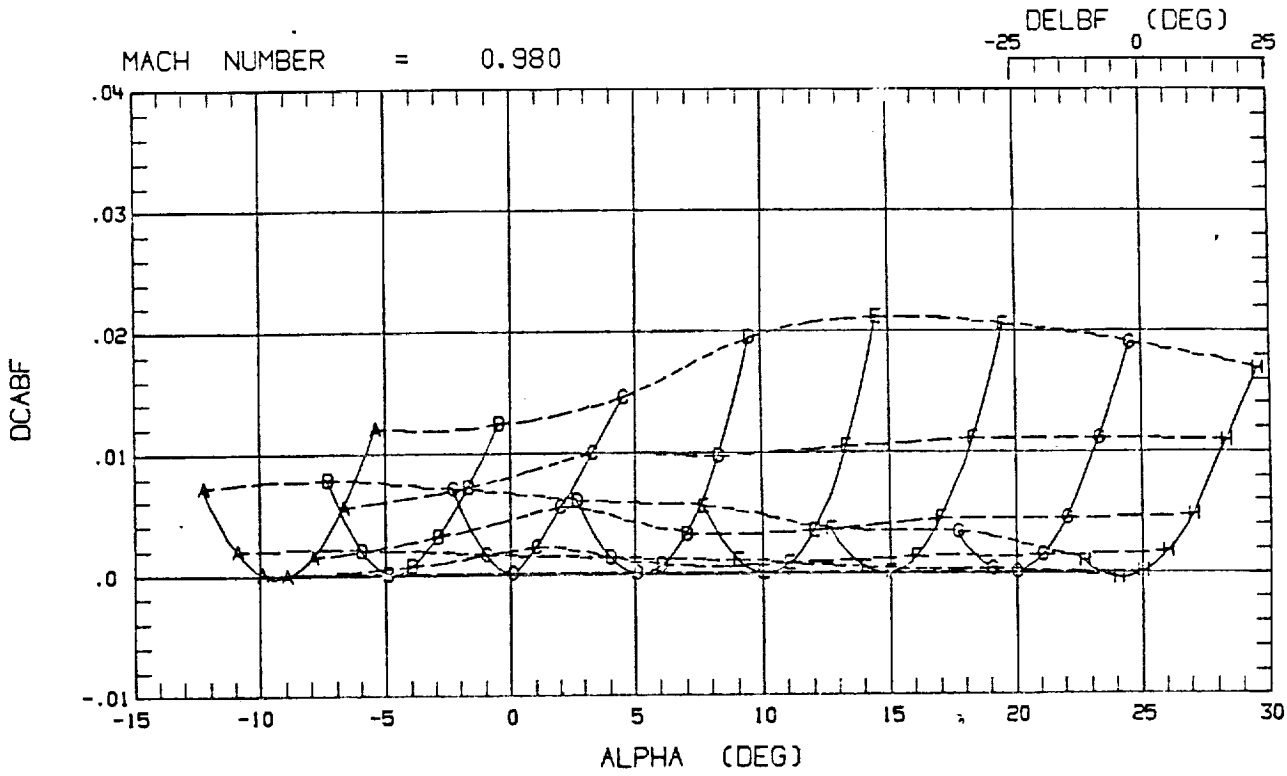


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00748	0.00767	0.00726	0.00654	0.00588	0.00361	0.00257	-0.00031
-5.000	0.00198	0.00199	0.00166	0.00150	0.00125	0.00046	0.00011	-0.00079
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00002	0.00052	0.00203	0.00021	0.00040	0.00115	0.00138	0.00175
10.000	0.00174	0.00280	0.00521	0.00241	0.00267	0.00394	0.00430	0.00456
16.300	0.00608	0.00691	0.00948	0.00854	0.00895	0.00983	0.00981	0.00938
22.500	0.01268	0.01210	0.01398	0.01847	0.01916	0.01821	0.01638	0.01374

ENGINEER WMZ
DATE 9-11-78

FIGURE 4.1.1.2-42
EFFECT OF BODY FLAP



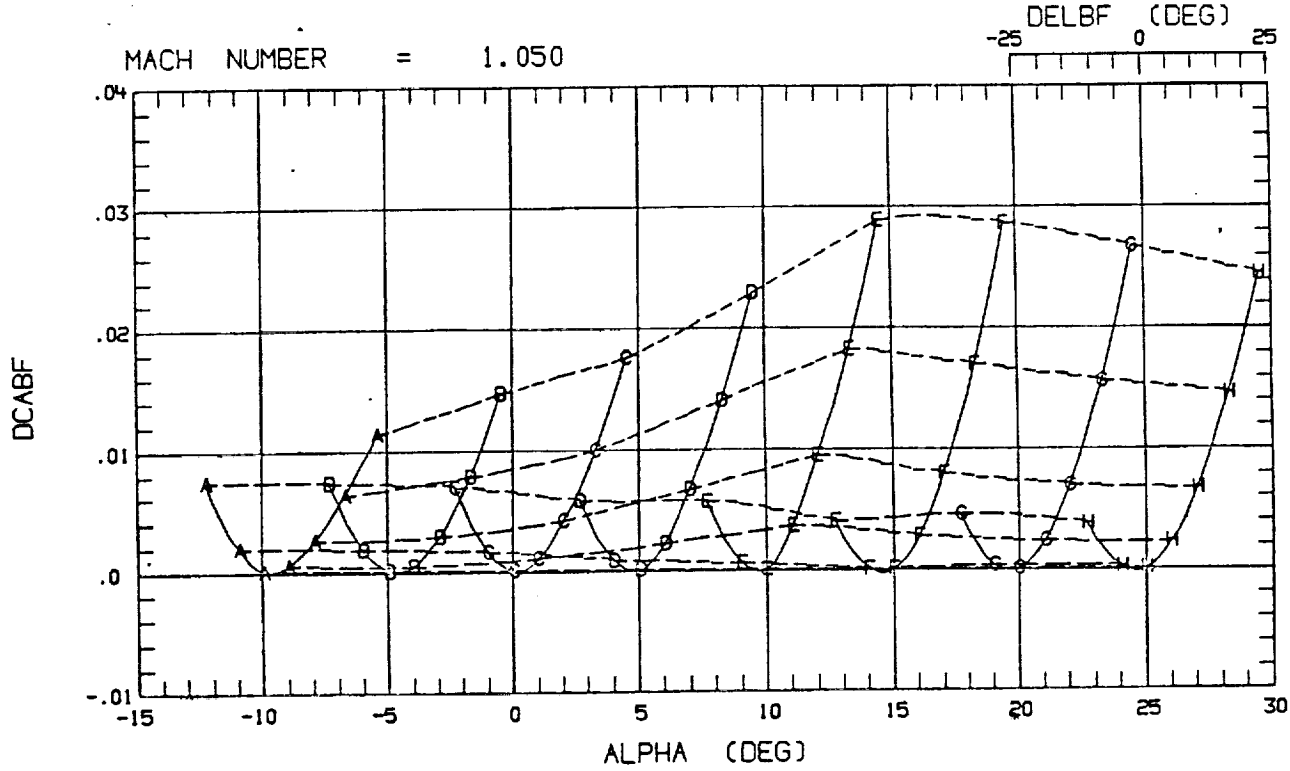
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00716	0.00771	0.00698	0.00600	0.00552	0.00358	0.00329	0.00088
-5.000	0.00192	0.00198	0.00154	0.00124	0.00103	0.00036	0.00026	-0.00051
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00016	0.00062	0.00217	0.00063	0.00074	0.00134	0.00136	0.00172
10.000	0.00139	0.00304	0.00548	0.00323	0.00347	0.00444	0.00442	0.00475
16.300	0.00554	0.00718	0.00989	0.00965	0.01037	0.01102	0.01103	0.01085
22.500	0.01194	0.01228	0.01452	0.01950	0.02114	0.02048	0.01895	0.01677

ENGINEER WHZ
DATE 4-21-78

FIGURE 4.1.1.2 -43
EFFECT OF BODY FLAP

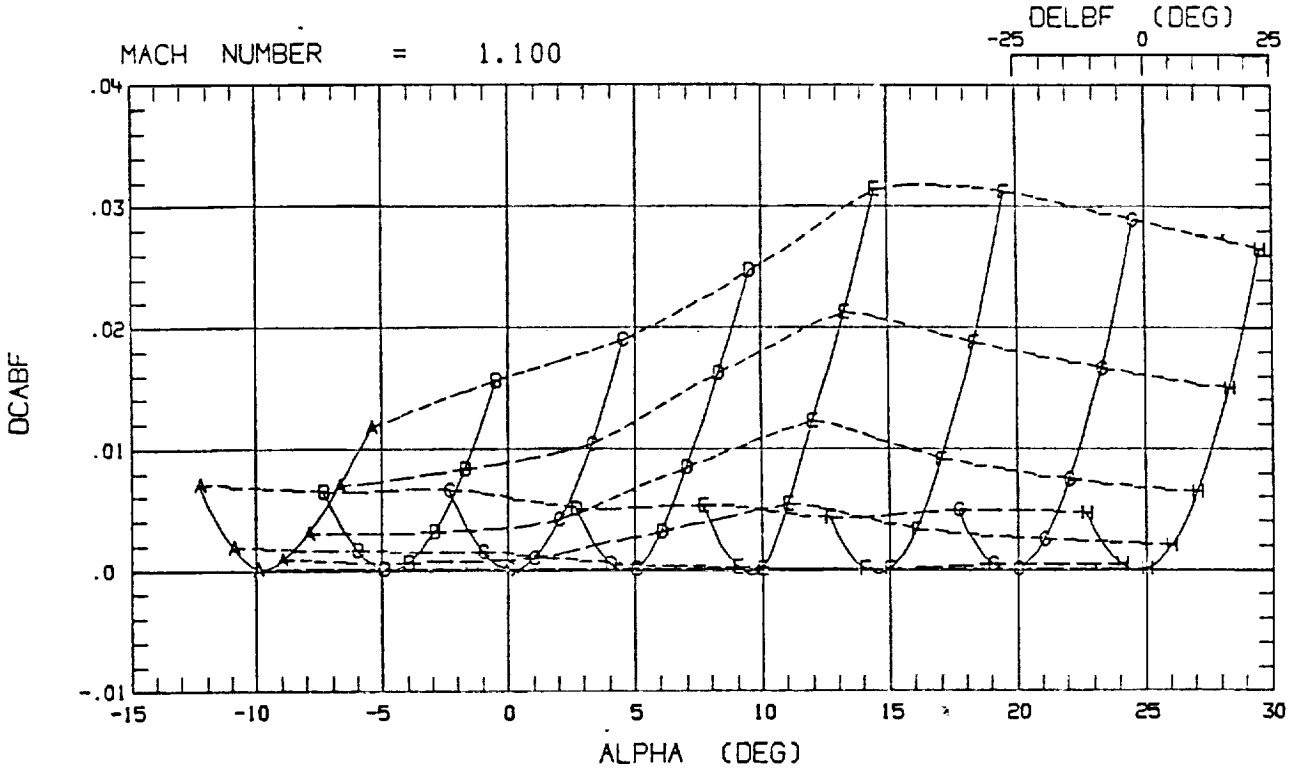


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00736	0.00728	0.00694	0.00570	0.00566	0.00401	0.00451	0.00369
-5.000	0.00193	0.00180	0.00153	0.00082	0.00051	0.00006	0.00033	0.00014
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00050	0.00045	0.00098	0.00218	0.00357	0.00271	0.00229	0.00218
10.000	0.00254	0.00285	0.00409	0.00667	0.00943	0.00785	0.00694	0.00658
16.300	0.00628	0.00780	0.00996	0.01404	0.01820	0.01687	0.01549	0.01449
22.500	0.01126	0.01459	0.01760	0.02290	0.02889	0.02862	0.02662	0.02436

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-44
EFFECT OF BODY FLAP



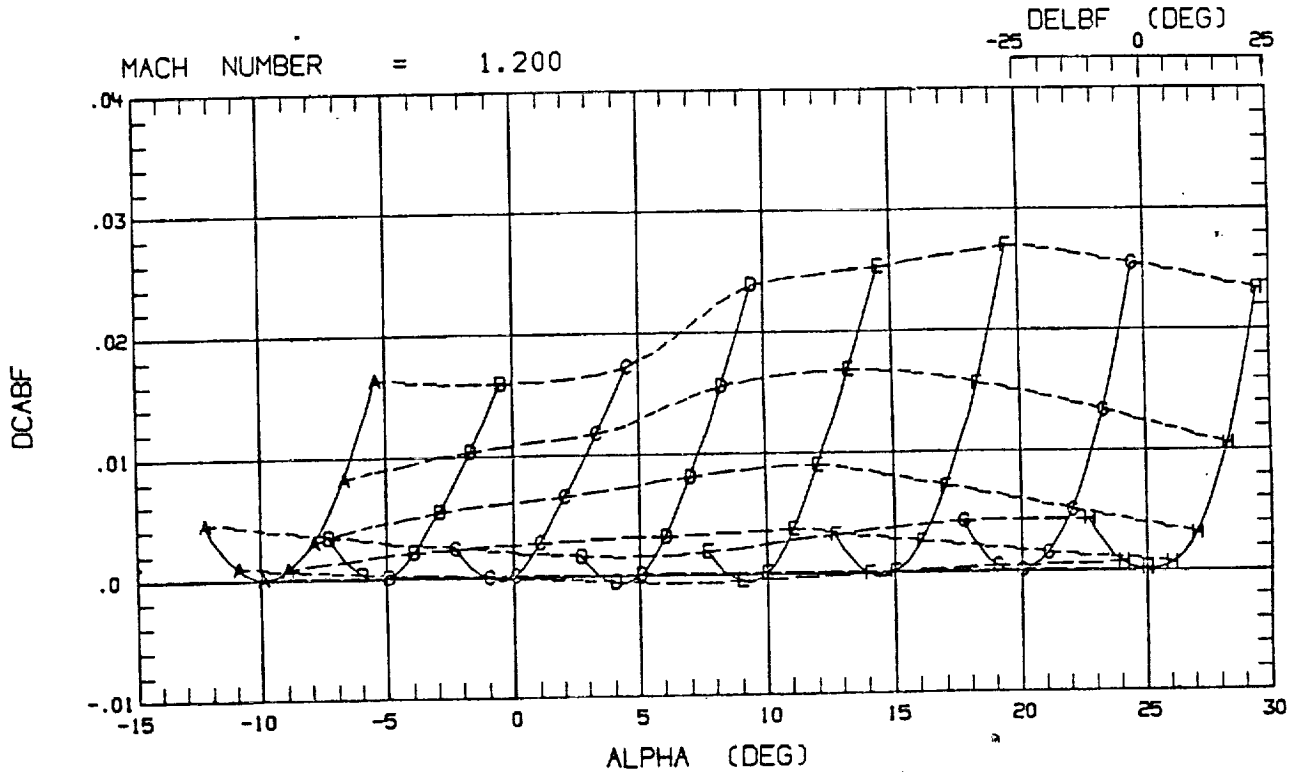
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00698	0.00642	0.00654	0.00501	0.00524	0.00418	0.00479	0.00462
-5.000	0.00177	0.00149	0.00137	0.00045	0.00014	-0.00002	0.00035	0.00041
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00074	0.00057	0.00094	0.00313	0.00539	0.00321	0.00240	0.00199
10.000	0.00298	0.00304	0.00403	0.00842	0.01222	0.00907	0.00734	0.00631
16.300	0.00683	0.00826	0.01031	0.01610	0.02127	0.01869	0.01648	0.01481
22.500	0.01175	0.01551	0.01890	0.02459	0.03142	0.03113	0.02878	0.02641

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-45
EFFECT OF BODY FLAP



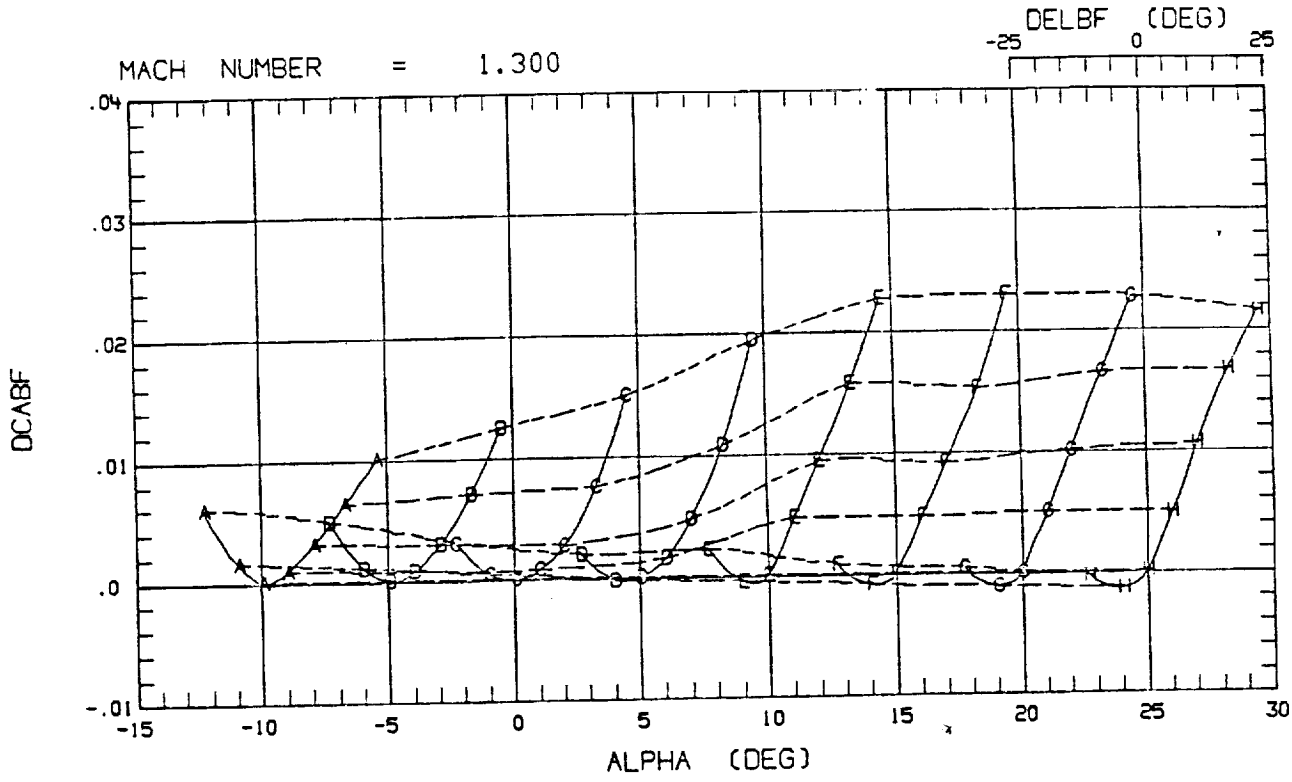
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00452	0.00329	0.00227	0.00150	0.00174	0.00313	0.00410	0.00423
-5.000	0.00087	0.00031	-0.00012	-0.00065	-0.00066	-0.00012	0.00037	0.00061
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00076	0.00200	0.00271	0.00313	0.00354	0.00245	0.00146	0.00056
10.000	0.00296	0.00537	0.00653	0.00807	0.00892	0.00704	0.00502	0.00294
16.300	0.00816	0.01033	0.01168	0.01551	0.01672	0.01557	0.01318	0.01039
22.500	0.01633	0.01590	0.01710	0.02394	0.02533	0.02698	0.02536	0.02321

ENGINEER Lumz
DATE 9-26-78

FIGURE 4.1.1.2-46
EFFECT OF BODY FLAP



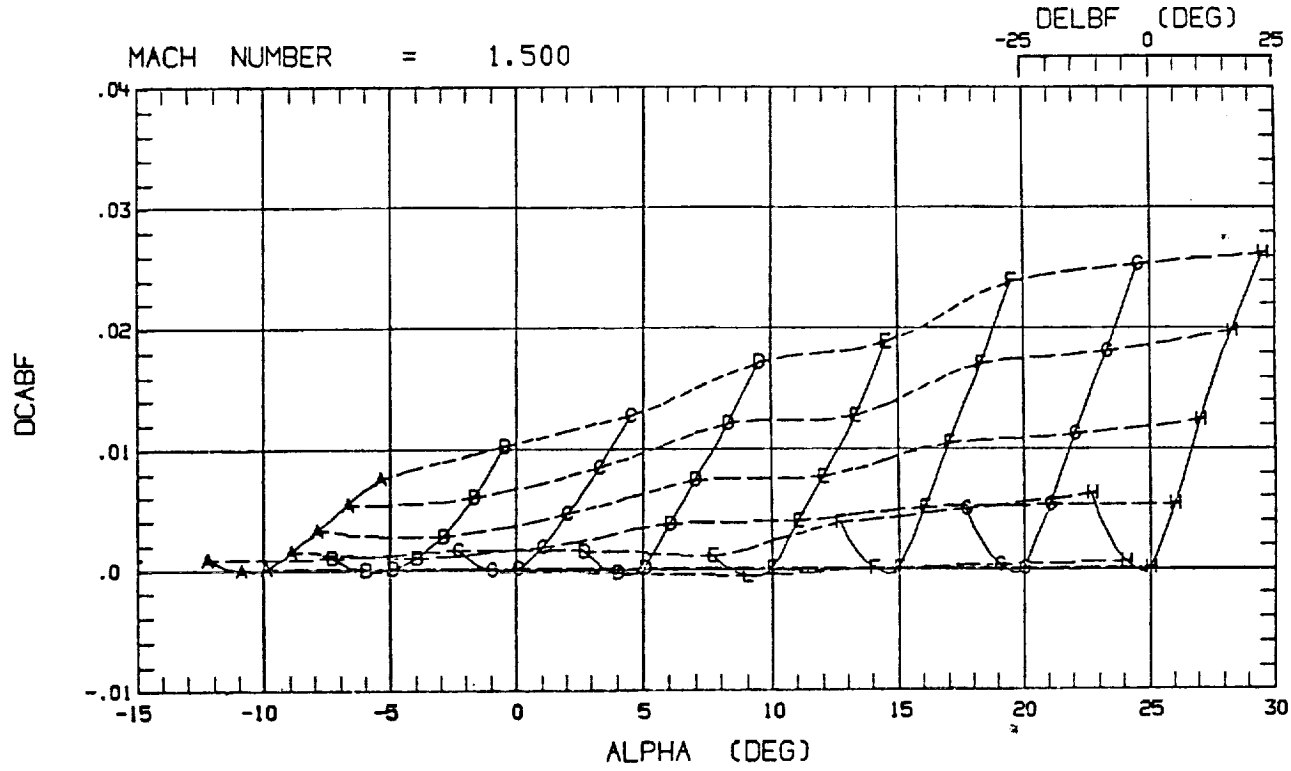
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00603	0.00488	0.00300	0.00192	0.00218	0.00076	0.00035	-0.00037
-5.000	0.00150	0.00108	0.00042	-0.00017	-0.00045	-0.00087	-0.00110	-0.00134
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00093	0.00074	0.00075	0.00158	0.00471	0.00472	0.00503	0.00485
10.000	0.00308	0.00290	0.00274	0.00468	0.00944	0.00913	0.01011	0.01052
16.300	0.00631	0.00701	0.00752	0.01086	0.01577	0.01530	0.01648	0.01662
22.500	0.01002	0.01242	0.01498	0.01944	0.02269	0.02303	0.02280	0.02146

ENGINEER wmz
DATE 9-21-78

FIGURE 4.1.1.2-47
EFFECT OF BODY FLAP



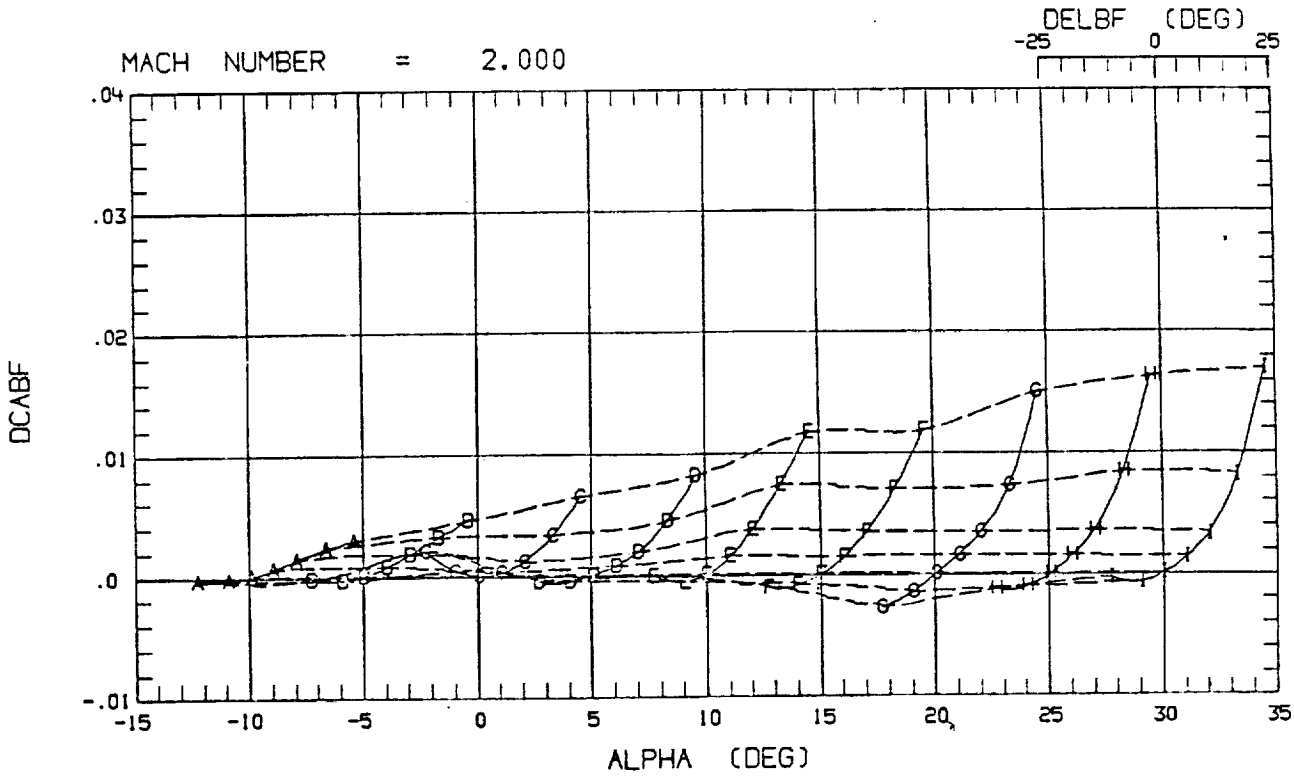
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00083	0.00089	0.00149	0.00146	0.00100	0.00378	0.00497	0.00620
-5.000	-0.00012	-0.00015	-0.00014	-0.00041	-0.00061	-0.00002	0.00029	0.00057
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00136	0.00097	0.00180	0.00369	0.00402	0.00510	0.00531	0.00540
10.000	0.00315	0.00274	0.00455	0.00733	0.00770	0.01046	0.01113	0.01237
16.300	0.00540	0.00597	0.00846	0.01208	0.01271	0.01703	0.01806	0.01974
22.500	0.00754	0.01020	0.01272	0.01718	0.01875	0.02394	0.02531	0.02613

ENGINEER WM3
DATE 9-21-78

FIGURE 4.1.1.2-48
EFFECT OF BODY FLAP

SD SH-0060 IM



CONFIGURATION

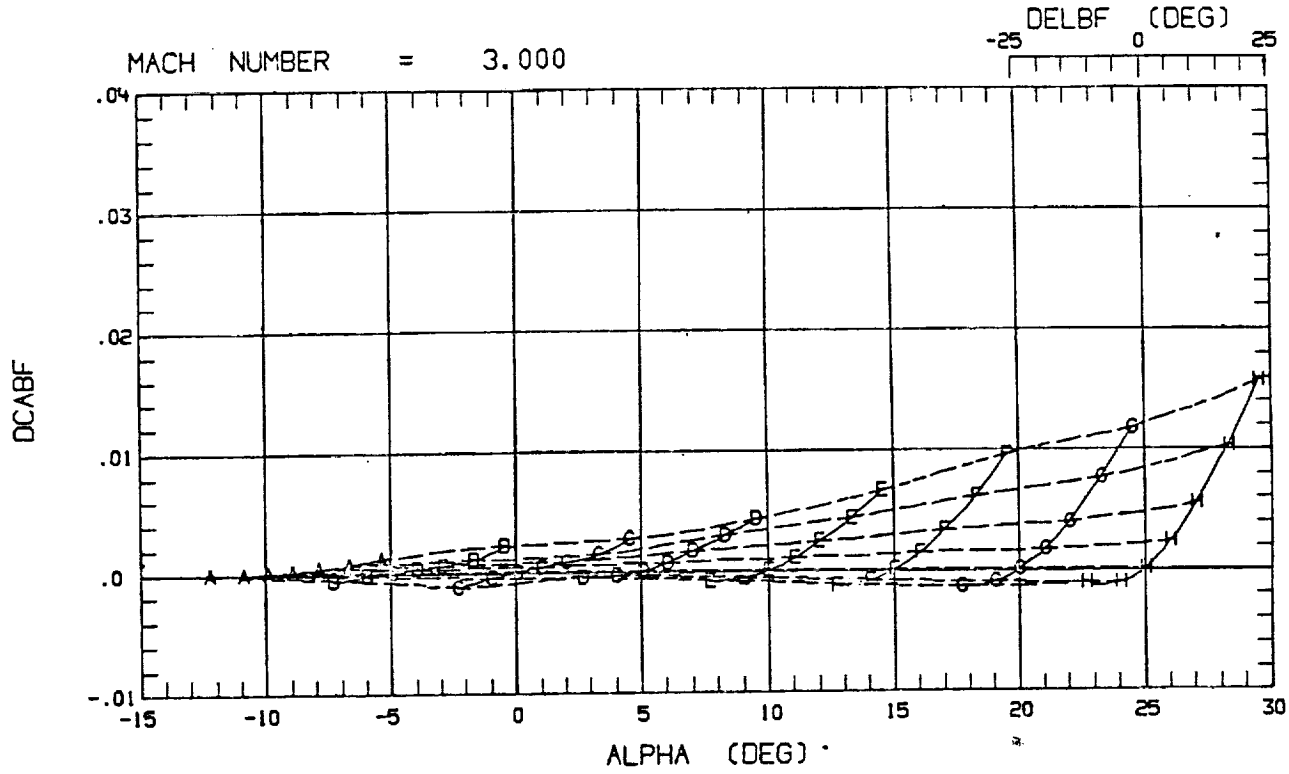
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT								
-11.700	-0.00035	-0.00026	0.00210	-0.00048	-0.00010	-0.00115	-0.00279	-0.00130	-0.00032
-5.000	-0.00028	-0.00032	0.00044	-0.00048	-0.00057	-0.00089	-0.00144	-0.00103	-0.00070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00064	0.00079	0.00026	0.00080	0.00149	0.00146	0.00161	0.00151	0.00131
10.000	0.00141	0.00185	0.00122	0.00197	0.00376	0.00348	0.00340	0.00360	0.00326
16.300	0.00226	0.00321	0.00336	0.00441	0.00740	0.00698	0.00725	0.00834	0.00805
22.500	0.00295	0.00456	0.00648	0.00811	0.01170	0.01181	0.01494	0.01626	0.01691

ENGINEER WMZ
DATE 9-27-78

FIGURE 4.1.1.2-49
EFFECT OF BODY FLAP

SD 78-SH-0050, IM



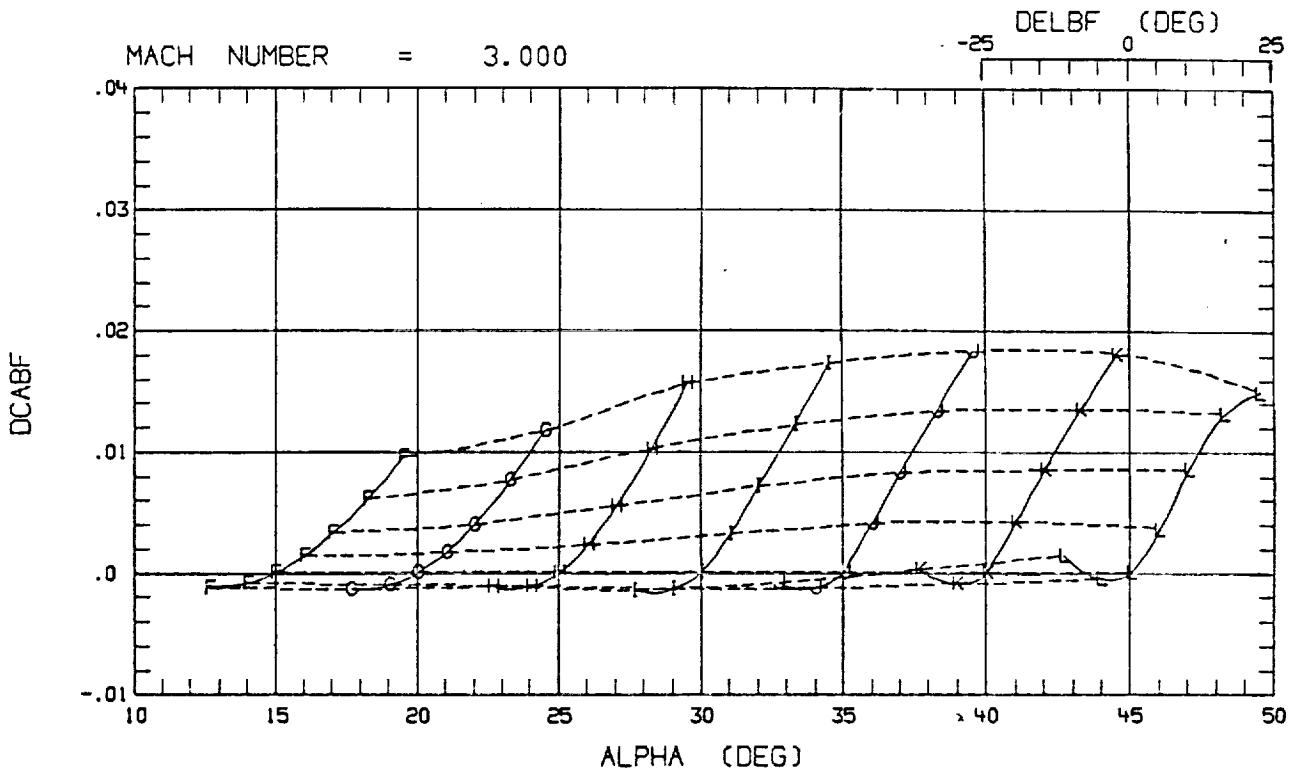
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00009	-0.00065	-0.00119	-0.00047	-0.00083	-0.00120	-0.00141	-0.00117
-5.000	-0.00008	-0.00029	-0.00049	-0.00037	-0.00059	-0.00084	-0.00102	-0.00113
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00014	0.00029	0.00044	0.00071	0.00102	0.00143	0.00163	0.00227
10.000	0.00035	0.00056	0.00081	0.00164	0.00240	0.00330	0.00401	0.00547
16.300	0.00069	0.00098	0.00136	0.00293	0.00440	0.00616	0.00763	0.01024
22.500	0.00113	0.00221	0.00267	0.00430	0.00661	0.00960	0.01176	0.01563

ENGINEER Wm Z
DATE 9-21-78

FIGURE 4.1.1.2-50
EFFECT OF BODY FLAP

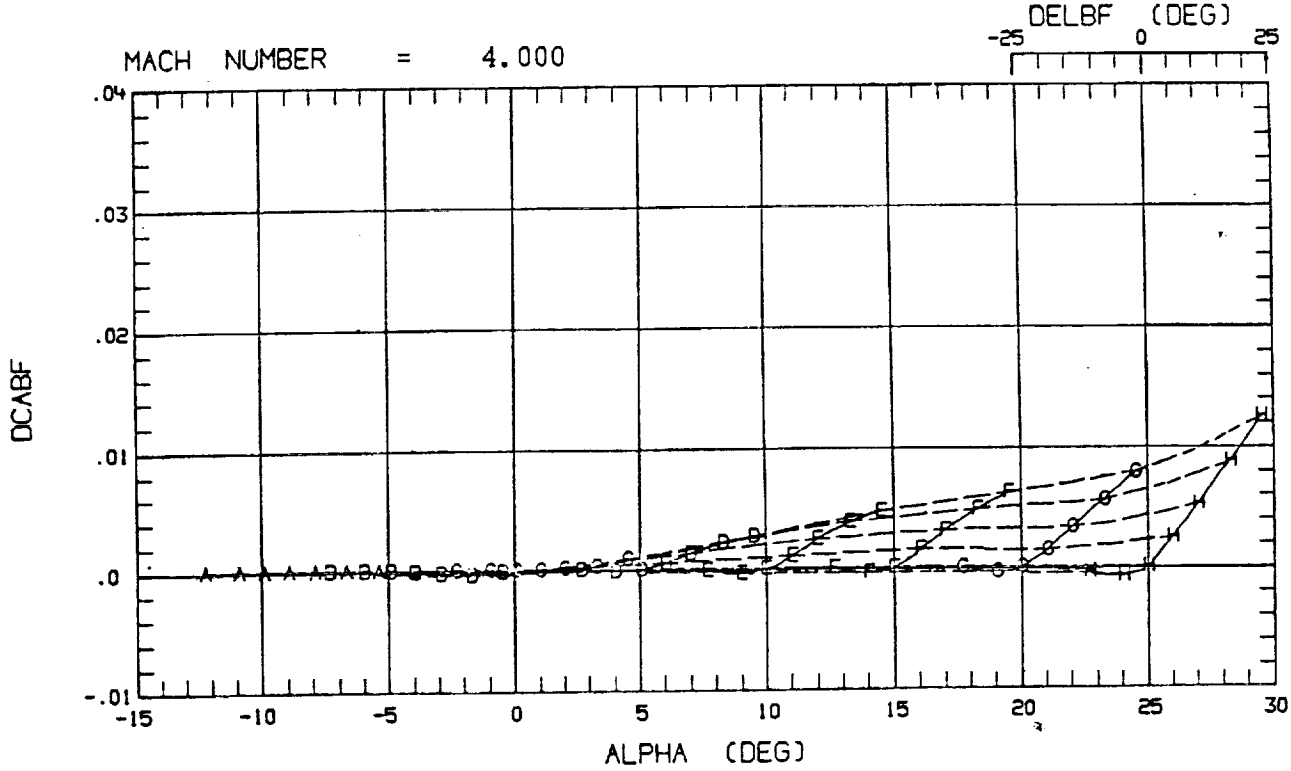


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT						
-11.700	-0.00120	-0.00141	-0.00117	-0.00151	-0.00090	0.00025	0.00141
-5.000	-0.00084	-0.00102	-0.00113	-0.00138	-0.00127	-0.00091	-0.00050
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00143	0.00163	0.00227	0.00318	0.00410	0.00421	0.00357
10.000	0.00330	0.00401	0.00547	0.00708	0.00824	0.00849	0.00858
16.300	0.00616	0.00763	0.01024	0.01215	0.01335	0.01350	0.01308
22.500	0.00960	0.01176	0.01563	0.01729	0.01830	0.01805	0.01485

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-51
EFFECT OF BODY FLAP

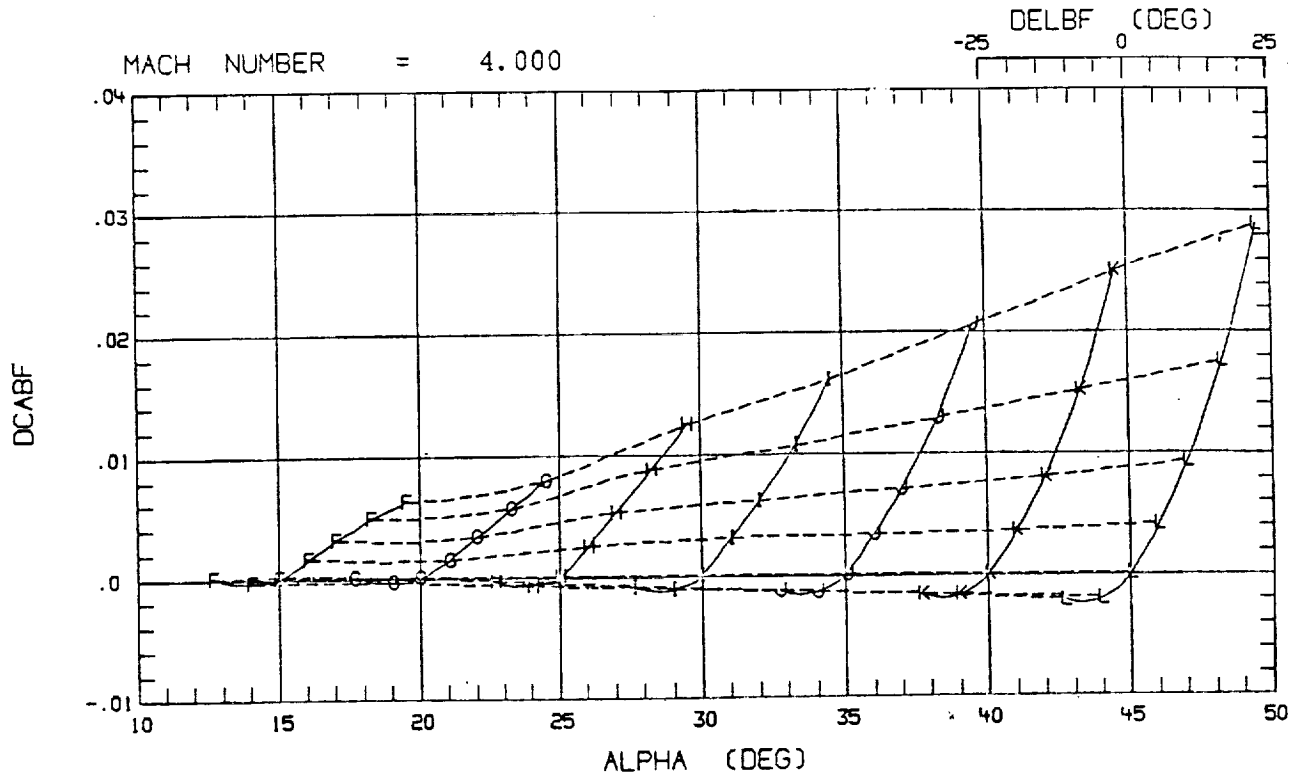


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.0	0.0	-0.00002	-0.00010	0.0	0.00008	-0.00031
-5.000	0.0	0.00003	-0.00002	-0.00016	-0.00031	-0.00036	-0.00039	-0.00075
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00001	-0.00010	0.00004	0.00058	0.00104	0.00149	0.00147	0.00247
10.000	0.00003	-0.00026	0.00010	0.00135	0.00240	0.00310	0.00330	0.00526
16.300	0.00005	-0.00038	0.00030	0.00215	0.00380	0.00484	0.00562	0.00883
22.500	0.0	-0.00008	0.00090	0.00271	0.00473	0.00625	0.00791	0.01241

ENGINEER WMZ
DATE 9-5-78

FIGURE 4.1.1.2-52
EFFECT OF BODY FLAP

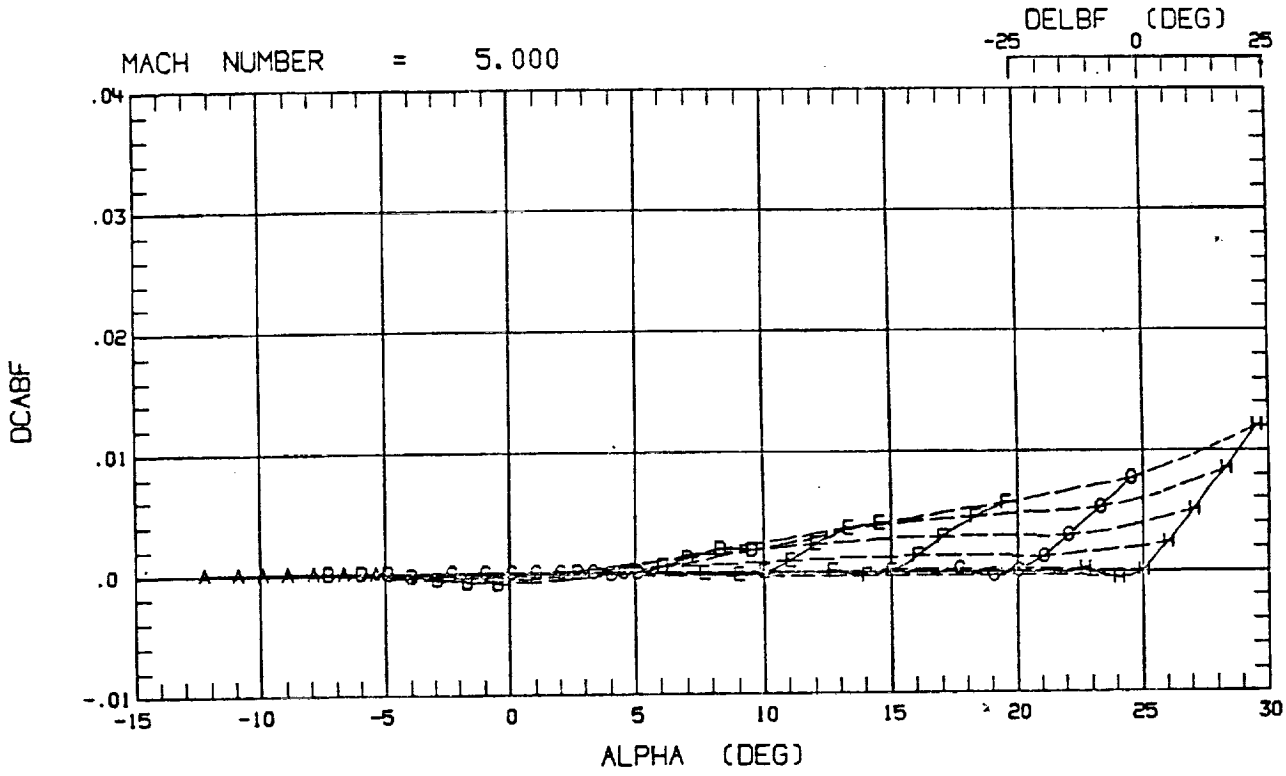


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT						
-11.700	0.0	0.00008	-0.00031	-0.00091	-0.00128	-0.00164	-0.00216
-5.000	-0.00036	-0.00039	-0.00075	-0.00108	-0.00137	-0.00165	-0.00199
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00149	0.00147	0.00247	0.00309	0.00331	0.00357	0.00410
10.000	0.00310	0.00330	0.00526	0.00615	0.00704	0.00799	0.00933
16.300	0.00484	0.00562	0.00883	0.01066	0.01290	0.01515	0.01750
22.500	0.00625	0.00791	0.01241	0.01601	0.02054	0.02497	0.02887

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-53
EFFECT OF BODY FLAP

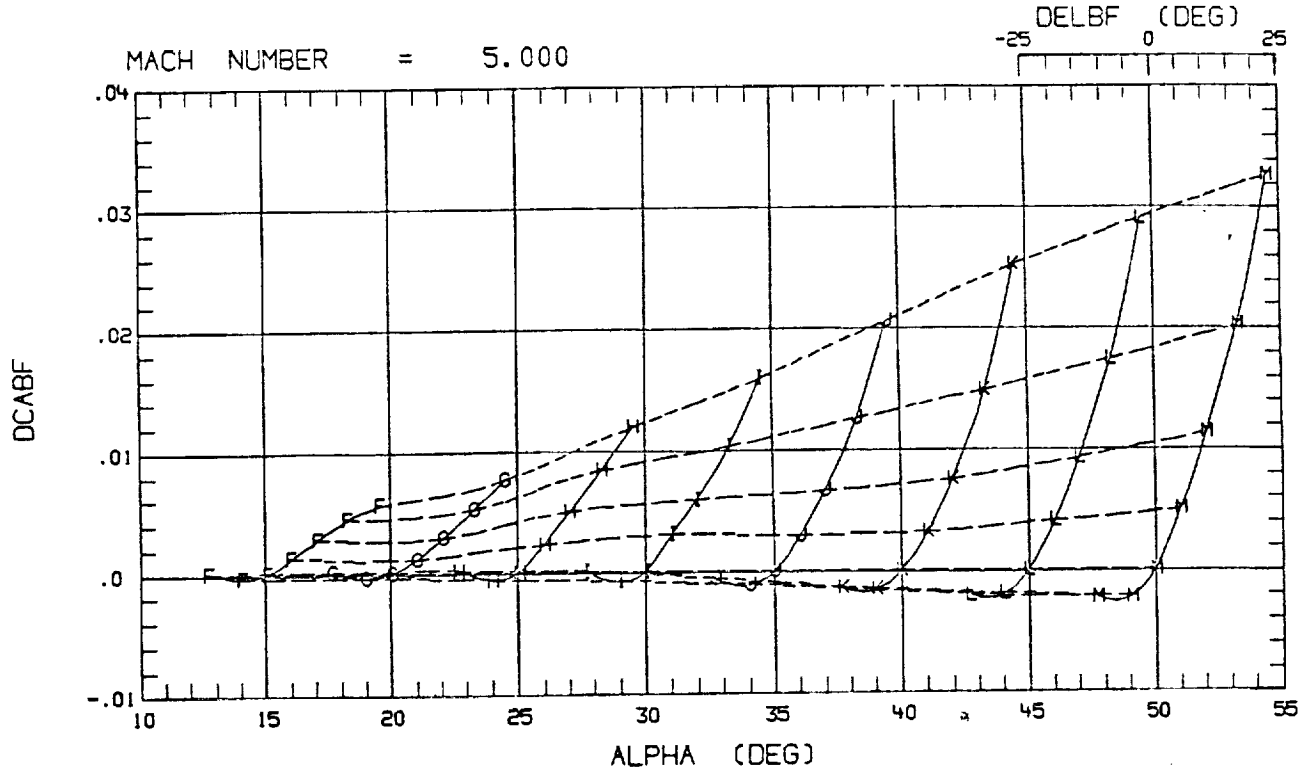


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.00001	0.0	-0.00002	-0.00009	0.00003	0.00017	0.00021
-5.000	0.0	0.00005	0.0	-0.00015	-0.00029	-0.00032	-0.00033	-0.00055
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00018	0.0	0.00048	0.00092	0.00130	0.00121	0.00237
10.000	0.0	-0.00045	0.0	0.00122	0.00227	0.00288	0.00290	0.00502
16.300	0.0	-0.00070	0.0	0.00188	0.00352	0.00450	0.00521	0.00844
22.500	0.0	-0.00080	0.0	0.00180	0.00391	0.00566	0.00765	0.01193

ENGINEER LWM2
DATE 9-21-78

FIGURE 4.1.1.2-54
EFFECT OF BODY FLAP



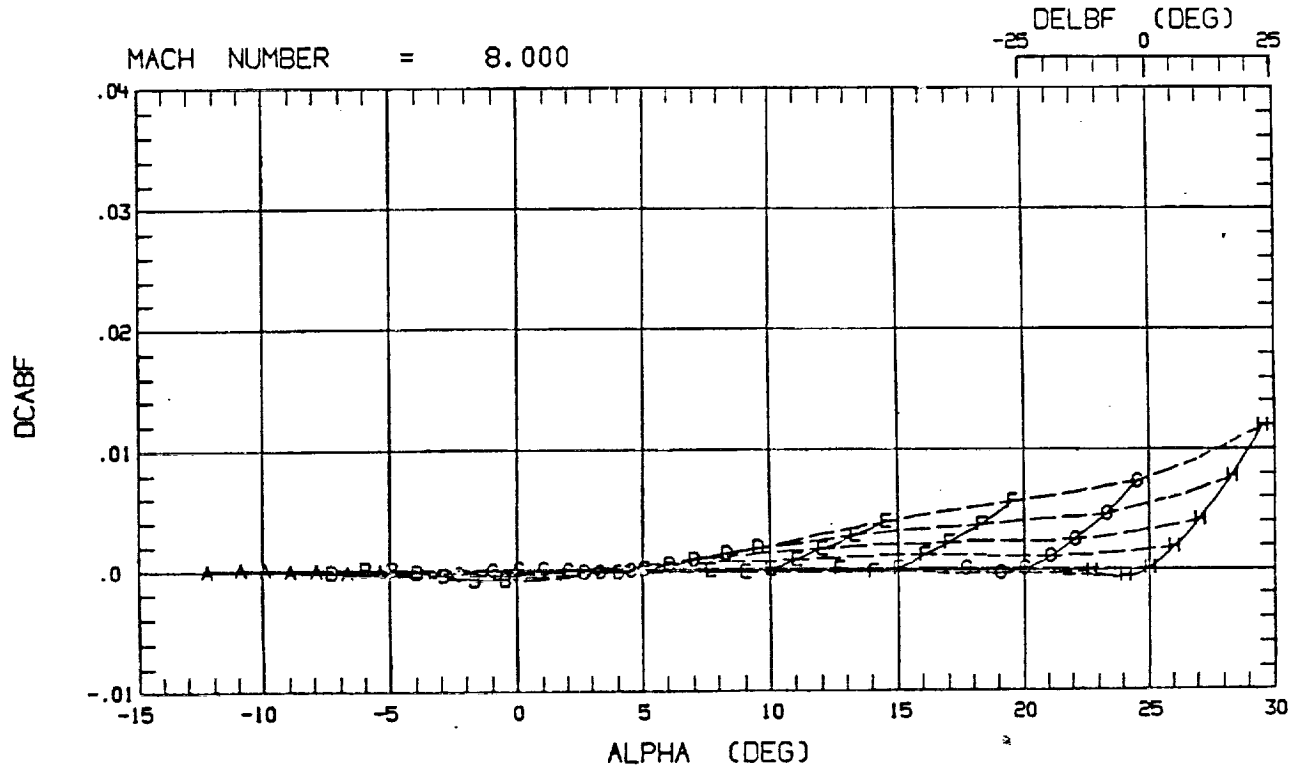
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00003	0.00017	0.00021	0.00003	-0.00062	-0.00140	-0.00198	-0.00221
-5.000	-0.00032	-0.00033	-0.00055	-0.00074	-0.00113	-0.00155	-0.00192	-0.00220
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00130	0.00121	0.00237	0.00307	0.00294	0.00321	0.00403	0.00500
10.000	0.00288	0.00290	0.00502	0.00591	0.00659	0.00750	0.00928	0.01126
16.300	0.00450	0.00521	0.00844	0.01028	0.01258	0.01488	0.01743	0.02014
22.500	0.00566	0.00765	0.01193	0.01588	0.02062	0.02522	0.02907	0.03265

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-55
EFFECT OF BODY FLAP

SD72-SH-0060 IM

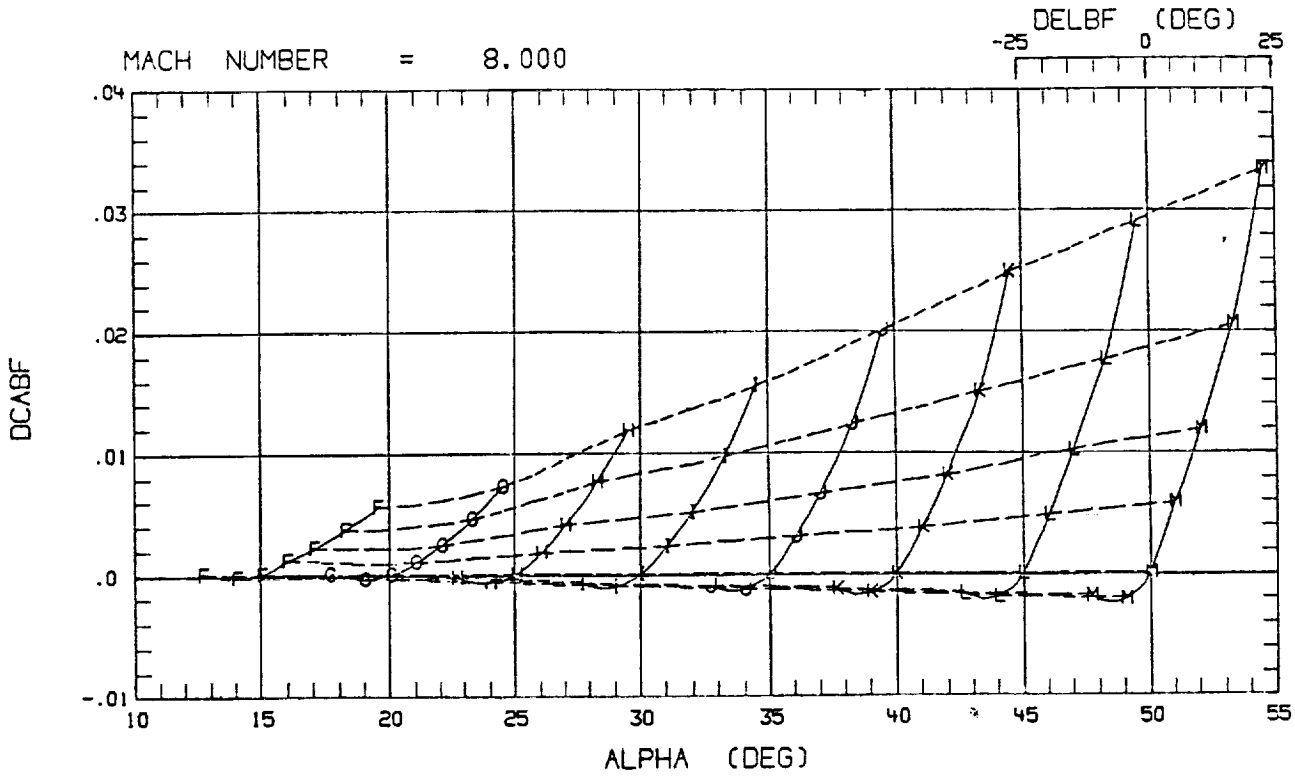


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00005	-0.00023	-0.00030	-0.00023	-0.00004	0.00003	0.00002	-0.00029
-5.000	-0.00001	-0.00002	-0.00008	-0.00017	-0.00022	-0.00027	-0.00033	-0.00066
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00004	-0.00021	-0.00003	0.00037	0.00083	0.00116	0.00101	0.00176
10.000	-0.00012	-0.00054	-0.00014	0.00080	0.00171	0.00221	0.00242	0.00409
16.300	-0.00020	-0.00083	-0.00020	0.00128	0.00278	0.00373	0.00462	0.00764
22.500	-0.00013	-0.00092	-0.00010	0.00181	0.00402	0.00559	0.00729	0.01182

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-56
EFFECT OF BODY FLAP



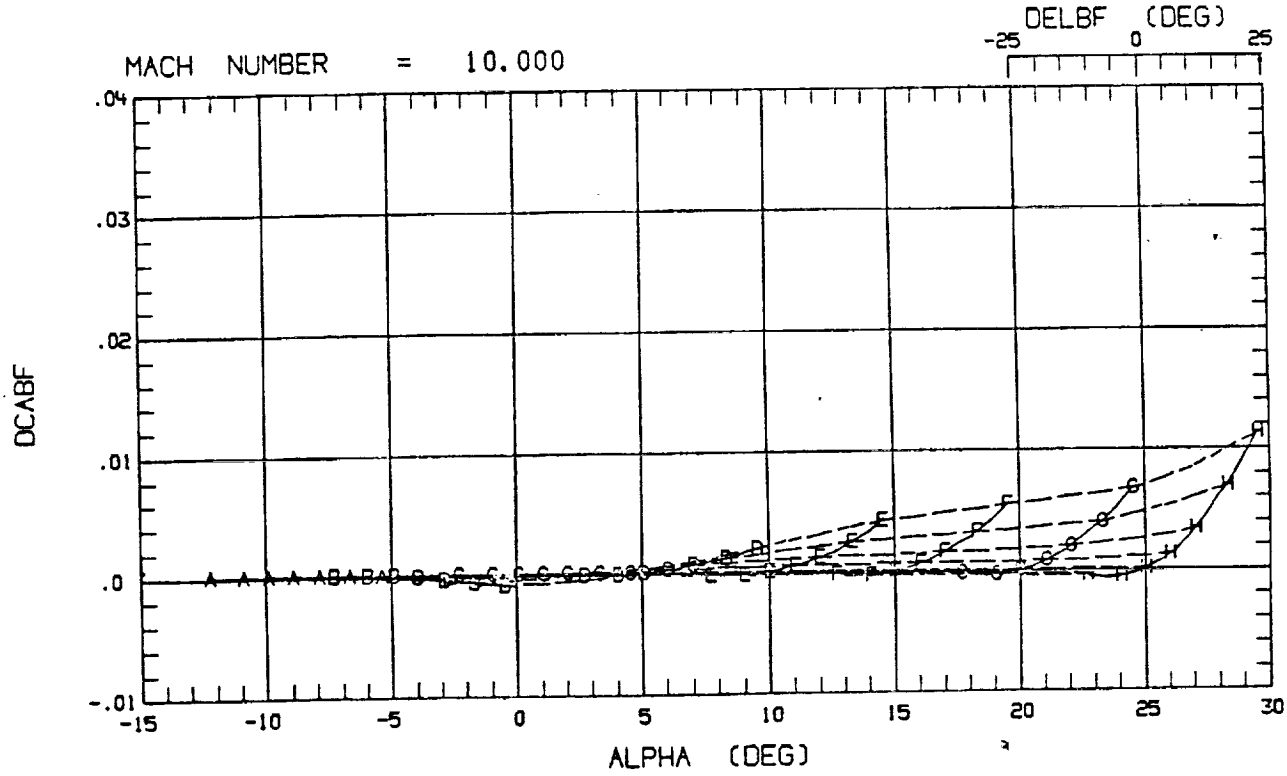
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00003	0.00002	-0.00029	-0.00076	-0.00099	-0.00123	-0.00160	-0.00183
-5.000	-0.00027	-0.00033	-0.00066	-0.00096	-0.00123	-0.00150	-0.00182	-0.00211
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00116	0.00101	0.00176	0.00233	0.00308	0.00380	0.00482	0.00582
10.000	0.00221	0.00242	0.00409	0.00511	0.00660	0.00819	0.01024	0.01187
16.300	0.00373	0.00462	0.00764	0.00963	0.01229	0.01501	0.01768	0.02056
22.500	0.00559	0.00729	0.01182	0.01546	0.02005	0.02487	0.02911	0.03346

ENGINEER WMZ
DATE 9-26-78

FIGURE 4.1.1.2-57
EFFECT OF BODY FLAP



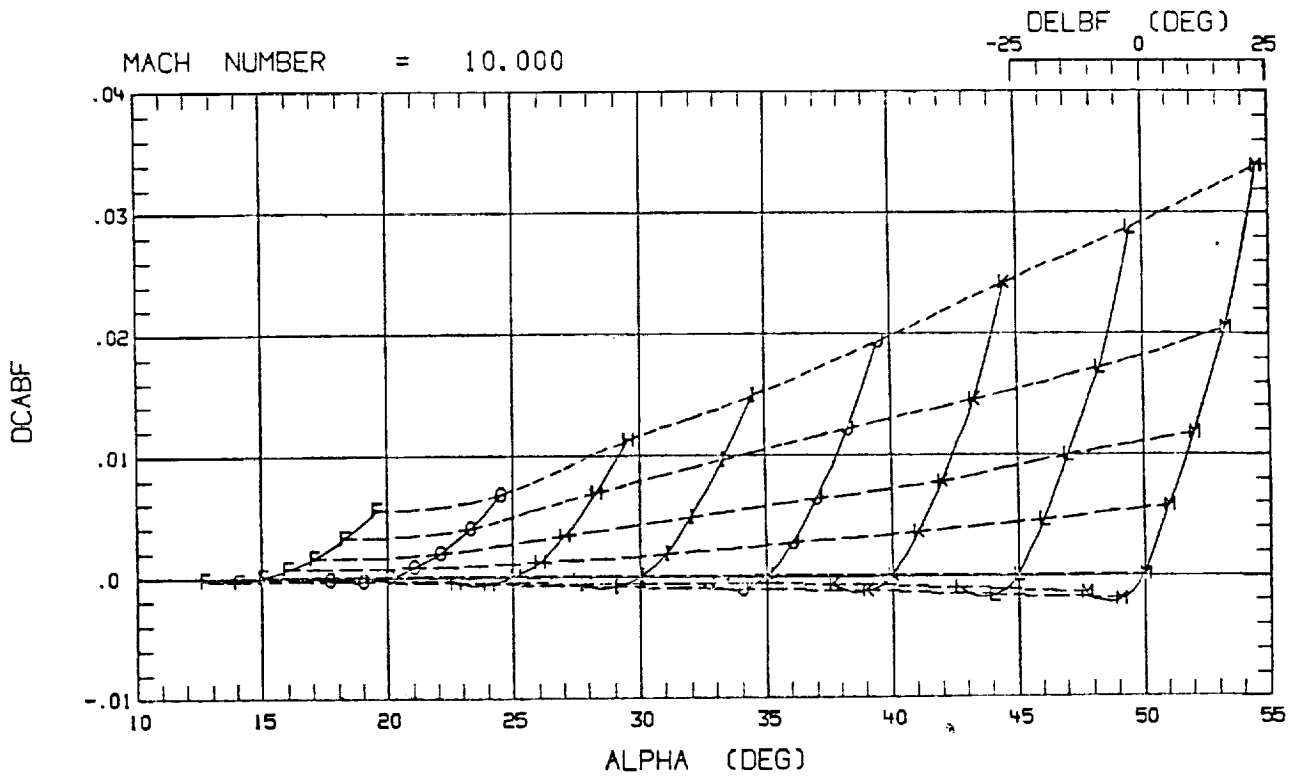
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.00001	0.0	-0.00005	-0.00017	-0.00024	-0.00027	-0.00044
-5.000	0.0	0.00005	0.0	-0.00010	-0.00023	-0.00031	-0.00038	-0.00065
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00013	0.0	0.00025	0.00049	0.00063	0.00073	0.00112
10.000	0.0	-0.00030	0.0	0.00060	0.00118	0.00152	0.00191	0.00332
16.300	0.0	-0.00055	0.0	0.00117	0.00239	0.00317	0.00402	0.00692
22.500	0.0	-0.00080	0.0	0.00197	0.00417	0.00546	0.00671	0.01122

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-58
EFFECT OF BODY FLAP



CONFIGURATION

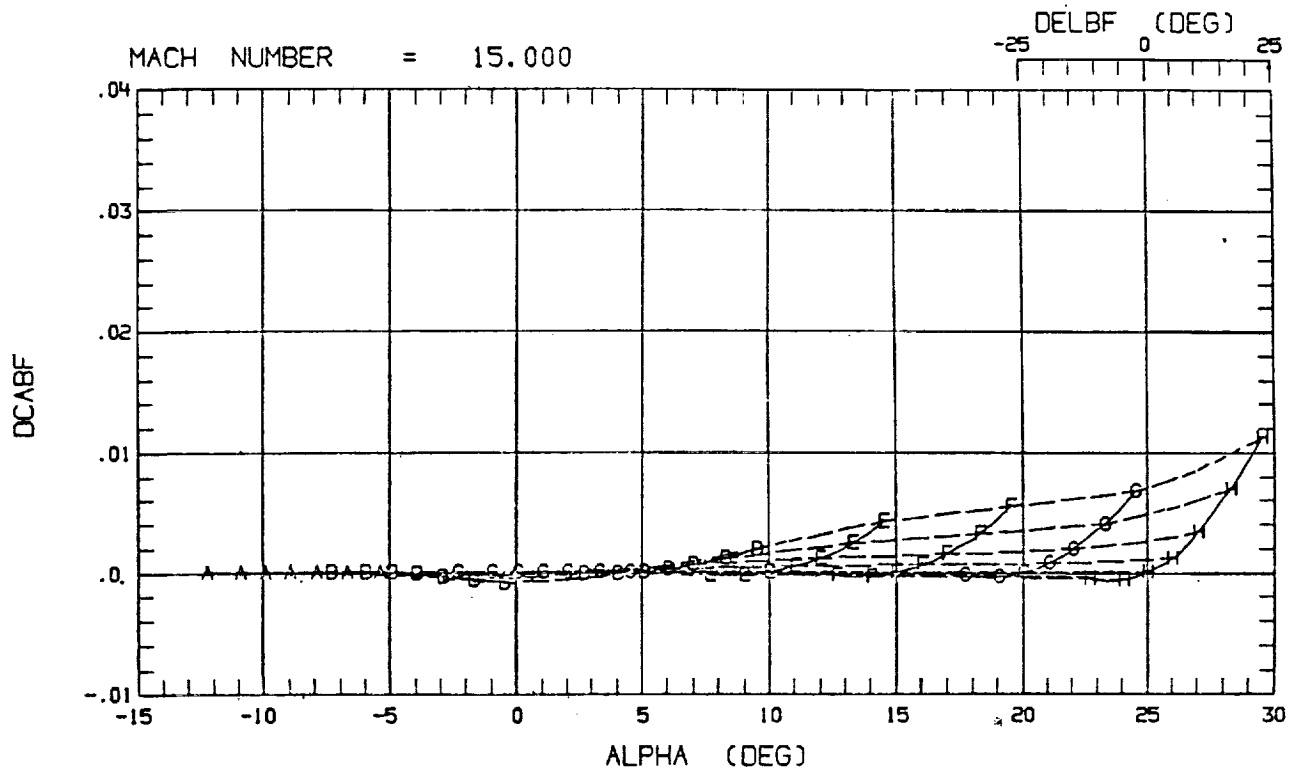
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00024	-0.00027	-0.00044	-0.00064	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00031	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00063	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00576
10.000	0.00152	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00317	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00546	0.00671	0.01122	0.01483	0.01931	0.02420	0.02876	0.03377

ENGINEER WMZ
DATE 9-26-78

FIGURE 4.1.1.2-59
EFFECT OF BODY FLAP

SL 78-3H-0060 IM



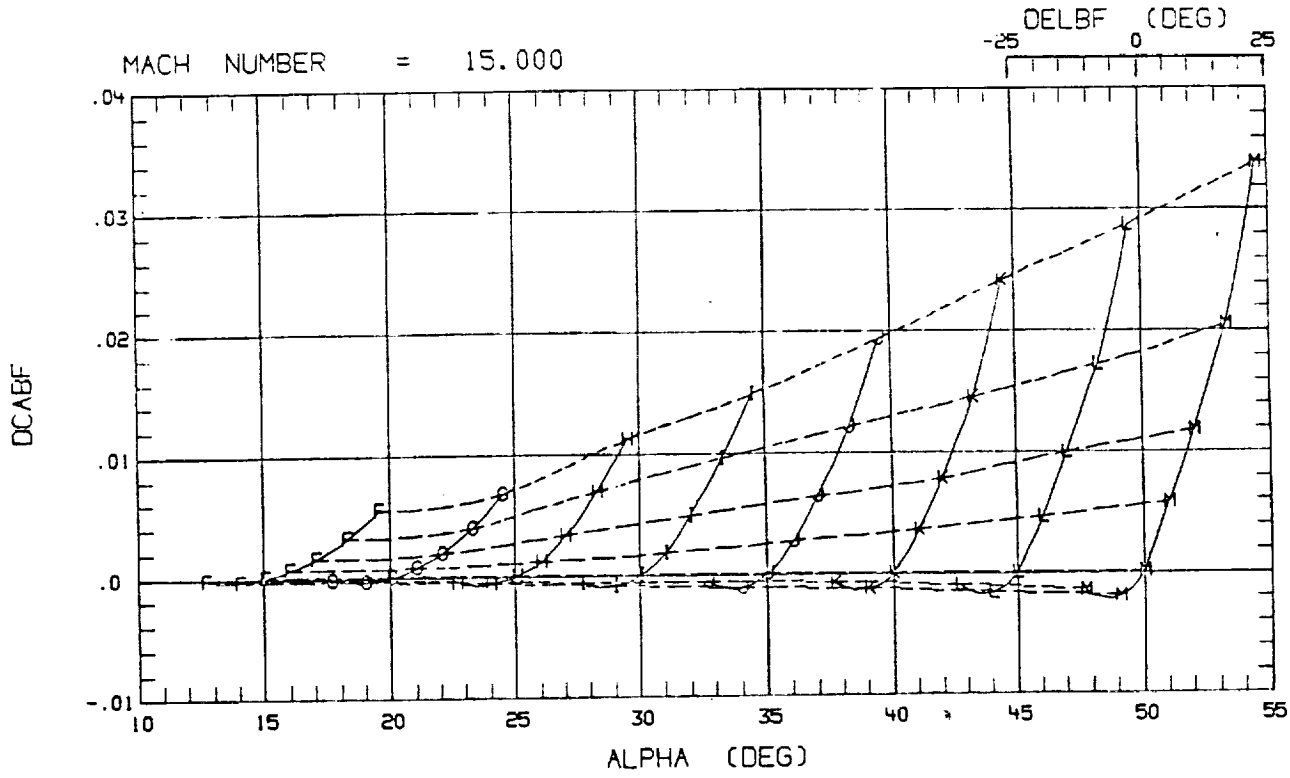
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.00001	0.0	-0.00005	-0.00017	-0.00024	-0.00027	-0.00044
-5.000	0.0	0.00005	0.0	-0.00010	-0.00023	-0.00031	-0.00038	-0.00065
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00013	0.0	0.00025	0.00049	0.00063	0.00073	0.00112
10.000	0.0	-0.00030	0.0	0.00060	0.00118	0.00152	0.00191	0.00332
16.300	0.0	-0.00055	0.0	0.00117	0.00239	0.00317	0.00402	0.00692
22.500	0.0	-0.00080	0.0	0.00197	0.00417	0.00546	0.00671	0.01122

ENGINEER WMZ
DATE 9-26-78

FIGURE 4.1.1.2-60
EFFECT OF BODY FLAP



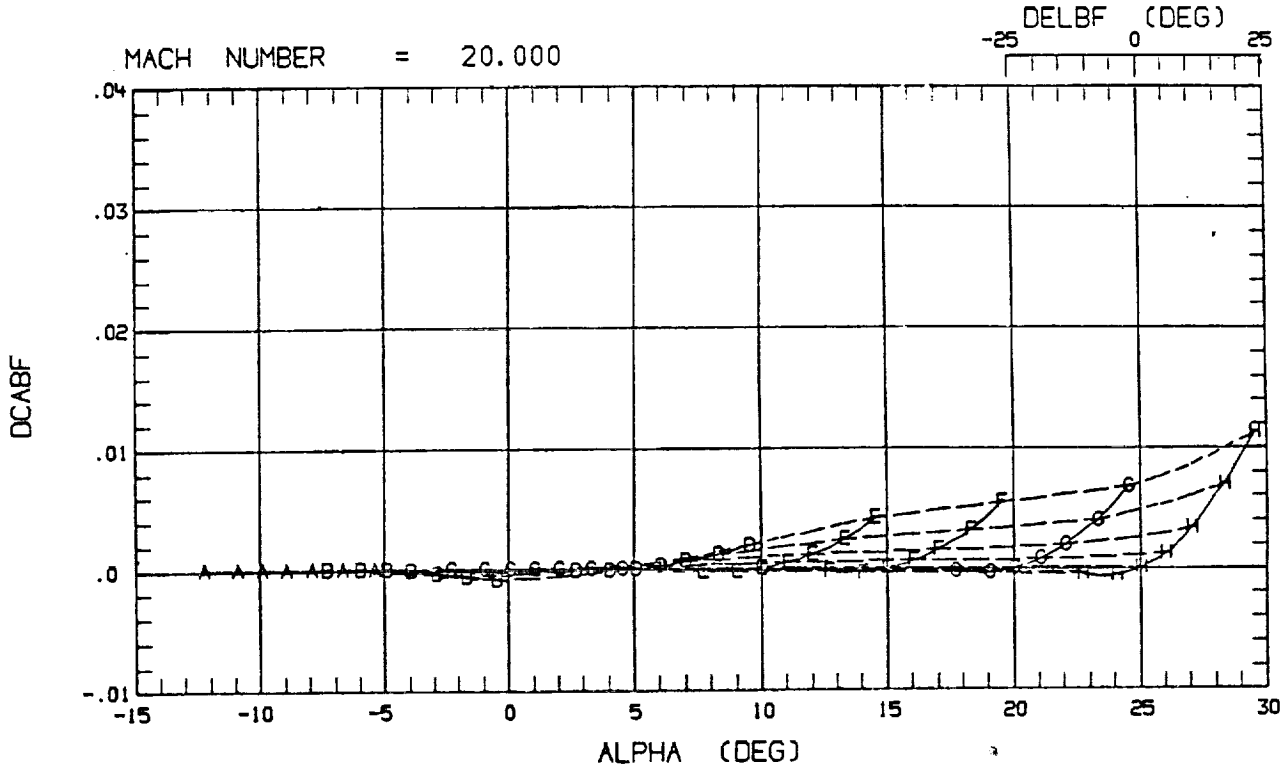
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00024	-0.00027	-0.00044	-0.00064	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00031	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00063	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00575
10.000	0.00152	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00317	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00546	0.00671	0.01122	0.01483	0.01931	0.02420	0.02876	0.03377

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-61
EFFECT OF BODY FLAP

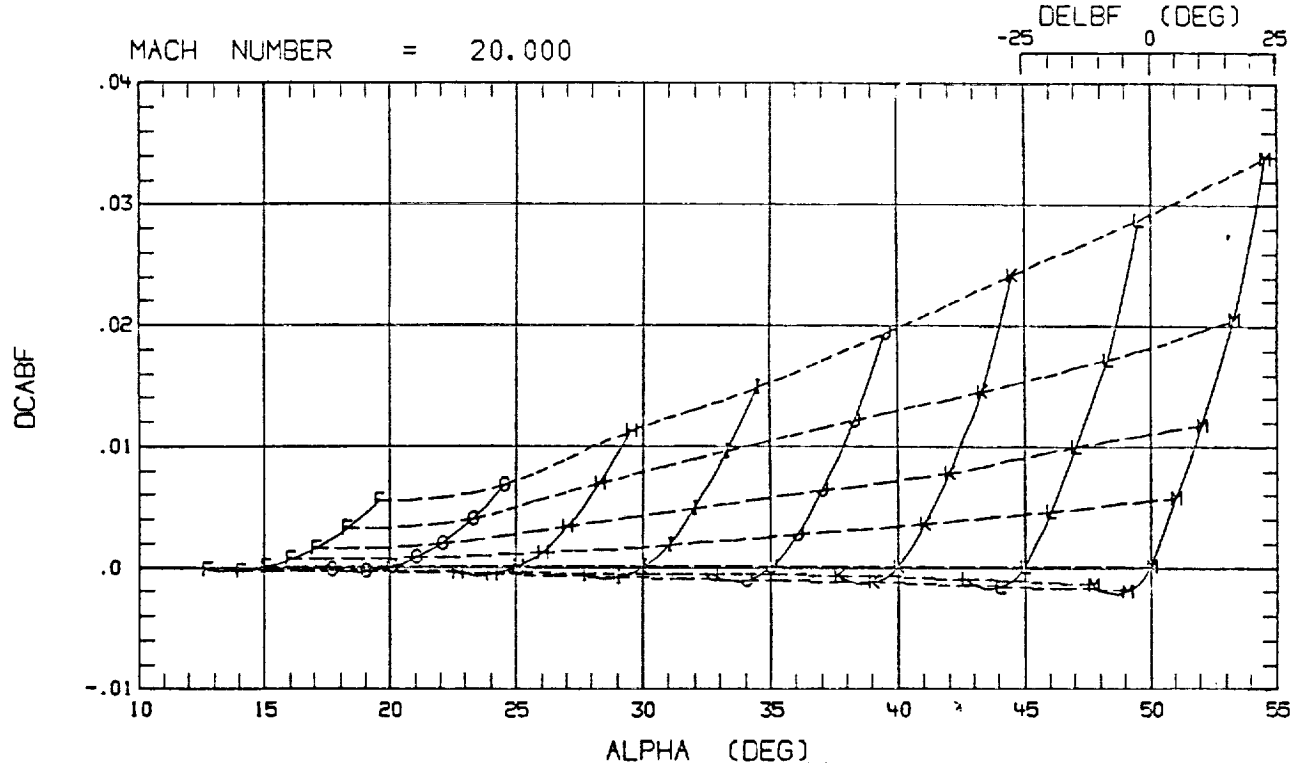


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.00001	0.0	-0.00005	-0.00017	-0.00024	-0.00027	-0.00044
-5.000	0.0	0.00005	0.0	-0.00010	-0.00023	-0.00031	-0.00038	-0.00065
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00013	0.0	0.00025	0.00049	0.00063	0.00073	0.00112
10.000	0.0	-0.00030	0.0	0.00060	0.00118	0.00152	0.00191	0.00332
16.300	0.0	-0.00055	0.0	0.00117	0.00239	0.00317	0.00402	0.00692
22.500	0.0	-0.00080	0.0	0.00197	0.00417	0.00546	0.00671	0.01122

ENGINEER WMR
DATE 9-21-78

FIGURE 4.1.1.2-62
EFFECT OF BODY FLAP

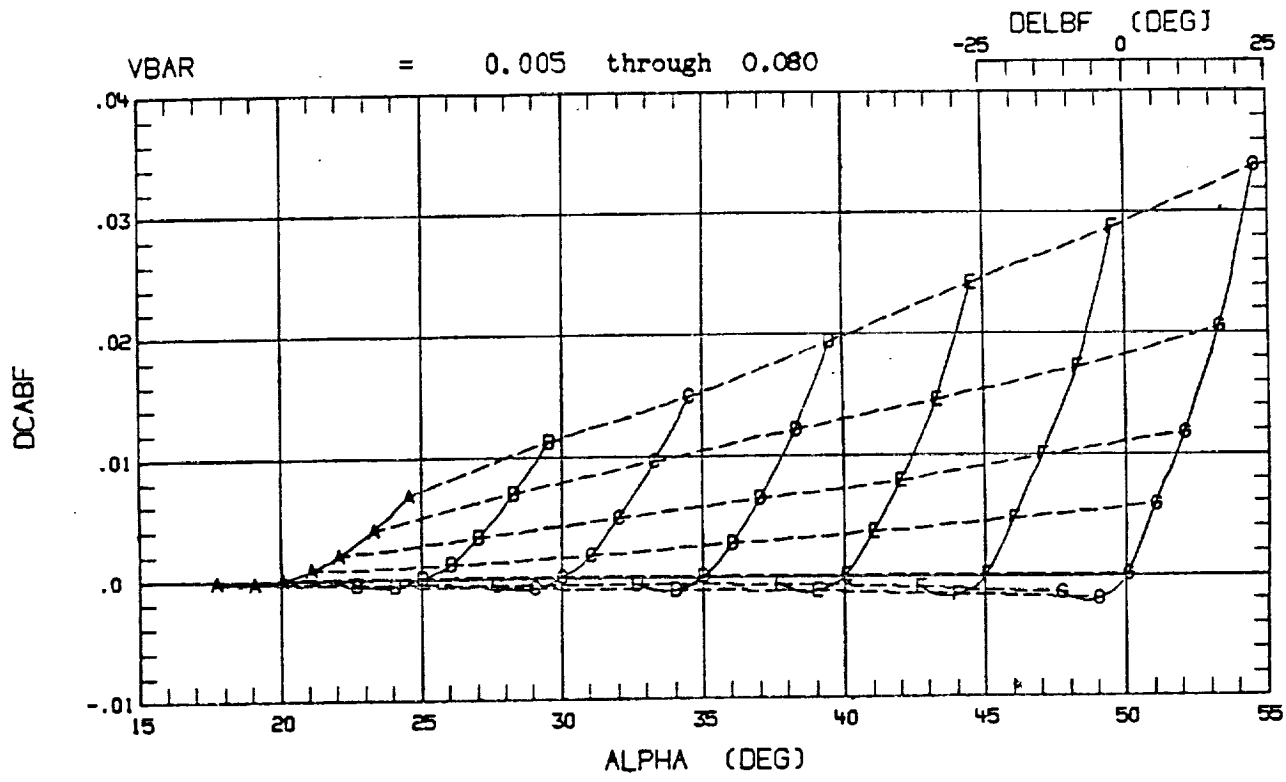


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00024	-0.00027	-0.00044	-0.00064	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00031	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00063	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00576
10.000	0.00152	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00317	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00546	0.00671	0.01122	0.01483	0.01931	0.02420	0.02876	0.03377

ENGINEER wmz
DATE 9-21-78

FIGURE 4.1.1.2-63
EFFECT OF BODY FLAP

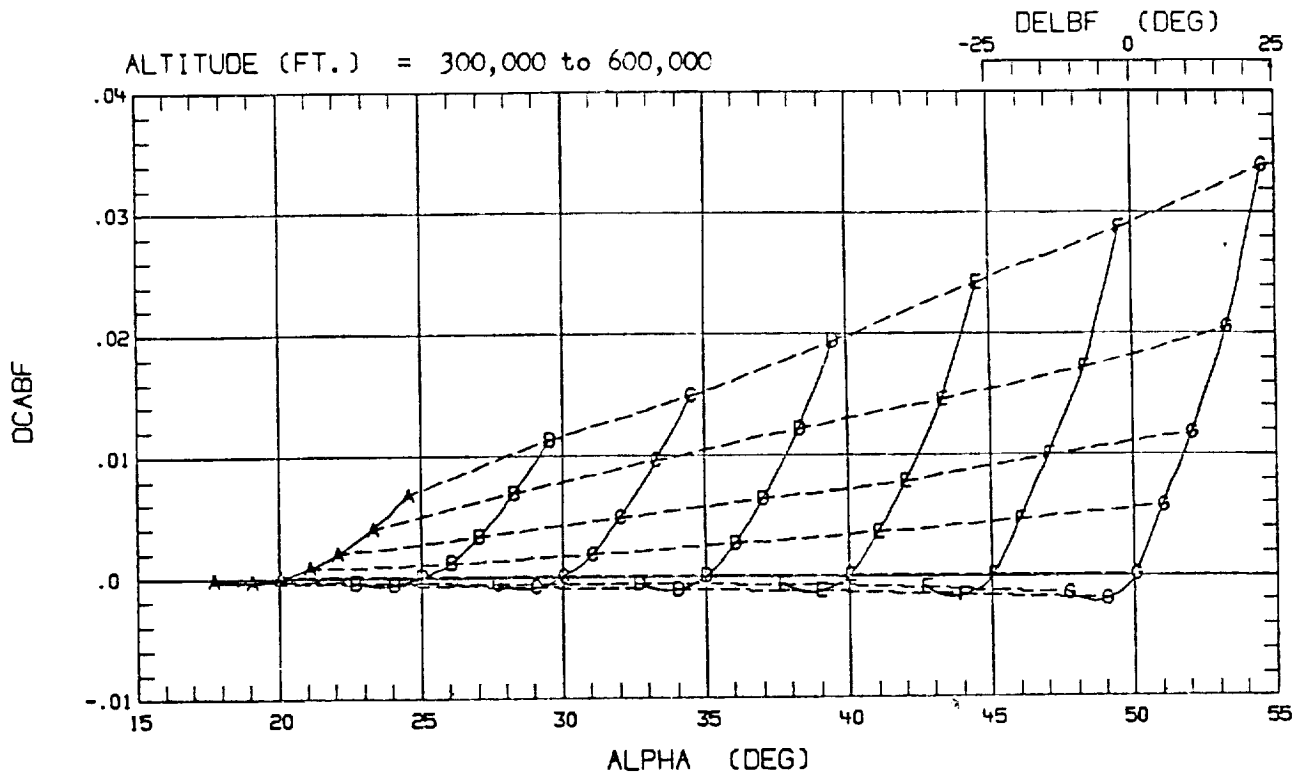


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT						
-11.700	-0.00027	-0.00044	-0.00064	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00576
10.000	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00671	0.01122	0.01483	0.01931	0.02420	0.02876	0.03377

ENGINEER_____
DATE_____

FIGURE 4.1.1.2- 64
EFFECT OF BODY FLAP



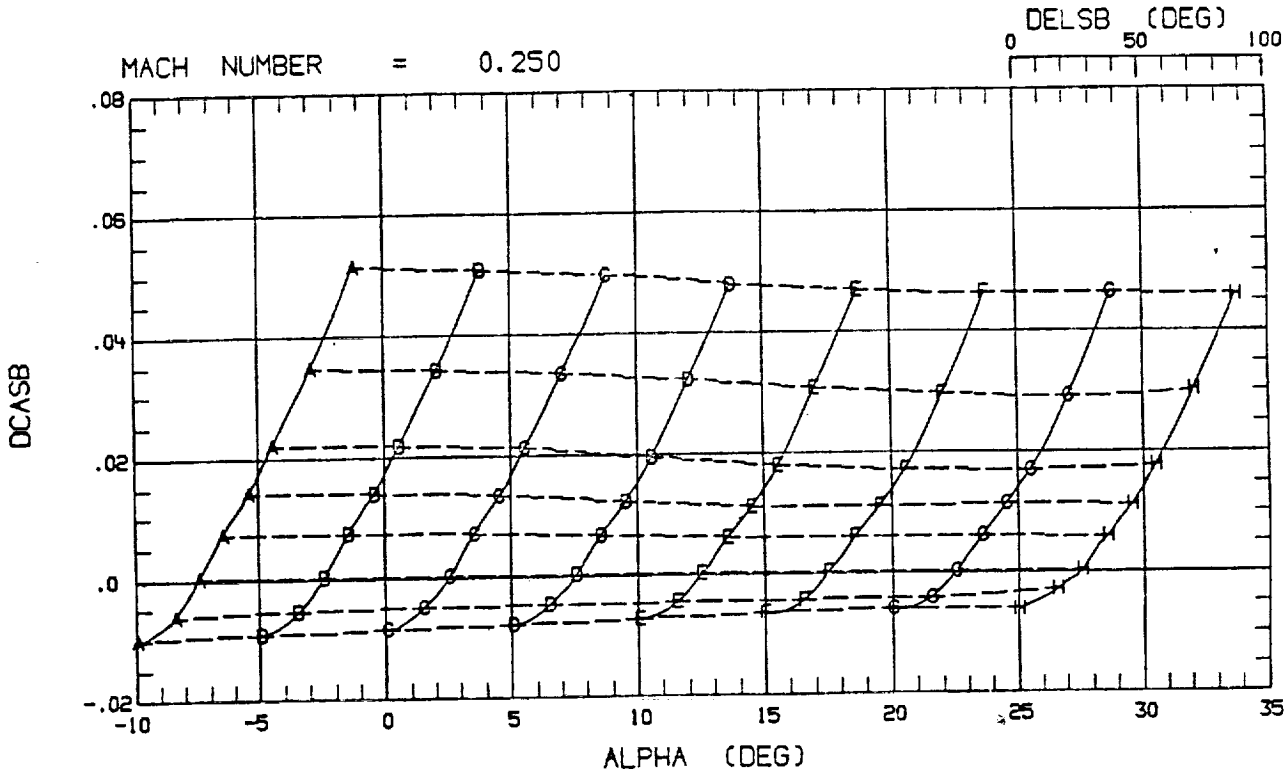
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT						
-11.700	-0.00027	-0.00044	-0.00064	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00576
10.000	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00671	0.01122	0.01483	0.01931	0.02420	0.02876	0.03377

ENGINEER_____
DATE_____

FIGURE 4.1.1.2-65
EFFECT OF BODY FLAP



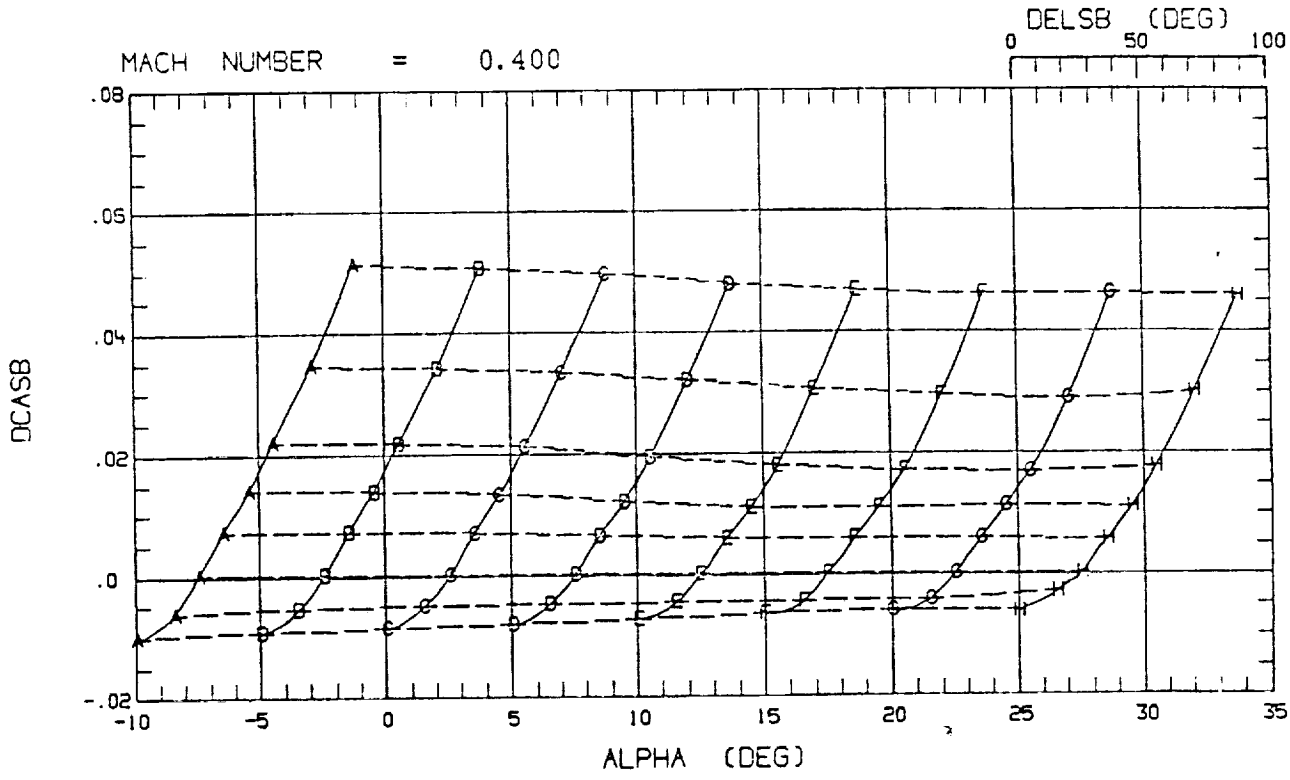
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.01009	-0.00923	-0.00870	-0.00809	-0.00730	-0.00659	-0.00593	-0.00634
15.000	-0.00620	-0.00550	-0.00500	-0.00483	-0.00463	-0.00442	-0.00419	-0.00296
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00718	0.00720	0.00700	0.00646	0.00597	0.00590	0.00581	0.00568
45.000	0.01401	0.01388	0.01330	0.01203	0.01088	0.01098	0.01113	0.01099
55.000	0.02184	0.02172	0.02100	0.01930	0.01775	0.01703	0.01688	0.01757
70.000	0.03448	0.03407	0.03340	0.03191	0.03046	0.02942	0.02893	0.03003
87.200	0.05123	0.05055	0.04960	0.04784	0.04669	0.04614	0.04616	0.04585

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.2- 66
EFFECT OF SPEEDBRAKE



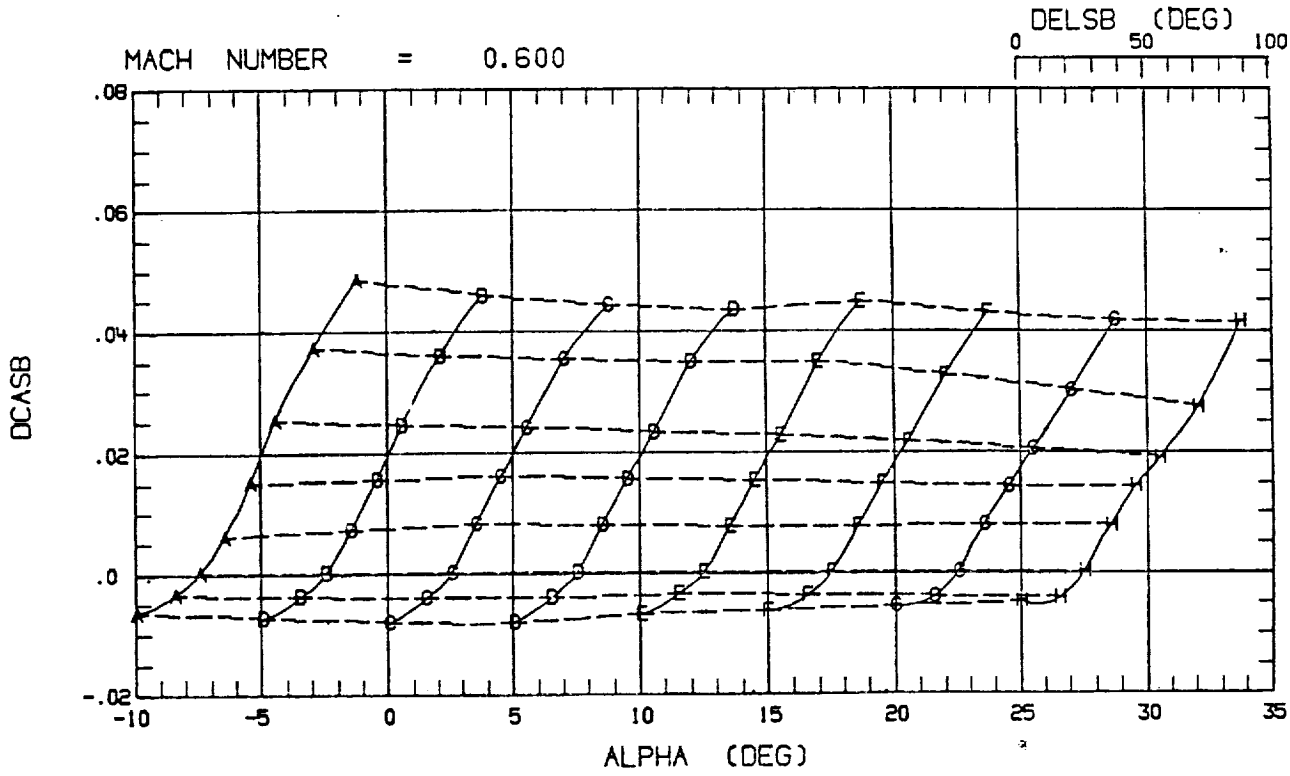
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.01009	-0.00923	-0.00870	-0.00809	-0.00730	-0.00659	-0.00593	-0.00634
15.000	-0.00620	-0.00550	-0.00500	-0.00483	-0.00463	-0.00442	-0.00419	-0.00296
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00718	0.00720	0.00700	0.00646	0.00597	0.00590	0.00581	0.00568
45.000	0.01401	0.01388	0.01330	0.01203	0.01088	0.01098	0.01113	0.01099
55.000	0.02184	0.02172	0.02100	0.01930	0.01775	0.01703	0.01688	0.01757
70.000	0.03448	0.03407	0.03340	0.03191	0.03046	0.02942	0.02893	0.03003
87.200	0.05123	0.05055	0.04960	0.04784	0.04669	0.04614	0.04616	0.04585

ENGINEER DSD
DATE 10-3-78

FIGURE 4.1.1.2-67
EFFECT OF SPEEDBRAKE

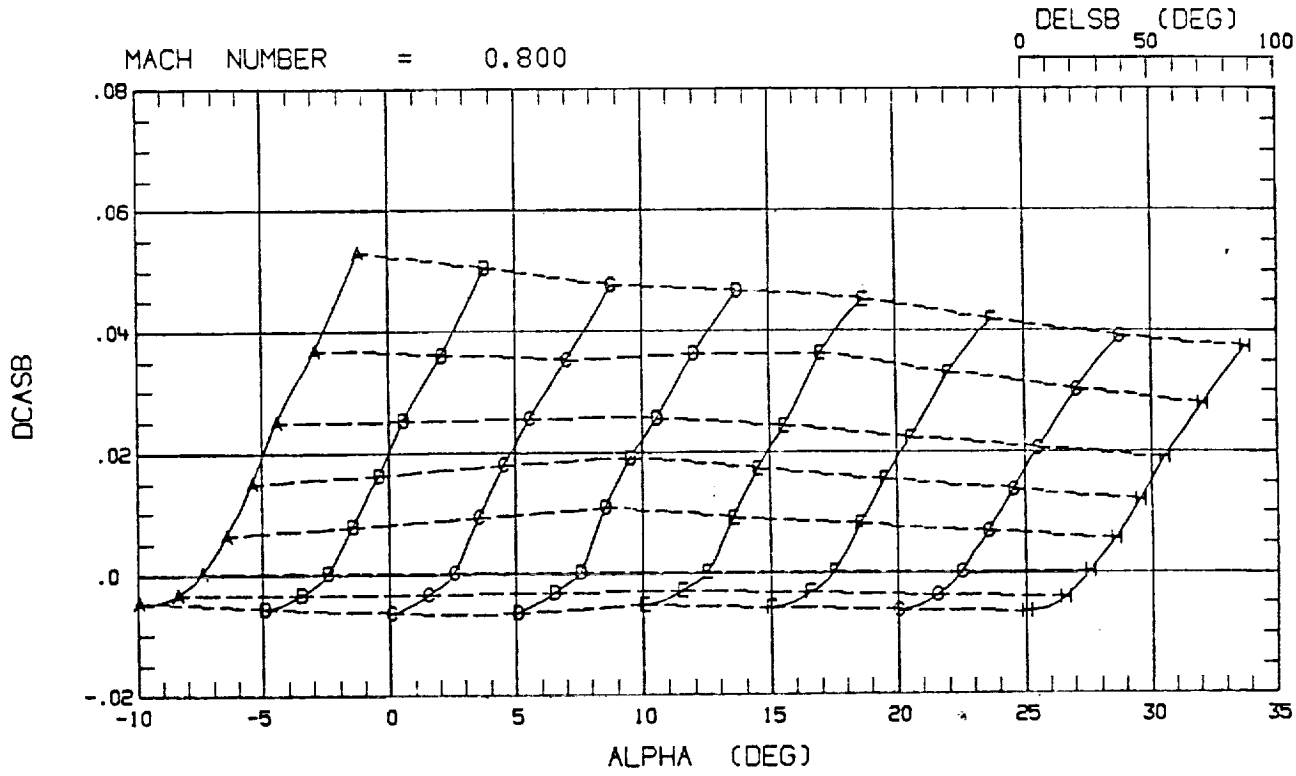


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00658	-0.00728	-0.00806	-0.00819	-0.00679	-0.00619	-0.00552	-0.00479
15.000	-0.00362	-0.00388	-0.00403	-0.00404	-0.00358	-0.00371	-0.00391	-0.00419
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00601	0.00708	0.00811	0.00789	0.00772	0.00761	0.00800	0.00770
45.000	0.01499	0.01549	0.01614	0.01559	0.01530	0.01474	0.01433	0.01418
55.000	0.02518	0.02441	0.02402	0.02318	0.02273	0.02168	0.02038	0.01887
70.000	0.03711	0.03591	0.03528	0.03478	0.03482	0.03252	0.03000	0.02733
87.200	0.04830	0.04583	0.04417	0.04355	0.04472	0.04289	0.04174	0.04135

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.2-68
EFFECT OF SPEEDBRAKE

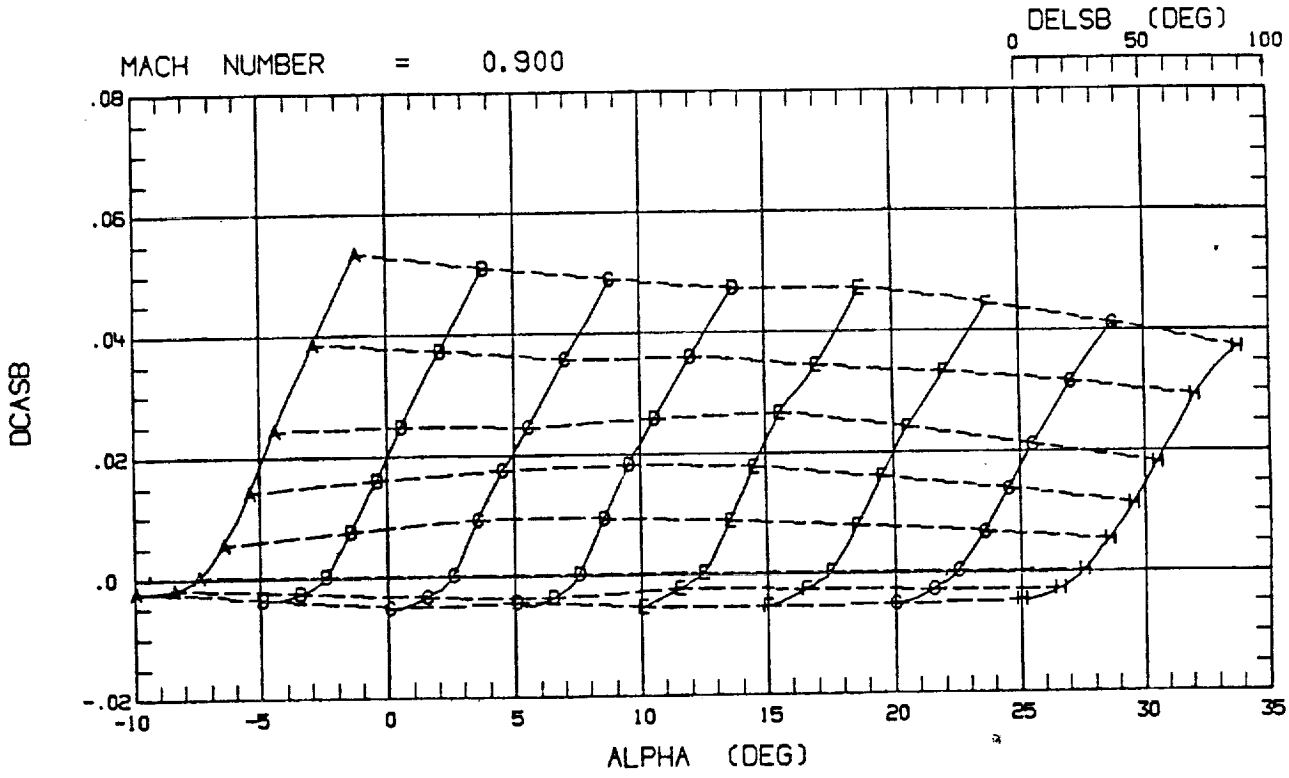


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00477	-0.00572	-0.00663	-0.00656	-0.00536	-0.00579	-0.00621	-0.00660
15.000	-0.00351	-0.00349	-0.00343	-0.00319	-0.00292	-0.00336	-0.00376	-0.00414
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00622	0.00762	0.00911	0.01066	0.00906	0.00783	0.00661	0.00543
45.000	0.01482	0.01615	0.01772	0.01893	0.01698	0.01521	0.01345	0.01175
55.000	0.02500	0.02506	0.02550	0.02551	0.02410	0.02223	0.02044	0.01877
70.000	0.03665	0.03596	0.03516	0.03604	0.03602	0.03290	0.03012	0.02775
87.200	0.05278	0.05024	0.04746	0.04654	0.04509	0.04163	0.03895	0.03715

ENGINEER DGD
DATE 12-4-78

FIGURE 4.1.1.2-69
EFFECT OF SPEEDBRAKE



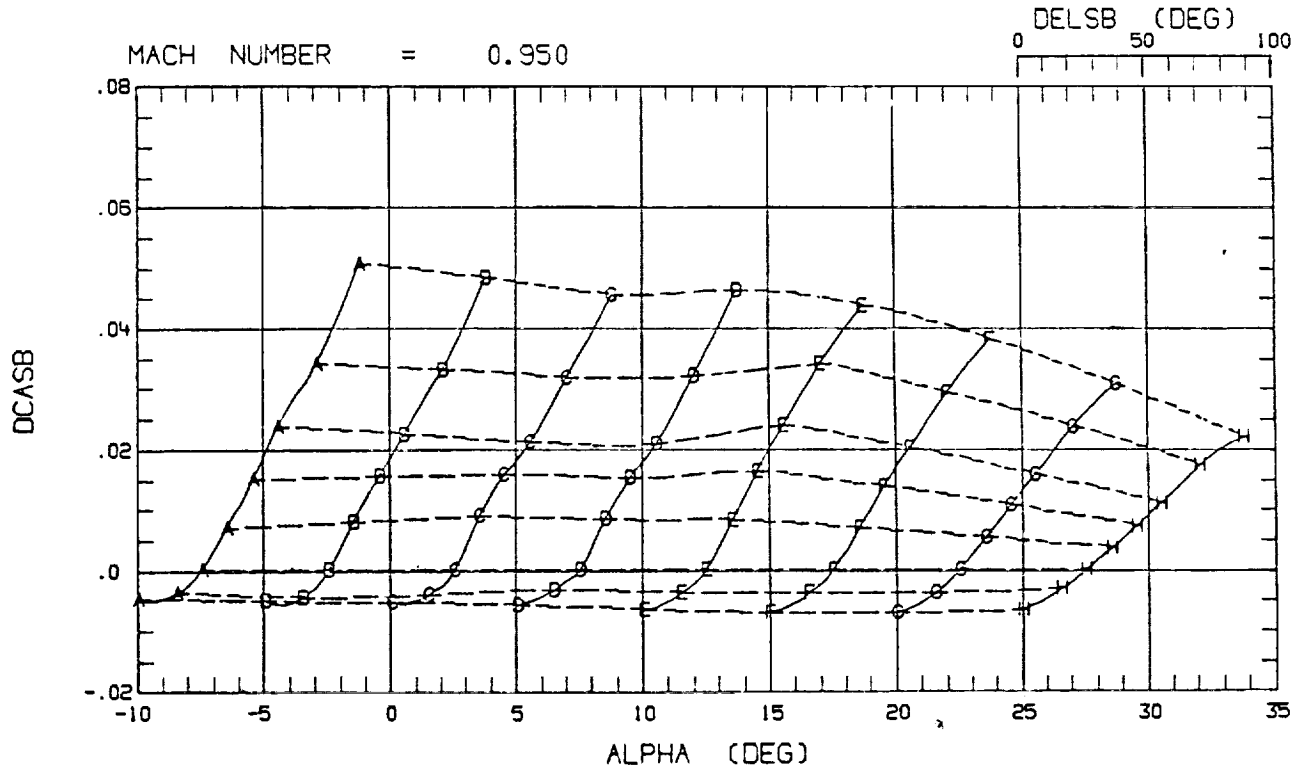
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00239	-0.00379	-0.00517	-0.00463	-0.00542	-0.00549	-0.00530	-0.00485
15.000	-0.00195	-0.00274	-0.00351	-0.00385	-0.00242	-0.00272	-0.00291	-0.00301
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00550	0.00741	0.00926	0.00928	0.00868	0.00769	0.00650	0.00514
45.000	0.01408	0.01585	0.01731	0.01799	0.01749	0.01566	0.01348	0.01102
55.000	0.02423	0.02467	0.02453	0.02574	0.02647	0.02391	0.02098	0.01779
70.000	0.03826	0.03710	0.03549	0.03584	0.03423	0.03304	0.03123	0.02887
87.200	0.05338	0.05084	0.04868	0.04729	0.04708	0.04433	0.04084	0.03673

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.2-70
EFFECT OF SPEEDBRAKE



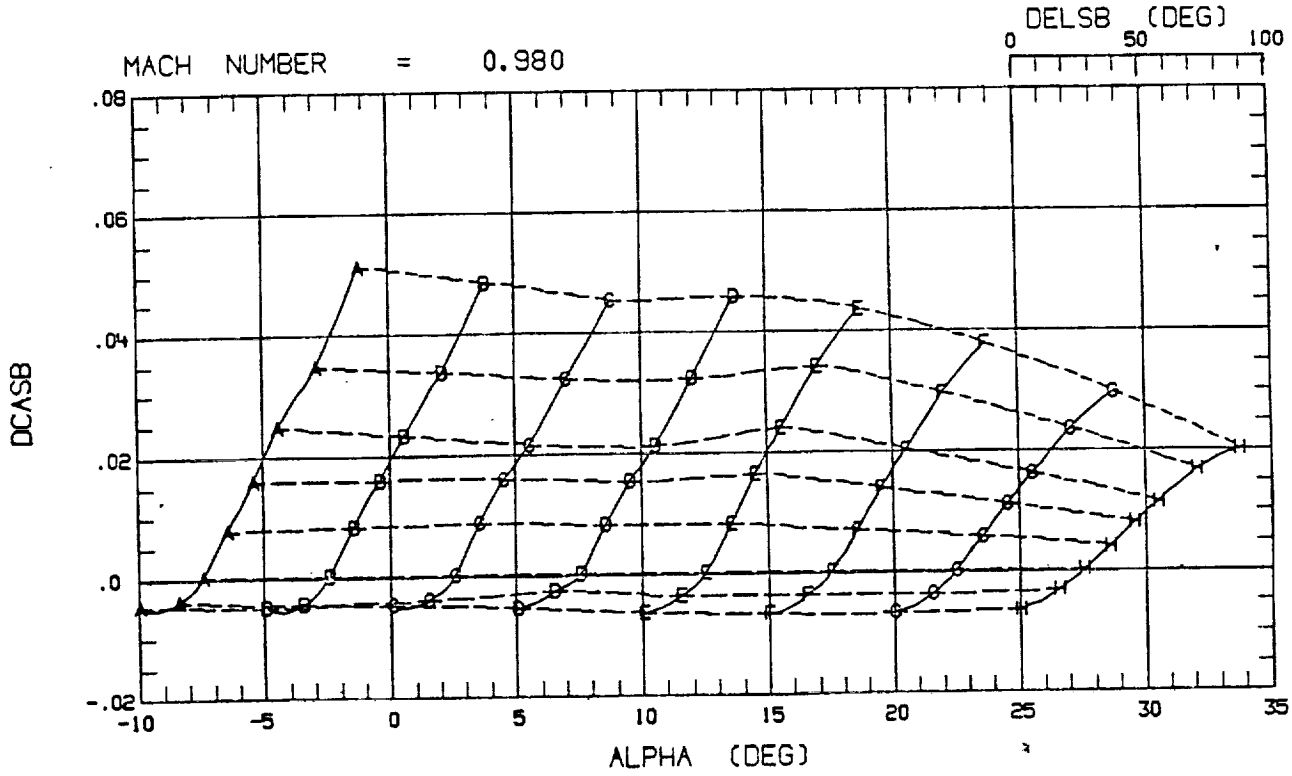
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00466	-0.00511	-0.00530	-0.00573	-0.00660	-0.00701	-0.00701	-0.00655
15.000	-0.00383	-0.00443	-0.00400	-0.00314	-0.00370	-0.00387	-0.00372	-0.00308
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00695	0.00793	0.00884	0.00830	0.00827	0.00689	0.00532	0.00357
45.000	0.01493	0.01541	0.01576	0.01519	0.01633	0.01367	0.01062	0.00729
55.000	0.02373	0.02249	0.02101	0.02093	0.02395	0.02013	0.01579	0.01103
70.000	0.03406	0.03307	0.03176	0.03210	0.03394	0.02935	0.02378	0.01741
87.200	0.05063	0.04824	0.04537	0.04624	0.04377	0.03803	0.03066	0.02187

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.2-71
EFFECT OF SPEEDBRAKE



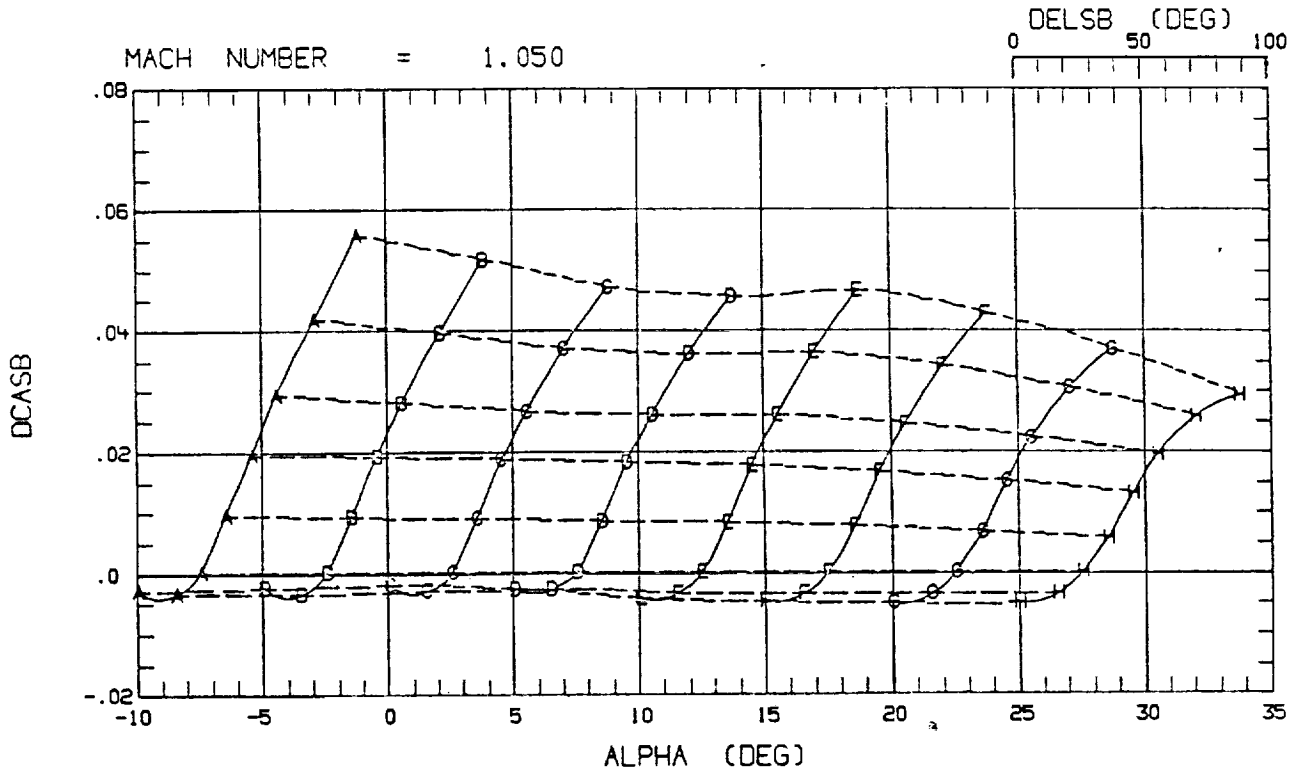
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00478	-0.00495	-0.00480	-0.00547	-0.00646	-0.00690	-0.00692	-0.00646
15.000	-0.00410	-0.00454	-0.00394	-0.00286	-0.00383	-0.00387	-0.00378	-0.00334
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00777	0.00826	0.00873	0.00814	0.00815	0.00691	0.00568	0.00384
45.000	0.01586	0.01591	0.01591	0.01516	0.01626	0.01377	0.01094	0.00782
55.000	0.02458	0.02303	0.02143	0.02102	0.02379	0.02016	0.01596	0.01132
70.000	0.03468	0.03358	0.03221	0.03219	0.03416	0.02939	0.02341	0.01658
87.200	0.05112	0.04840	0.04533	0.04584	0.04346	0.03752	0.02954	0.01991

ENGINEER DCD
DATE 10-3-78

FIGURE 4.1.1.2-72
EFFECT OF SPEEDBRAKE

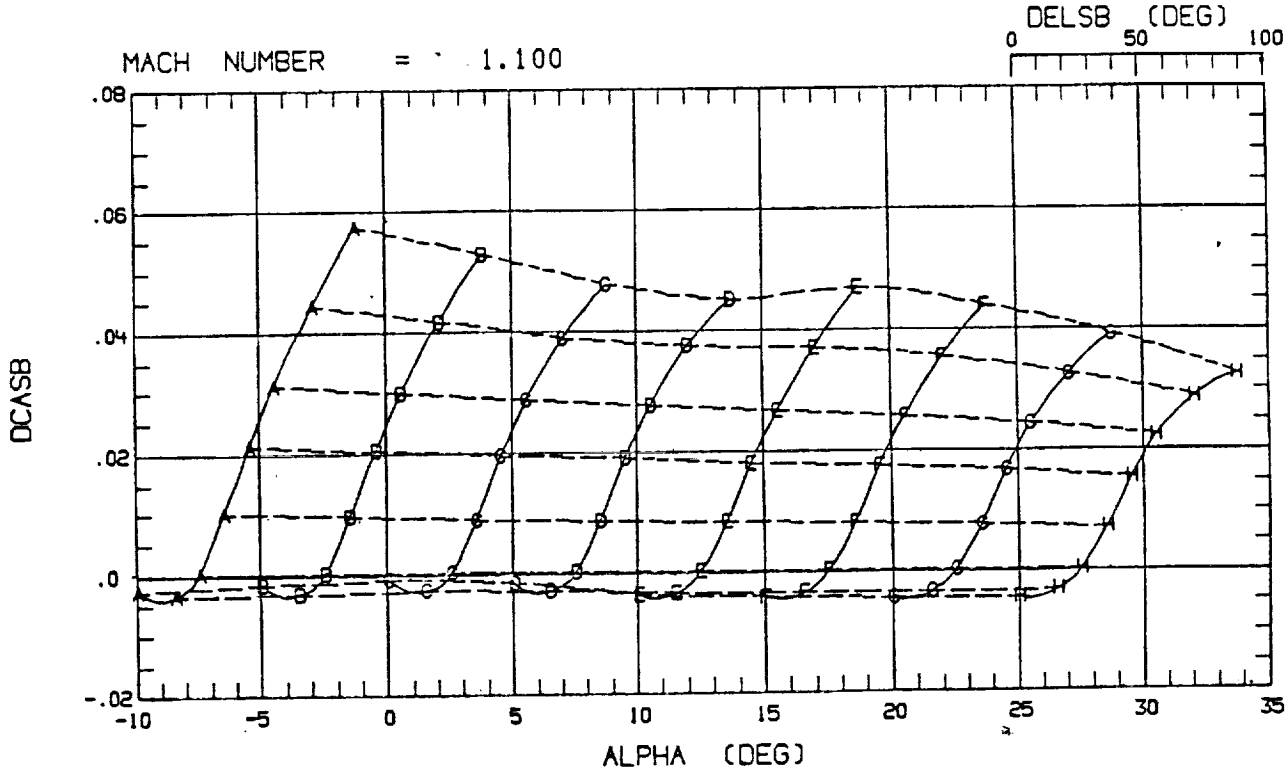


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00302	-0.00254	-0.00201	-0.00267	-0.00436	-0.00487	-0.00514	-0.00515
15.000	-0.00353	-0.00345	-0.00311	-0.00269	-0.00348	-0.00360	-0.00362	-0.00349
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00955	0.00910	0.00890	0.00853	0.00828	0.00761	0.00674	0.00558
45.000	0.01940	0.01905	0.01860	0.01813	0.01764	0.01650	0.01497	0.01311
55.000	0.02930	0.02789	0.02648	0.02604	0.02596	0.02436	0.02217	0.01945
70.000	0.04158	0.03934	0.03686	0.03602	0.03625	0.03400	0.03039	0.02676
87.200	0.05554	0.05159	0.04701	0.04548	0.04647	0.04274	0.03689	0.02921

ENGINEER T&D
DATE 10-4-78

FIGURE 4.1.1.2-73
EFFECT OF SPEEDBRAKE

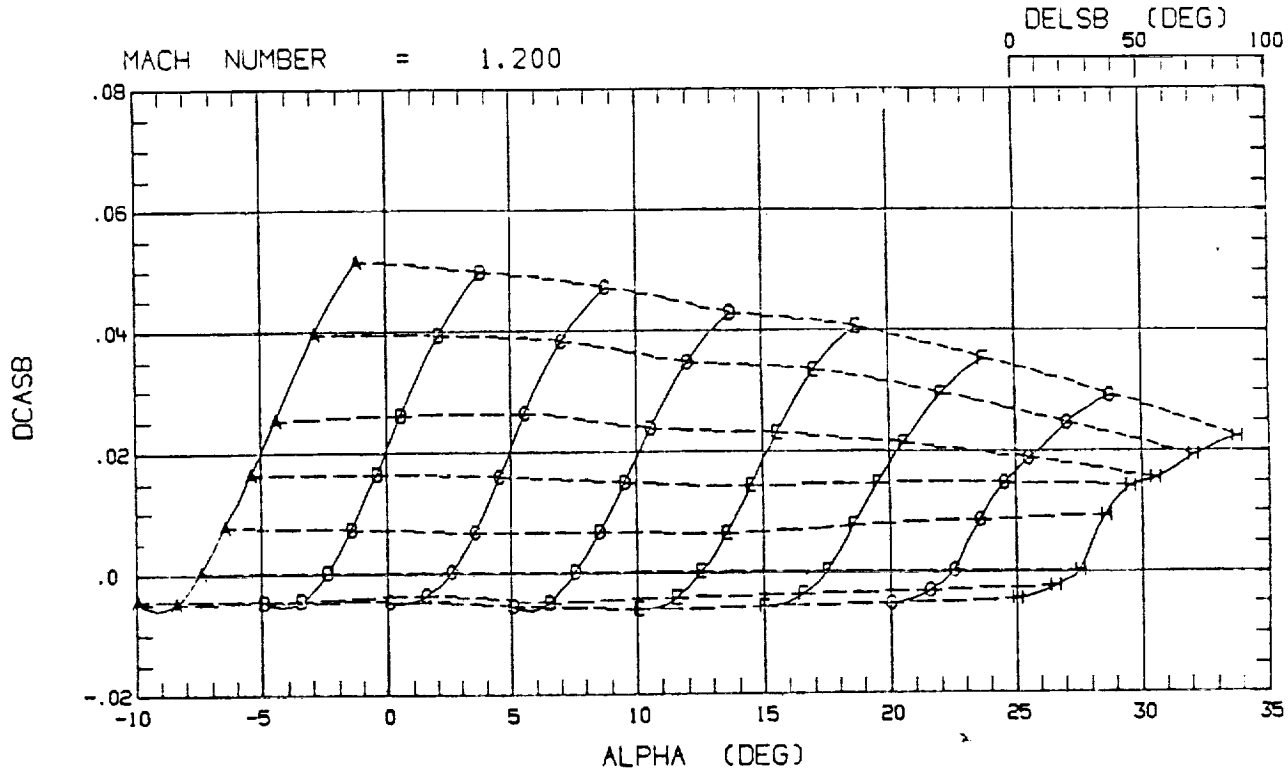


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00263	-0.00179	-0.00091	-0.00177	-0.00371	-0.00420	-0.00450	-0.00462
15.000	-0.00359	-0.00322	-0.00284	-0.00302	-0.00347	-0.00354	-0.00350	-0.00335
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01006	0.00943	0.00878	0.00844	0.00813	0.00785	0.00742	0.00683
45.000	0.02110	0.02024	0.01939	0.01886	0.01784	0.01733	0.01645	0.01523
55.000	0.03102	0.02970	0.02836	0.02758	0.02637	0.02563	0.02407	0.02201
70.000	0.04410	0.04152	0.03875	0.03724	0.03690	0.03523	0.03241	0.02854
87.200	0.05710	0.05260	0.04756	0.04493	0.04680	0.04383	0.03897	0.03236

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.2- 74
EFFECT OF SPEEDBRAKE



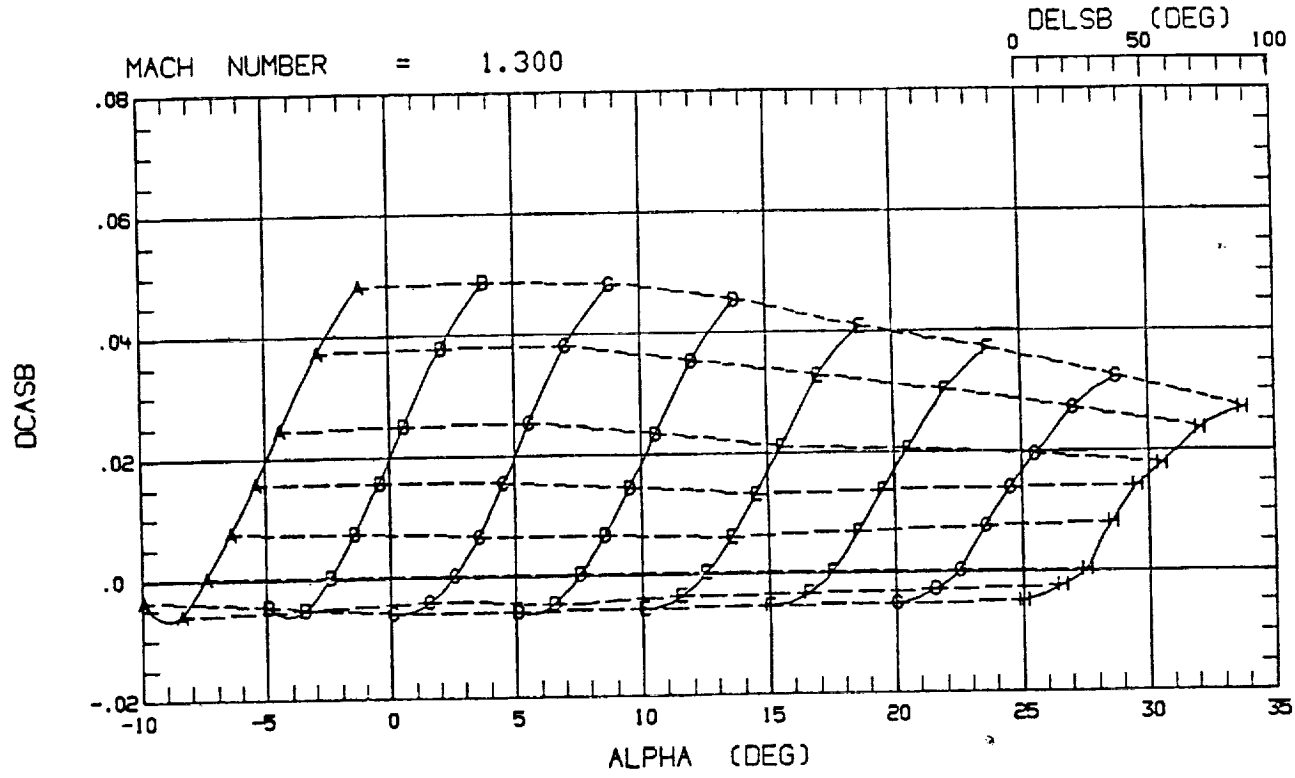
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00441	-0.00465	-0.00467	-0.00548	-0.00513	-0.00575	-0.00522	-0.00454
15.000	-0.00506	-0.00444	-0.00368	-0.00491	-0.00418	-0.00371	-0.00316	-0.00256
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00758	0.00726	0.00663	0.00659	0.00629	0.00754	0.00855	0.00928
45.000	0.01618	0.01624	0.01580	0.01473	0.01415	0.01464	0.01461	0.01406
55.000	0.02513	0.02598	0.02625	0.02373	0.02280	0.02100	0.01848	0.01529
70.000	0.03946	0.03919	0.03822	0.03464	0.03337	0.02930	0.02447	0.01903
87.200	0.05129	0.04958	0.04705	0.04279	0.04031	0.03517	0.02907	0.02217

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.2-75
EFFECT OF SPEEDBRAKE



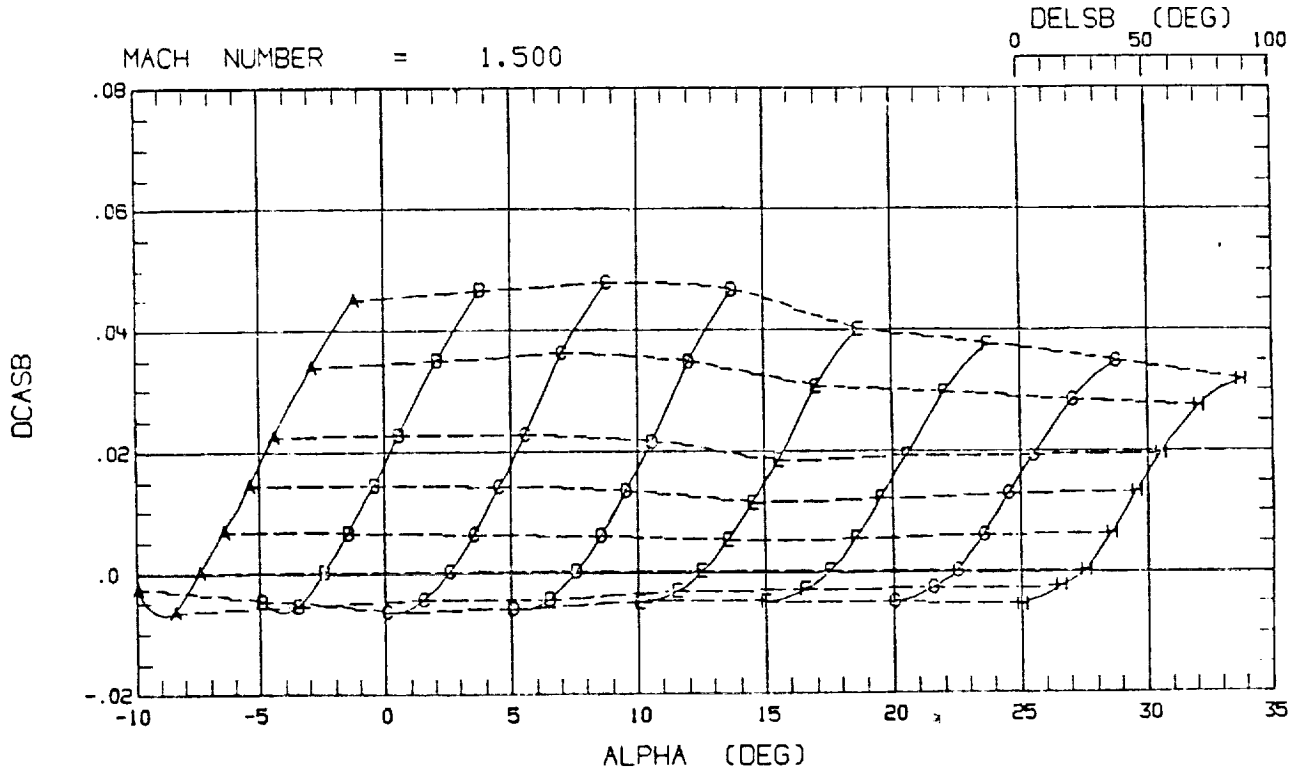
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00372	-0.00488	-0.00601	-0.00600	-0.00575	-0.00550	-0.00529	-0.00510
15.000	-0.00613	-0.00526	-0.00429	-0.00486	-0.00386	-0.00348	-0.00301	-0.00253
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00729	0.00704	0.00652	0.00634	0.00591	0.00673	0.00743	0.00800
45.000	0.01558	0.01562	0.01528	0.01428	0.01302	0.01358	0.01387	0.01397
55.000	0.02433	0.02493	0.02509	0.02309	0.02095	0.02040	0.01926	0.01769
70.000	0.03700	0.03772	0.03779	0.03512	0.03255	0.02996	0.02688	0.02343
87.200	0.04804	0.04849	0.04791	0.04521	0.04069	0.03675	0.03205	0.02675

ENGINEER DGD
DATE 12-4-78

FIGURE 4.1.1.2-76
EFFECT OF SPEEDBRAKE



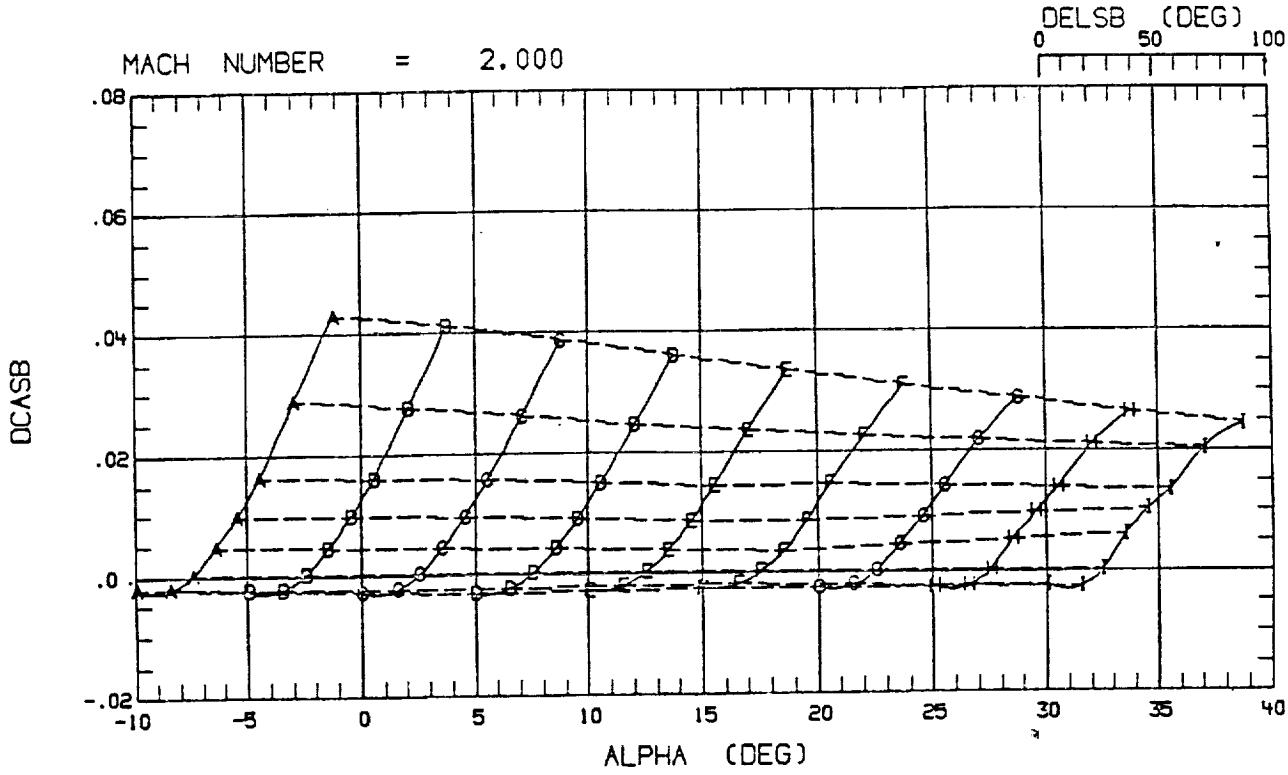
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00277	-0.00465	-0.00650	-0.00592	-0.00493	-0.00490	-0.00515	-0.00549
15.000	-0.00646	-0.00549	-0.00452	-0.00443	-0.00327	-0.00304	-0.00281	-0.00259
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00663	0.00648	0.00614	0.00578	0.00521	0.00532	0.00591	0.00606
45.000	0.01416	0.01422	0.01403	0.01318	0.01129	0.01189	0.01267	0.01295
55.000	0.02241	0.02266	0.02264	0.02145	0.01827	0.01902	0.01919	0.01944
70.000	0.03378	0.03482	0.03599	0.03445	0.03057	0.02945	0.02822	0.02713
87.200	0.04491	0.04639	0.04767	0.04659	0.03986	0.03741	0.03458	0.03144

ENGINEER DGD
DATE [illegible]

FIGURE 4.1.1.2-77
EFFECT OF SPEEDBRAKE



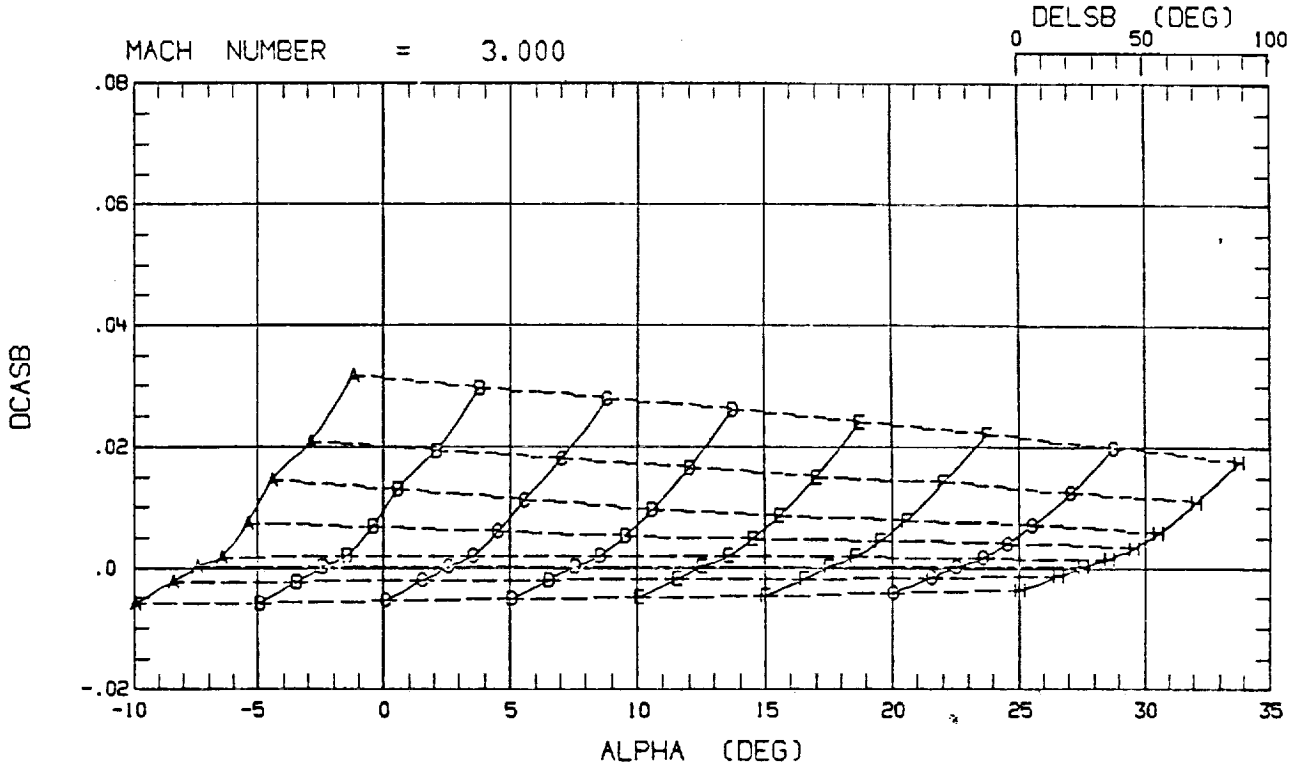
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.								
0.0	-0.00215	-0.00256	-0.00295	-0.00332	-0.00304	-0.00275	-0.00275	-0.00266	-0.00250
15.000	-0.00236	-0.00241	-0.00243	-0.00242	-0.00222	-0.00206	-0.00233	-0.00257	-0.00277
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00463	0.00449	0.00427	0.00400	0.00365	0.00333	0.00427	0.00517	0.00601
45.000	0.00982	0.00973	0.00948	0.00906	0.00844	0.00843	0.00905	0.00959	0.01008
55.000	0.01594	0.01584	0.01547	0.01487	0.01415	0.01445	0.01411	0.01371	0.01328
70.000	0.02868	0.02745	0.02596	0.02436	0.02335	0.02239	0.02159	0.02084	0.02017
87.200	0.04281	0.04084	0.03849	0.03585	0.03324	0.03067	0.02840	0.02624	0.02427

ENGINEER DGD
DATE 10-4-79

FIGURE 4.1.1.2-78
EFFECT OF SPEEDBRAKE



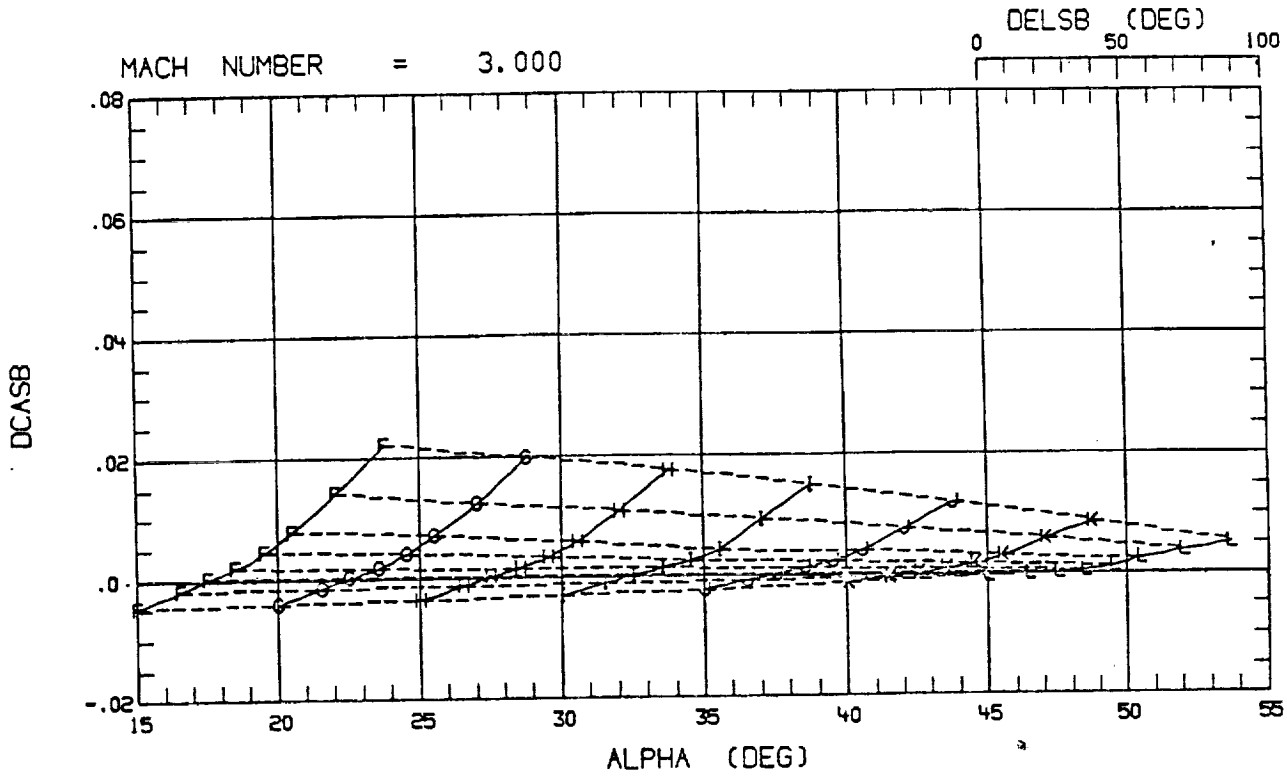
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00610	-0.00592	-0.00565	-0.00529	-0.00506	-0.00481	-0.00417	-0.00377
15.000	-0.00244	-0.00237	-0.00226	-0.00212	-0.00202	-0.00193	-0.00167	-0.00151
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00167	0.00175	0.00179	0.00178	0.00178	0.00171	0.00146	0.00140
45.000	0.00727	0.00660	0.00587	0.00509	0.00466	0.00439	0.00397	0.00321
55.000	0.01427	0.01269	0.01104	0.00937	0.00841	0.00772	0.00691	0.00552
70.000	0.02064	0.01919	0.01774	0.01634	0.01486	0.01389	0.01215	0.01081
87.200	0.03148	0.02957	0.02773	0.02604	0.02380	0.02185	0.01954	0.01743

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.2-79
EFFECT OF SPEEDBRAKE

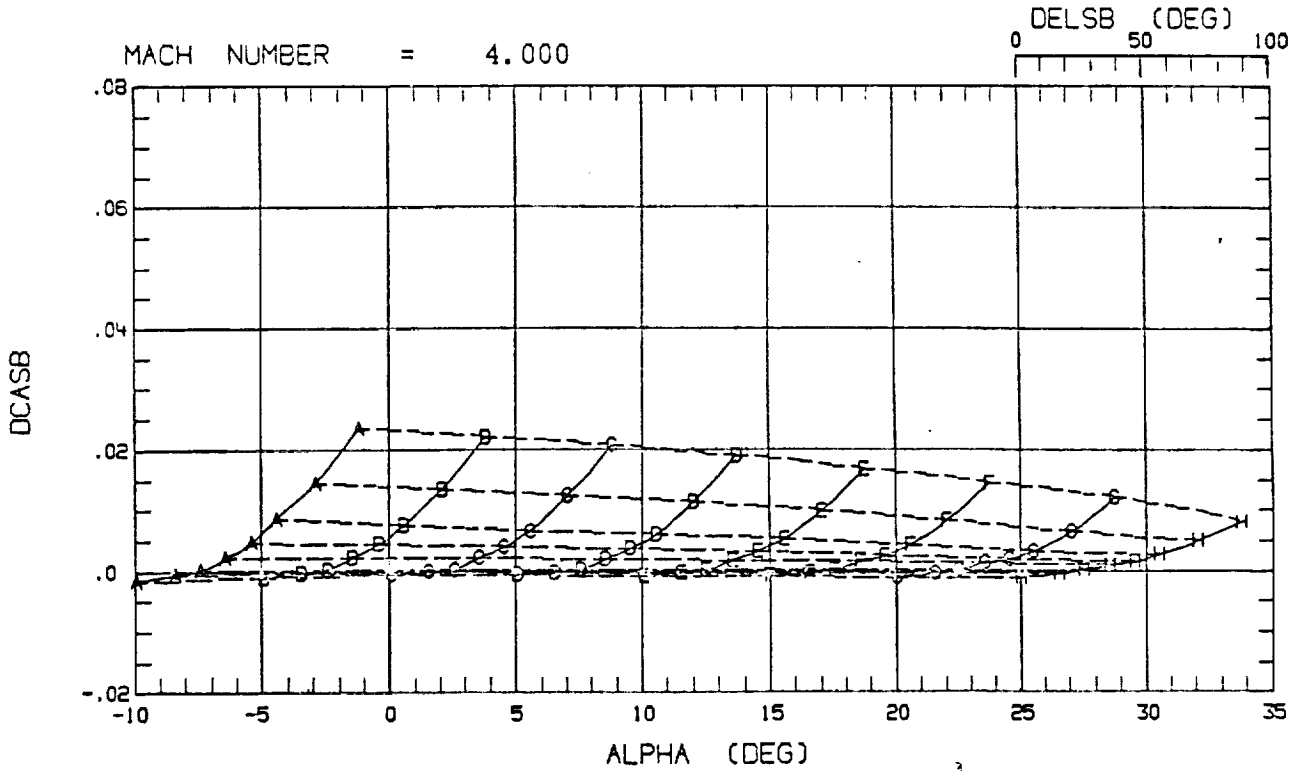


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.						
0.0	-0.00481	-0.00417	-0.00377	-0.00317	-0.00242	-0.00153	-0.00052
15.000	-0.00193	-0.00167	-0.00151	-0.00127	-0.00096	-0.00061	-0.00021
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00171	0.00146	0.00140	0.00124	0.00100	0.00069	0.00031
45.000	0.00439	0.00397	0.00321	0.00237	0.00208	0.00150	0.00110
55.000	0.00772	0.00691	0.00552	0.00406	0.00385	0.00274	0.00223
70.000	0.01389	0.01215	0.01081	0.00924	0.00747	0.00556	0.00354
87.200	0.02185	0.01954	0.01743	0.01483	0.01182	0.00847	0.00485

ENGINEER DGD
DATE 10-4-82

FIGURE 4.1.1.2-80
EFFECT OF SPEEDBRAKE



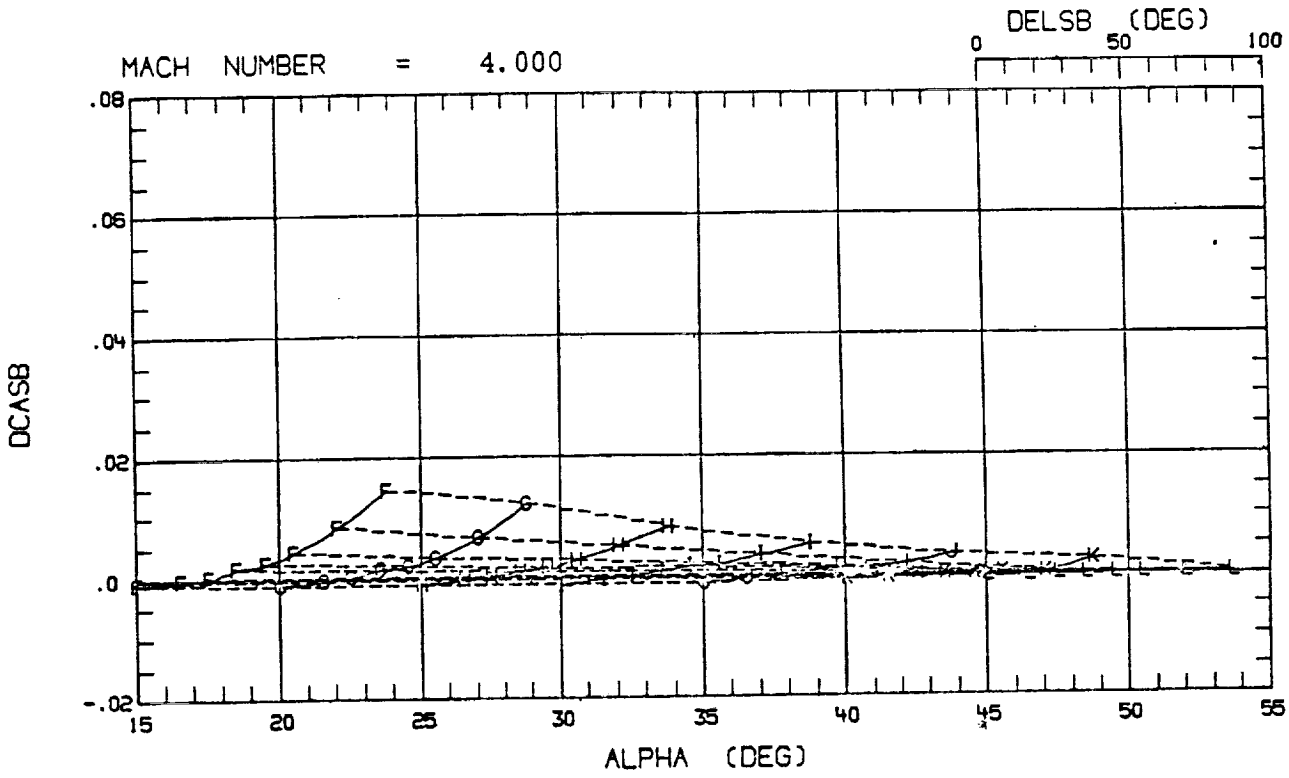
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00177	-0.00115	-0.00070	-0.00083	-0.00095	-0.00106	-0.00117	-0.00127
15.000	-0.00071	-0.00047	-0.00030	-0.00035	-0.00040	-0.00045	-0.00049	-0.00053
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00198	0.00204	0.00200	0.00183	0.00165	0.00145	0.00125	0.00083
45.000	0.00455	0.00425	0.00390	0.00349	0.00302	0.00244	0.00185	0.00142
55.000	0.00842	0.00739	0.00650	0.00588	0.00518	0.00417	0.00313	0.00257
70.000	0.01430	0.01323	0.01220	0.01113	0.00979	0.00810	0.00629	0.00480
87.200	0.02349	0.02200	0.02050	0.01874	0.01661	0.01438	0.01189	0.00803

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.2-81
EFFECT OF SPEEDBRAKE



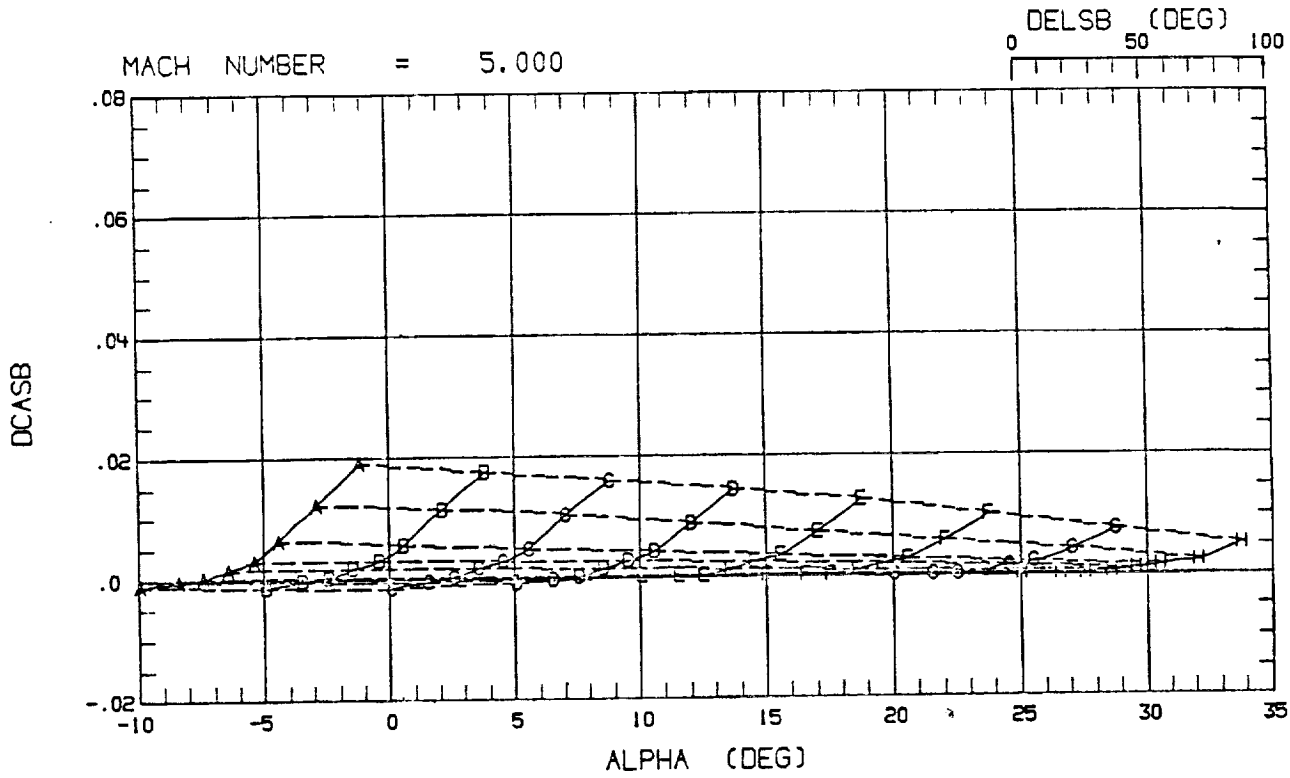
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.						
0.0	-0.00106	-0.00117	-0.00127	-0.00135	-0.00119	-0.00070	-0.00028
15.000	-0.00045	-0.00049	-0.00053	-0.00056	-0.00053	-0.00042	-0.00032
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00145	0.00125	0.00083	0.00083	0.00056	0.0	0.0
45.000	0.00244	0.00185	0.00142	0.00145	0.00098	0.0	0.0
55.000	0.00417	0.00313	0.00257	0.00190	0.00111	0.00023	0.0
70.000	0.00810	0.00629	0.00480	0.00325	0.00178	0.00038	0.0
87.200	0.01438	0.01189	0.00803	0.00521	0.00329	0.00240	0.0

ENGINEER DGD
DATE 10-1-78

FIGURE 4.1.1.2-82
EFFECT OF SPEEDBRAKE



CONFIGURATION

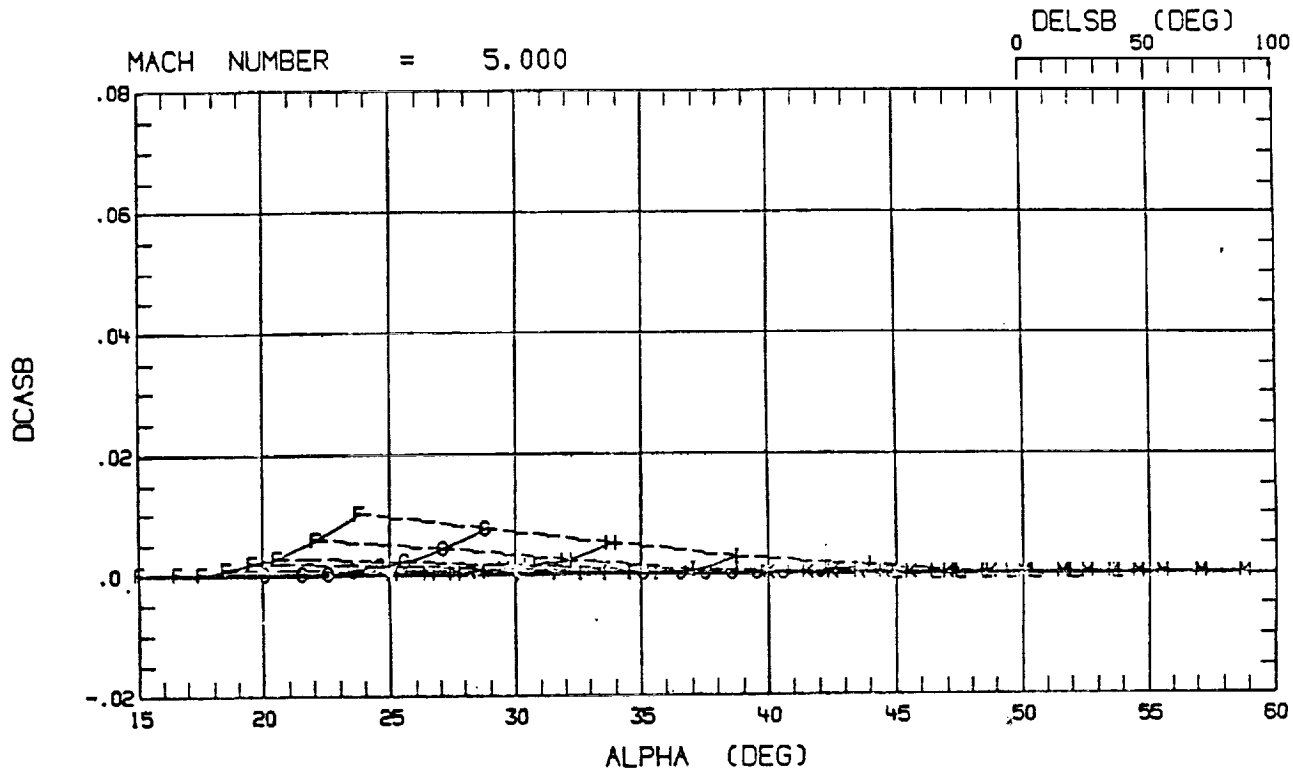
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00119	-0.00158	-0.00160	-0.00089	0.0	0.0	0.0	0.0
15.000	-0.00043	-0.00058	-0.00060	-0.00034	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00144	0.00152	0.00150	0.00131	0.00109	0.00085	0.00061	0.00040
45.000	0.00287	0.00280	0.00270	0.00253	0.00228	0.00188	0.00141	0.00071
55.000	0.00625	0.00543	0.00470	0.00408	0.00338	0.00267	0.00196	0.00133
70.000	0.01203	0.01133	0.01030	0.00877	0.00710	0.00562	0.00402	0.00217
87.200	0.01878	0.01729	0.01580	0.01425	0.01238	0.00995	0.00731	0.00490

ENGINEER DGD
DATE 10-3-75

FIGURE 4.1.1.2-83
EFFECT OF SPEEDBRAKE

SL72-SH CCCC 1M

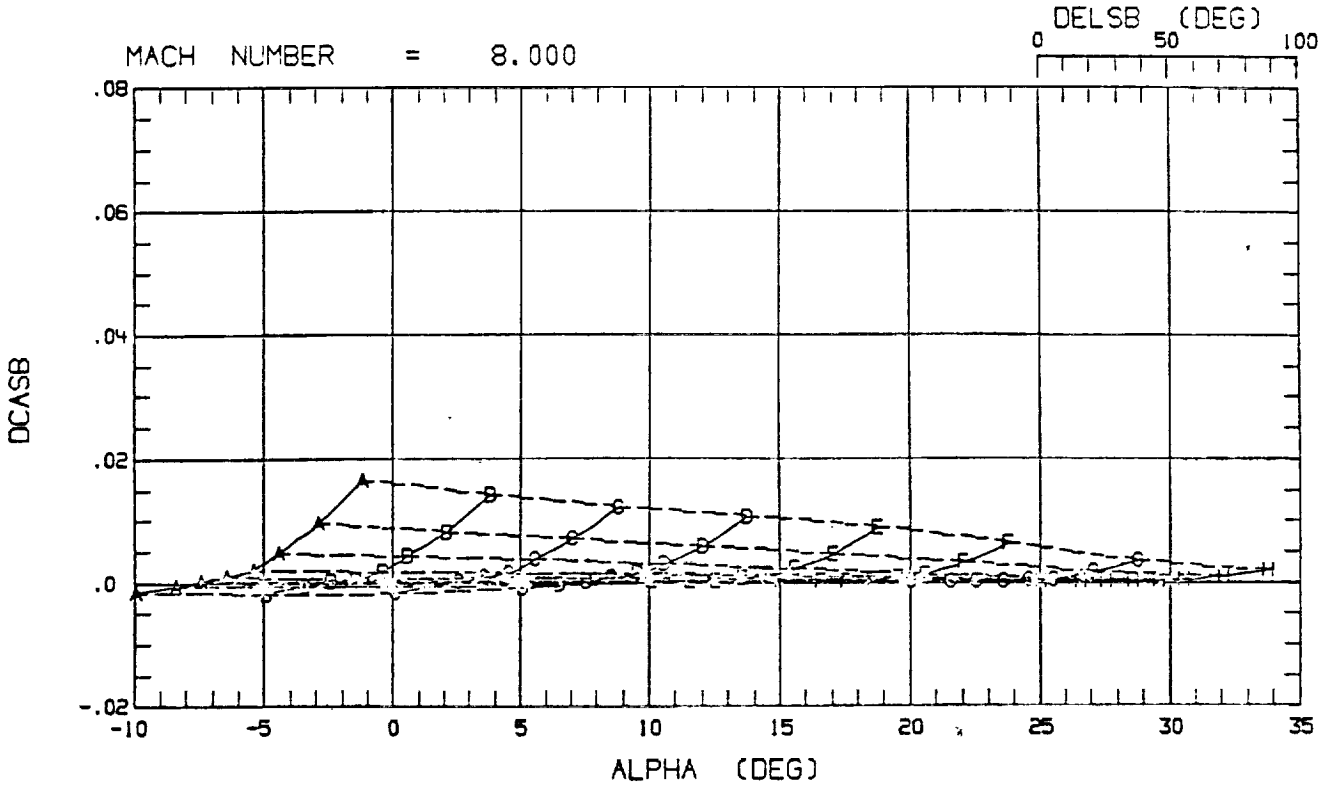


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00085	0.00061	0.00040	0.00010	0.00006	0.0	0.0	0.0
45.000	0.00188	0.00141	0.00071	0.00015	0.00006	0.0	0.0	0.0
55.000	0.00267	0.00196	0.00133	0.00015	0.00005	0.0	0.0	0.0
70.000	0.00562	0.00402	0.00217	0.00050	0.00029	0.0	0.0	0.0
87.200	0.00995	0.00731	0.00490	0.00271	0.00123	0.0	0.0	0.0

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.2-84
EFFECT OF SPEEDBRAKE



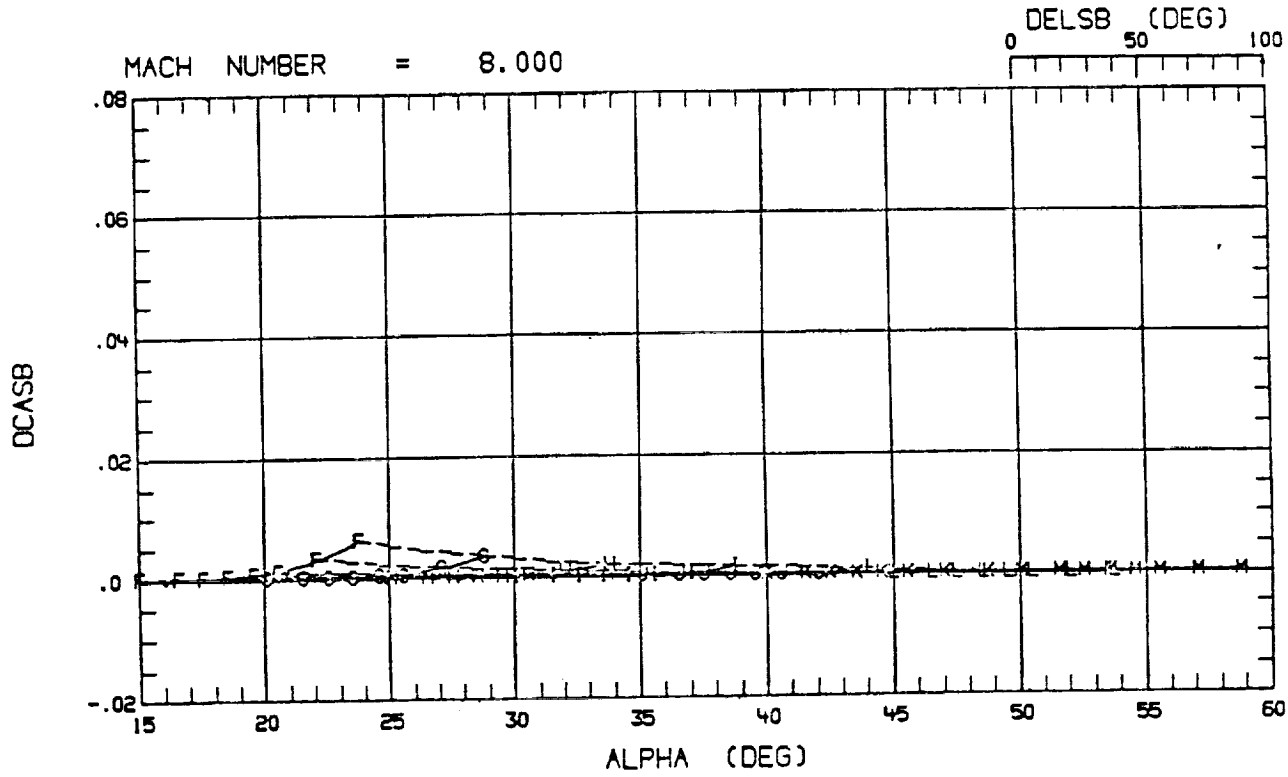
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00177	-0.00188	-0.00180	-0.00099	0.0	0.0	0.0	0.0
15.000	-0.00069	-0.00073	-0.00070	-0.00038	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00090	0.00032	0.00070	0.00059	0.00046	0.00028	0.00010	0.00008
45.000	0.00191	0.00163	0.00140	0.00121	0.00098	0.00062	0.00024	0.00017
55.000	0.00461	0.00409	0.00350	0.00277	0.00199	0.00119	0.00041	0.00025
70.000	0.00932	0.00803	0.00680	0.00564	0.00434	0.00297	0.00156	0.00092
87.200	0.01638	0.01409	0.01210	0.01056	0.00876	0.00610	0.00325	0.00192

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.2-85
EFFECT OF SPEEDBRAKE



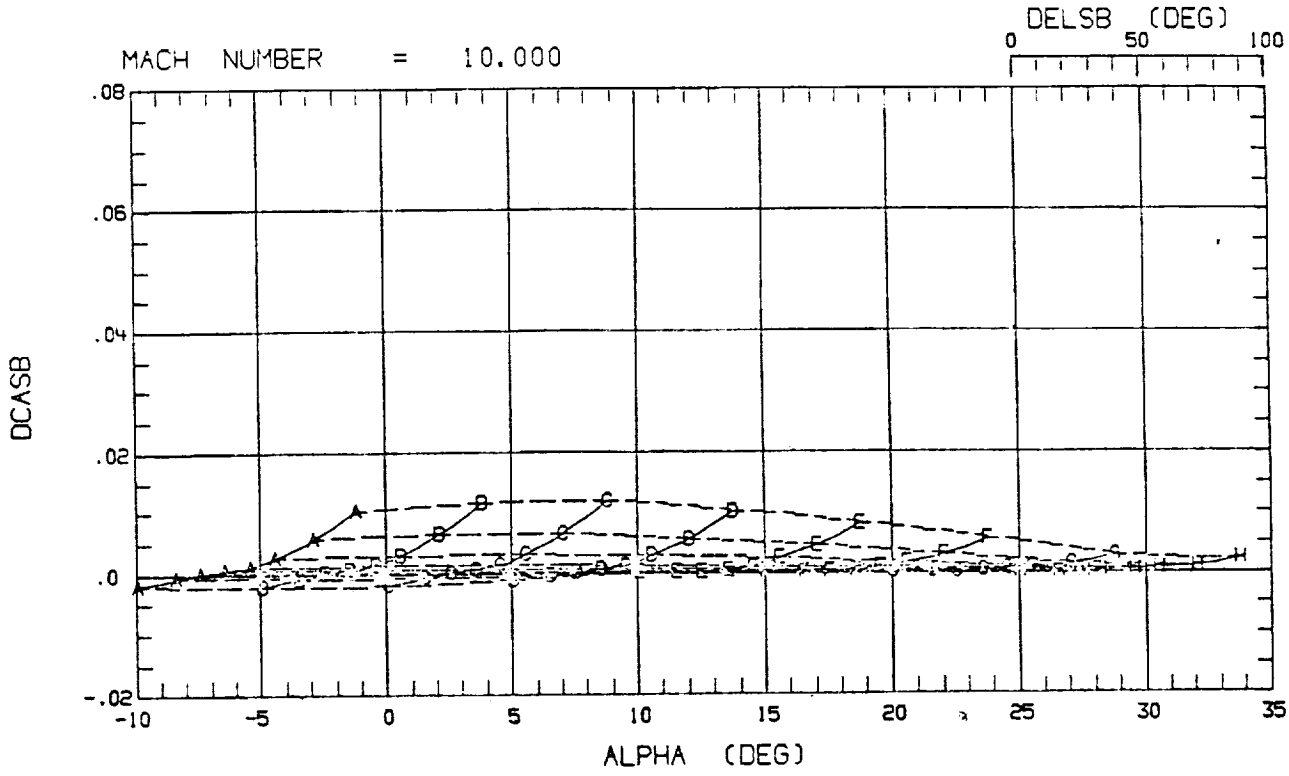
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00028	0.00010	0.00008	0.0	0.0	0.0	0.0	0.0
45.000	0.00062	0.00024	0.00017	0.0	0.0	0.0	0.0	0.0
55.000	0.00119	0.00041	0.00025	0.00010	0.00003	0.0	0.0	0.0
70.000	0.00297	0.00156	0.00092	0.00020	0.00007	0.0	0.0	0.0
87.200	0.00610	0.00325	0.00192	0.00138	0.00069	0.0	0.0	0.0

ENGINEER DGD
DATE 10-3-72

FIGURE 4.1.1.2-86
EFFECT OF SPEEDBRAKE



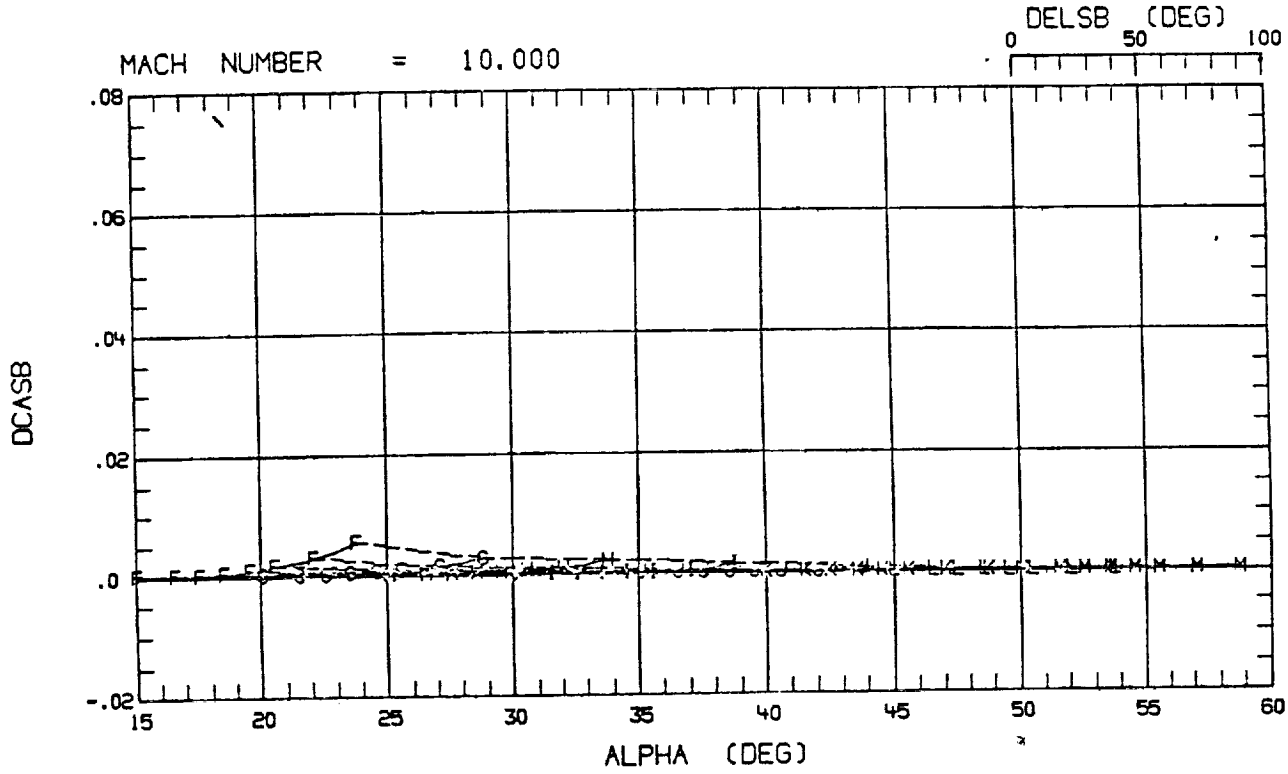
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00207	-0.00221	-0.00210	-0.00114	0.0	0.0	0.0	0.0
15.000	-0.00079	-0.00084	-0.00080	-0.00043	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00055	0.00063	0.00068	0.00054	0.00041	0.00031	0.00024	0.00018
45.000	0.00102	0.00123	0.00130	0.00111	0.00088	0.00069	0.00052	0.00035
55.000	0.00254	0.00289	0.00300	0.00276	0.00228	0.00155	0.00079	0.00053
70.000	0.00557	0.00631	0.00640	0.00549	0.00425	0.00278	0.00127	0.00092
87.200	0.01008	0.01150	0.01170	0.01007	0.00797	0.00543	0.00268	0.00219

ENGINEER DGD
DATE 10-24-78

FIGURE 4.1.1.2- 87
EFFECT OF SPEEDBRAKE



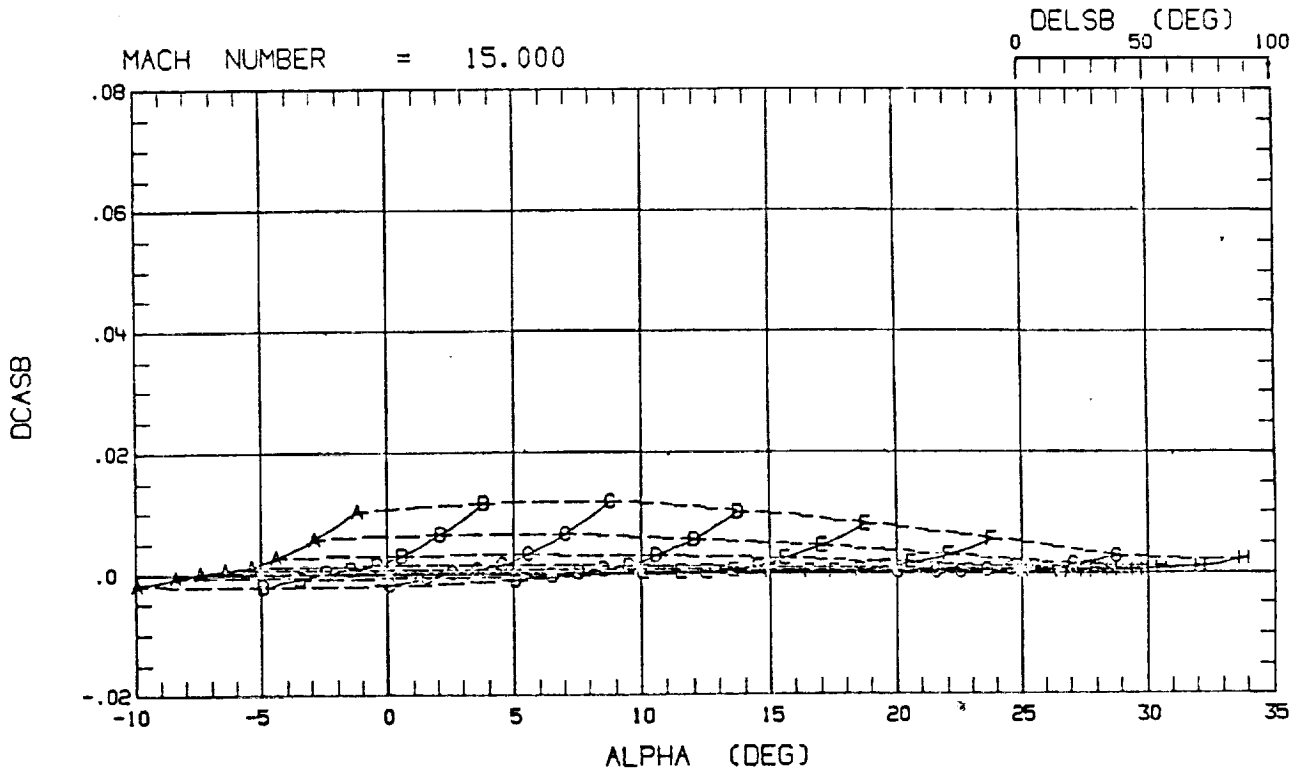
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00031	0.00024	0.00018	0.0	0.0	0.0	0.0	0.0
45.000	0.00069	0.00052	0.00035	0.0	0.0	0.0	0.0	0.0
55.000	0.00155	0.00079	0.00053	0.00010	0.00003	0.0	0.0	0.0
70.000	0.00278	0.00127	0.00092	0.00020	0.00007	0.0	0.0	0.0
87.200	0.00543	0.00268	0.00219	0.00138	0.00068	0.0	0.0	0.0

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.2-88
EFFECT OF SPEEDBRAKE



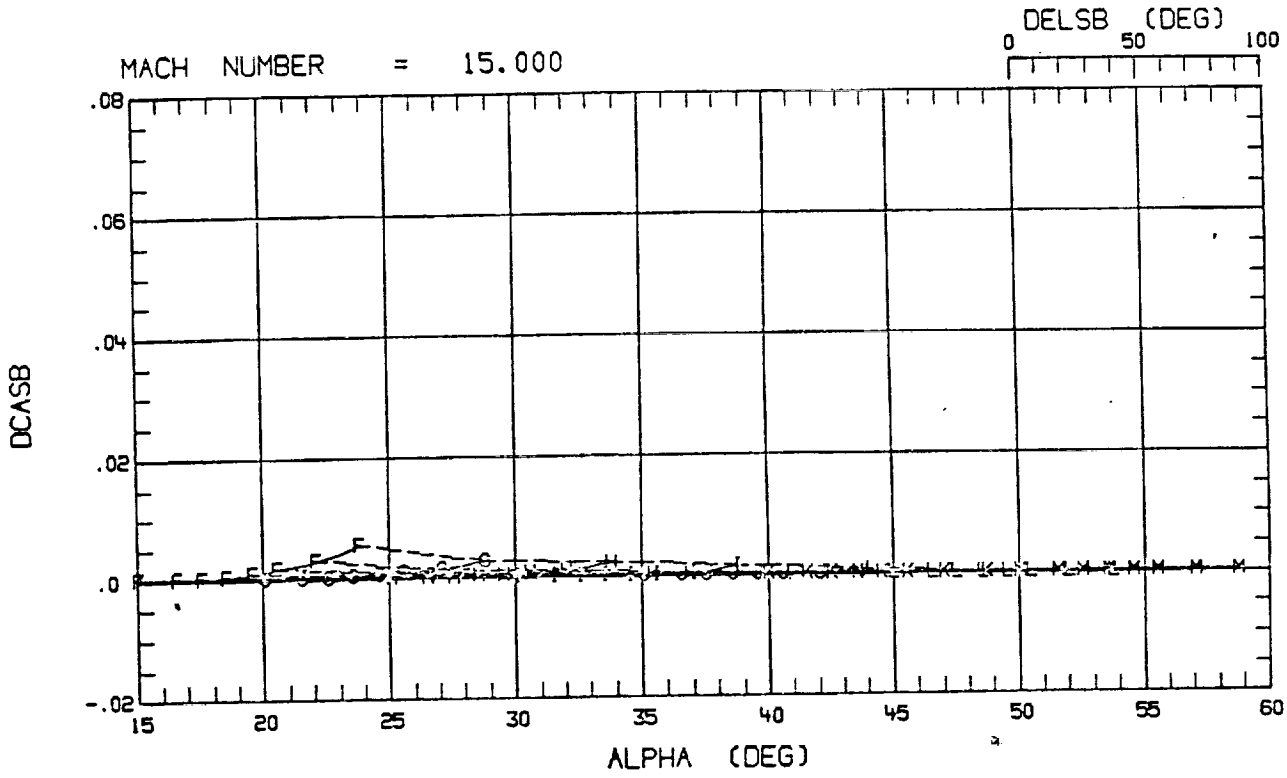
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00207	-0.00221	-0.00210	-0.00114	0.0	0.0	0.0	0.0
15.000	-0.00079	-0.00084	-0.00080	-0.00043	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00055	0.00063	0.00068	0.00054	0.00041	0.00031	0.00024	0.00018
45.000	0.00102	0.00123	0.00130	0.00111	0.00088	0.00069	0.00052	0.00035
55.000	0.00254	0.00289	0.00300	0.00276	0.00228	0.00155	0.00079	0.00053
70.000	0.00557	0.00631	0.00640	0.00549	0.00425	0.00278	0.00127	0.00092
87.200	0.01008	0.01150	0.01170	0.01007	0.00797	0.00543	0.00268	0.00219

ENGINEER DGL
DATE 10-4-78

FIGURE 4.1.1.2-89
EFFECT OF SPEEDBRAKE



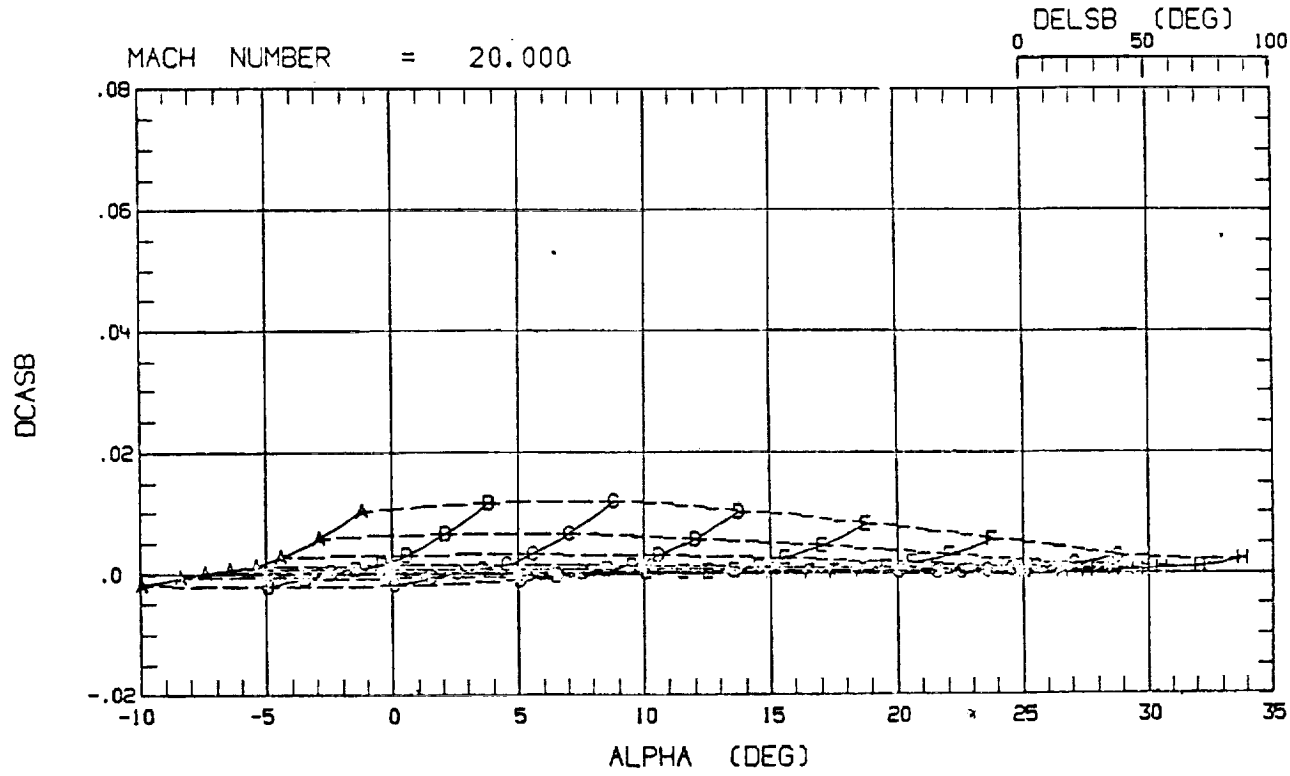
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00031	0.00024	0.00018	0.0	0.0	0.0	0.0	0.0
45.000	0.00069	0.00052	0.00035	0.0	0.0	0.0	0.0	0.0
55.000	0.00155	0.00079	0.00053	0.00010	0.00003	0.0	0.0	0.0
70.000	0.00278	0.00127	0.00092	0.00020	0.00007	0.0	0.0	0.0
87.200	0.00543	0.00268	0.00219	0.00138	0.00068	0.0	0.0	0.0

ENGINEER DGD
DATE 10-24-78

FIGURE 4.1.1.2- 90
EFFECT OF SPEEDBRAKE



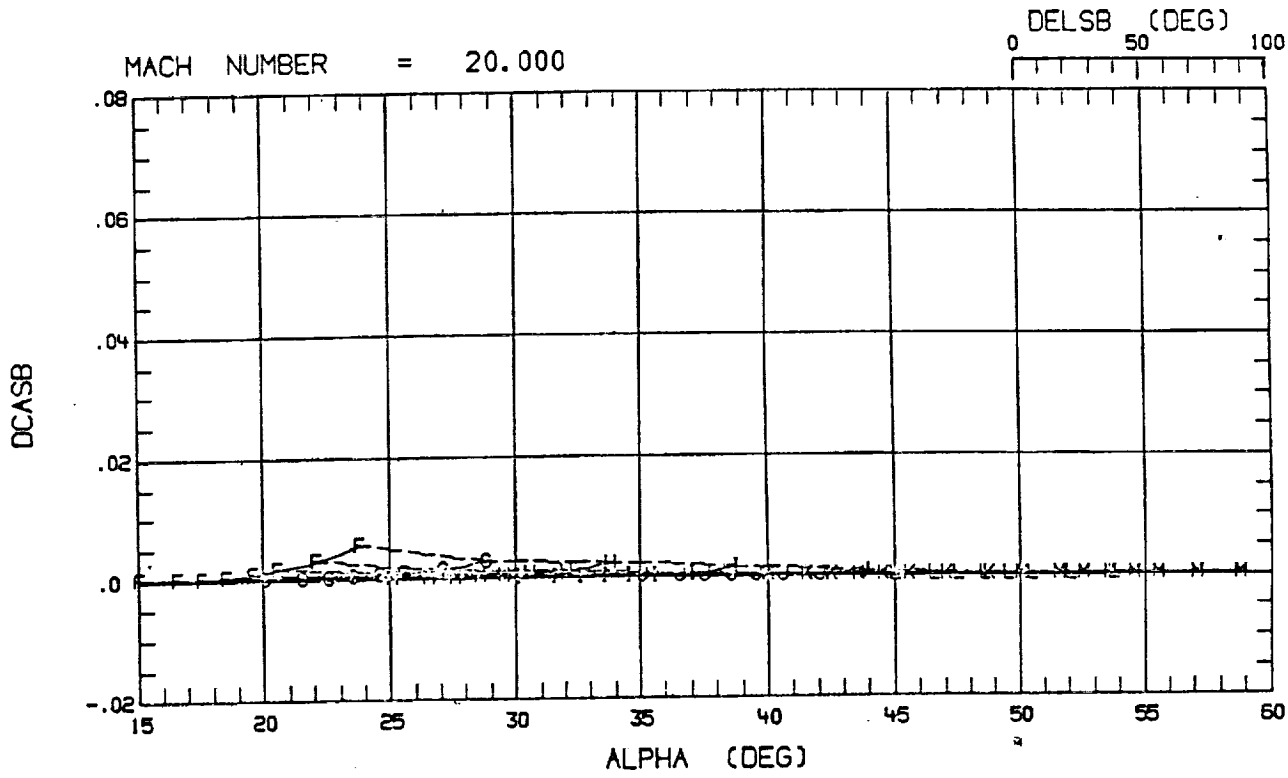
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	-0.00207	-0.00221	-0.00210	-0.00114	0.0	0.0	0.0	0.0
15.000	-0.00079	-0.00084	-0.00080	-0.00043	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00055	0.00063	0.00068	0.00054	0.00041	0.00031	0.00024	0.00018
45.000	0.00102	0.00123	0.00130	0.00111	0.00088	0.00069	0.00052	0.00035
55.000	0.00254	0.00289	0.00300	0.00276	0.00228	0.00155	0.00079	0.00053
70.000	0.00557	0.00631	0.00640	0.00549	0.00425	0.00278	0.00127	0.00092
87.200	0.01008	0.01150	0.01170	0.01007	0.00797	0.00543	0.00268	0.00219

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.2-91
EFFECT OF SPEEDBRAKE



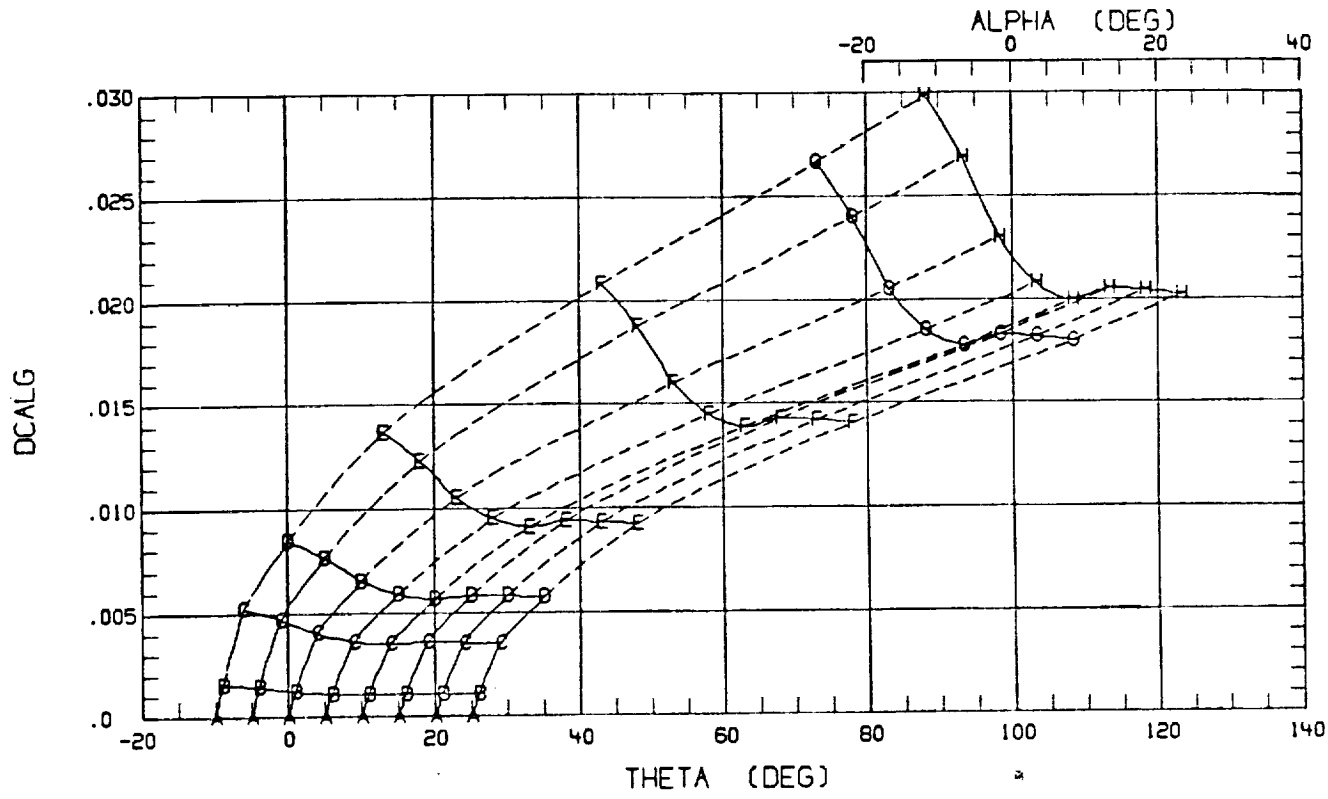
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE AXIAL FORCE INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00031	0.00024	0.00018	0.0	0.0	0.0	0.0	0.0
45.000	0.00069	0.00052	0.00035	0.0	0.0	0.0	0.0	0.0
55.000	0.00155	0.00079	0.00053	0.00010	0.00003	0.0	0.0	0.0
70.000	0.00278	0.00127	0.00092	0.00020	0.00007	0.0	0.0	0.0
87.200	0.00543	0.00268	0.00219	0.00138	0.00068	0.0	0.0	0.0

ENGINEER DGD
DATE 12-4-78

FIGURE 4.1.1.2-92
EFFECT OF SPEEDBRAKE



CONFIGURATION

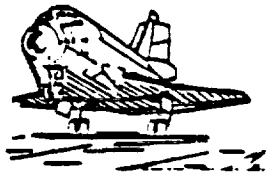
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	THETA (DEG)							
	0.0 A	1.000 B	4.000 C	10.000 D	23.000 E	53.000 F	83.000 G	98.000 H
ALPHA (DEG)	LANDING GEAR AXIAL FORCE COEFFIC							
-10.000	0.0	0.00155	0.00520	0.00844	0.01364	0.02078	0.02663	0.02968
-5.000	0.0	0.00141	0.00467	0.00760	0.01227	0.01870	0.02395	0.02687
0.0	0.0	0.00120	0.00400	0.00650	0.01050	0.01600	0.02050	0.02300
5.000	0.0	0.00109	0.00361	0.00586	0.00948	0.01444	0.01850	0.02075
10.000	0.0	0.00104	0.00347	0.00563	0.00909	0.01385	0.01776	0.01992
15.000	0.0	0.00107	0.00357	0.00579	0.00936	0.01426	0.01828	0.02050
20.000	0.0	0.00106	0.00354	0.00576	0.00930	0.01418	0.01817	0.02039
25.000	0.0	0.00106	0.00351	0.00570	0.00921	0.01403	0.01798	0.02017

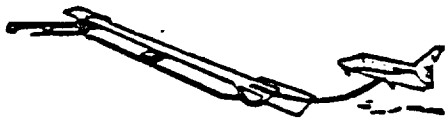
ENGINEER DGD
DATE 10-20-79

FIGURE 4.1.1.2-93
LANDING GEAR AXIAL FORCE COEFFICIENT INCREMENT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$



CONFIGURATION

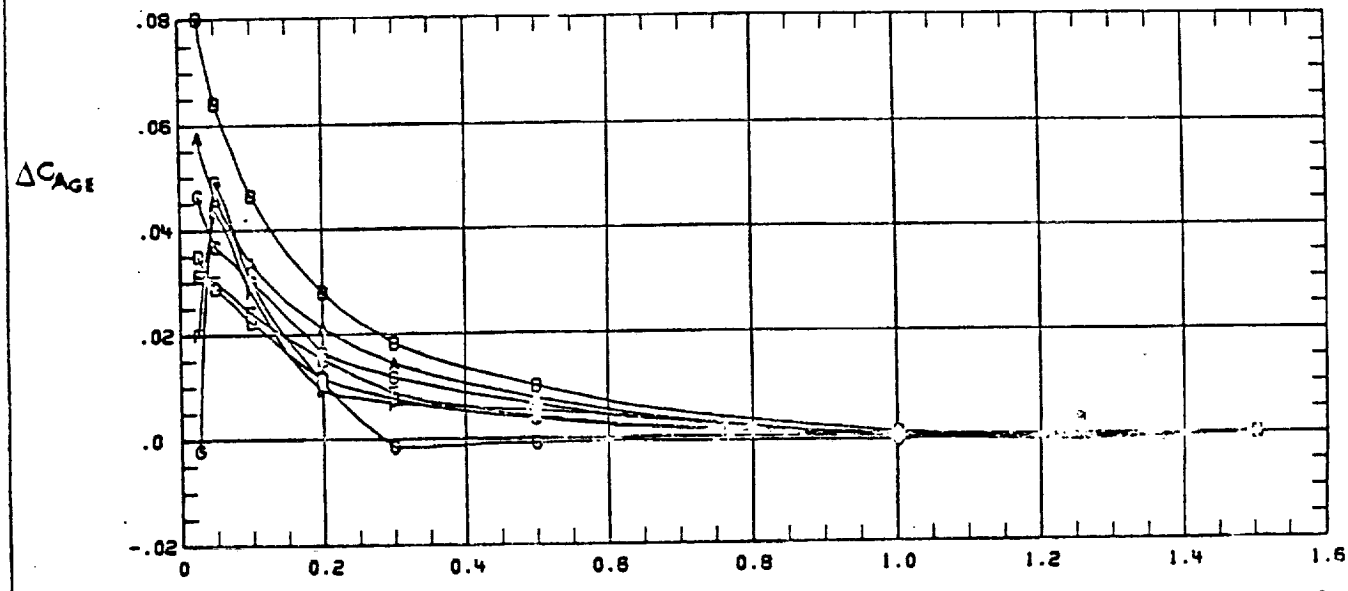
BASELINE ORBITER VEHICLE

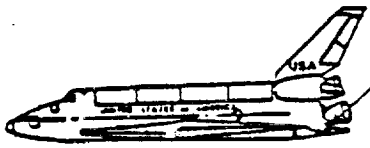
CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.78, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

AREA	S_{ref} = 2690.000 ft²
SPAN	b_{ref} = 78.056 ft
MAC	c_{ref} = 39.560 ft
BODY LENGTH	L_B = 1290.300 in

$\delta_e = -40.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL



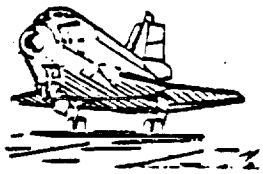


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.05748	0.08000	0.04629	0.03479	0.03105	0.01978	-0.00225
0.050	0.04603	0.06400	0.03664	0.02877	0.02972	0.04346	0.04889
0.100	0.03337	0.04630	0.02991	0.02231	0.02393	0.02774	0.02994
0.200	0.02094	0.02770	0.01648	0.01153	0.01533	0.00930	0.01085
0.300	0.01440	0.01820	0.01177	0.00749	0.00872	0.00673	-0.00166
0.500	0.00750	0.00980	0.00628	0.00365	0.00411	0.00524	-0.00087
1.000	-0.00020	0.00050	0.0	-0.00028	0.00015	-0.00021	-0.00086
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

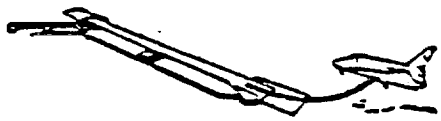
ENGINEER: [illegible]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-94
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$



CONFIGURATION

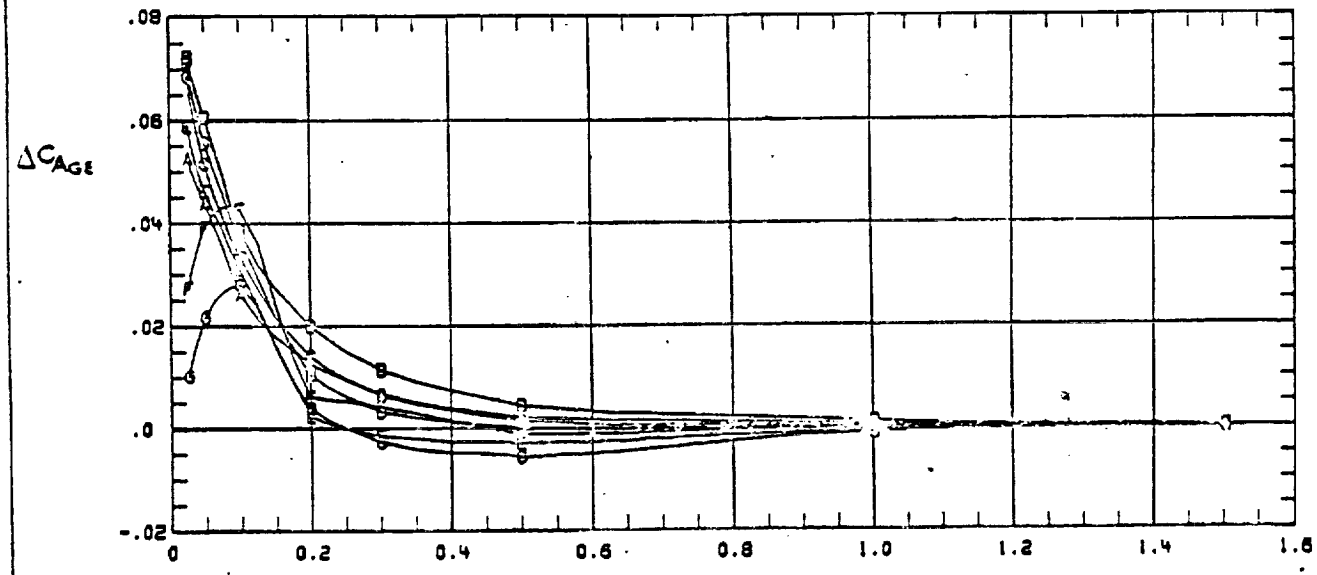
BASELINE ORBITER VEHICLE

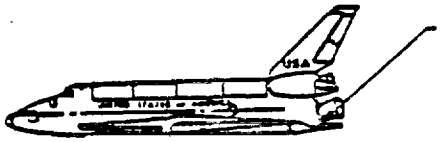
CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = FS 1076.70, Y_{cg} = BL 0.00, Z_{cg} = WBL 375.30

REFERENCE DIMENSIONS

AREA S_{ref} = 2690.000 ft²
SPAN b_{ref} = 78.056 ft
MAC c_{ref} = 38.560 ft
BODY LENGTH L_B = 1290.300 in

$\delta_e = -30.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



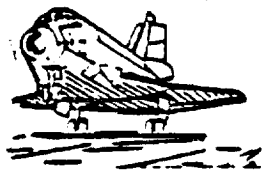


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.05229	0.07200	0.06813	0.07114	0.05857	0.02722	0.01016
0.050	0.04350	0.06030	0.05112	0.05543	0.04590	0.03908	0.02167
0.100	0.02610	0.03830	0.03333	0.03686	0.03084	0.04250	0.02785
0.200	0.01269	0.01990	0.01397	0.01056	0.00220	0.00619	0.00381
0.300	0.00663	0.01140	0.00644	0.00316	-0.00150	0.00399	-0.00276
0.500	0.00198	0.00440	0.00143	-0.00008	-0.00307	-0.00128	-0.00549
1.000	0.00051	0.00100	0.0	-0.00028	-0.00083	0.00027	-0.00086
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JT
DATE: 10-19-71
REVISED:

Figure 4.1.1.2-95
GROUND EFFECT

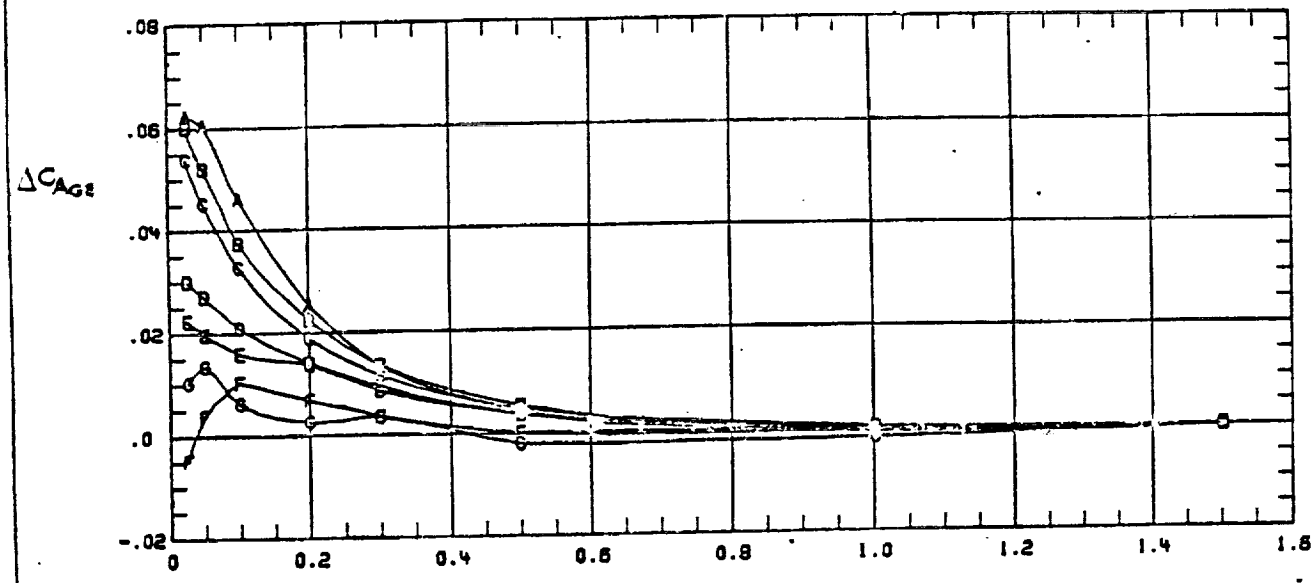
Landing Gear Down

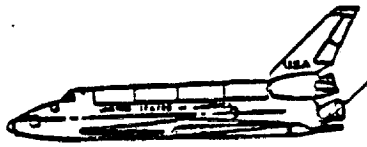


$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -20.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



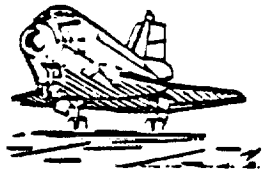


HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.06208	0.05970	0.05365	0.02991	0.02235	-0.00463	0.01035
0.050	0.06027	0.05180	0.04498	0.02681	0.01971	0.00375	0.01333
0.100	0.04590	0.03710	0.03242	0.02087	0.01577	0.01023	0.00604
0.200	0.02530	0.02230	0.01861	0.01392	0.01366	0.00675	0.00251
0.300	0.01307	0.01340	0.01132	0.00844	0.00918	0.00353	0.00342
0.500	0.00389	0.00510	0.00454	0.00362	0.00342	-0.00019	-0.00207
1.000	-0.00070	0.0	0.00028	0.00029	0.0	-0.00055	-0.00171
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

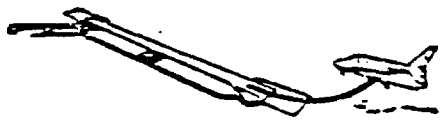
ENGINEER: JS
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-96
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$



CONFIGURATION

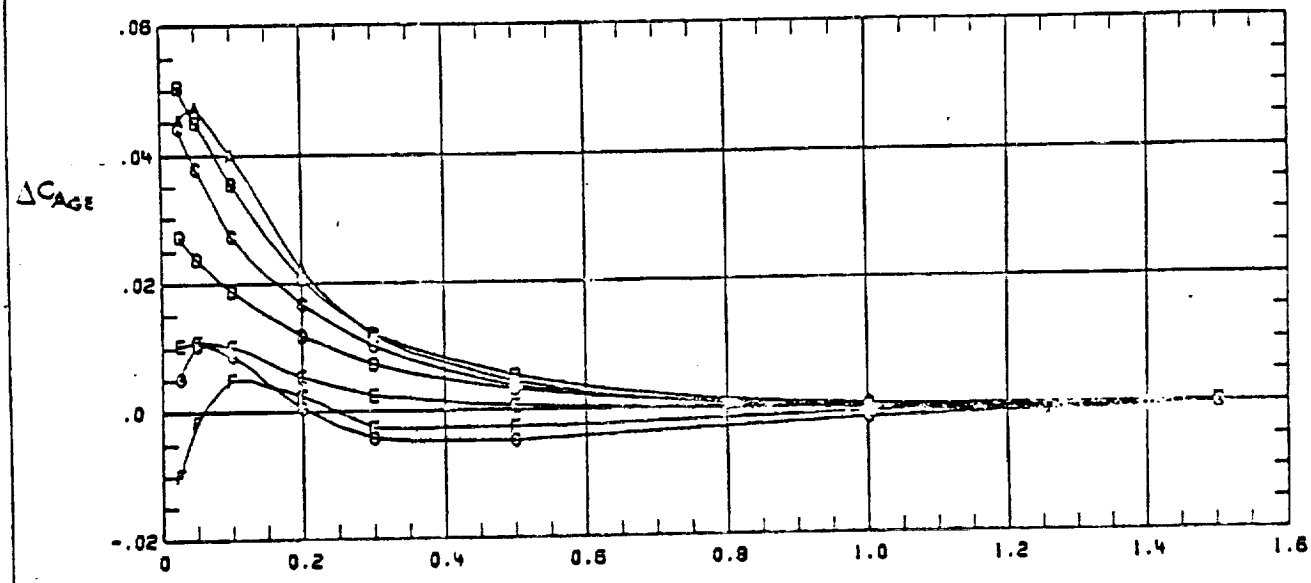
BASELINE ORBITER VEHICLE

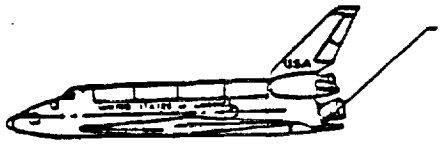
CENTER OF GRAVITY
OR
MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -15.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



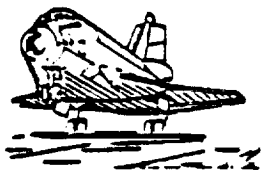


HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.04522	0.05030	0.04398	0.02713	0.01019	-0.00995	0.00506
0.050	0.04707	0.04510	0.03781	0.02357	0.01071	-0.00175	0.01019
0.100	0.03975	0.03530	0.02712	0.01862	0.01005	0.00490	0.00852
0.200	0.02193	0.02050	0.01671	0.01178	0.00528	0.00220	0.00041
0.300	0.01178	0.01200	0.01003	0.00713	0.00238	-0.00258	-0.00429
0.500	0.00433	0.00530	0.00358	0.00317	0.00061	-0.00271	-0.00473
1.000	-0.00056	0.0	0.00007	0.0	-0.00042	-0.00110	-0.00205
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

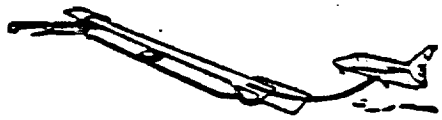
ENGINEER: F
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-97
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$



CONFIGURATION

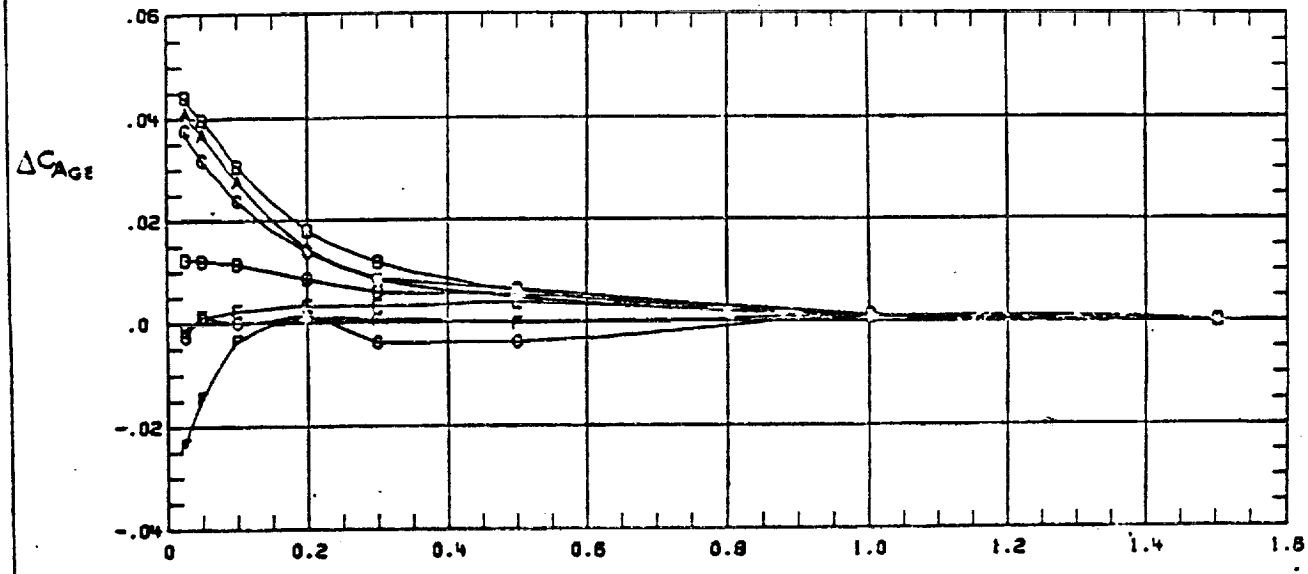
BASELINE ORBITER VEHICLE

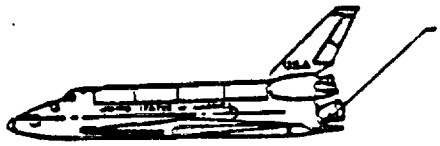
CENTER OF GRAVITY X_{cg} = FS 1078.70
OR Y_{cg} = BL 0.00
MOMENT REFERENCE Z_{cg} = WL 375.00

REFERENCE DIMENSIONS

AREA S_{ref} = 2690.000 ft²
SPAN b_{ref} = 78.056 in
MAC c_{ref} = 39.560 in
BODY LENGTH L_B = 1296.300 in

$\delta_e = -10.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL





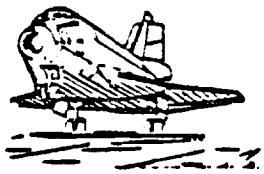
Reference Point for h/b
X_e 1506.84
Z_e 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.04082	0.04380	0.03730	0.01234	-0.00143	-0.02351	-0.00270
0.050	0.03658	0.03950	0.03184	0.01203	0.00096	-0.01440	0.00071
0.100	0.02733	0.03050	0.02368	0.01127	0.00223	-0.00369	-0.00017
0.200	0.01426	0.01780	0.01357	0.00831	0.00307	0.00073	0.00119
0.300	0.00818	0.01150	0.00843	0.00571	0.00298	0.00052	-0.00379
0.500	0.00464	0.00590	0.00619	0.00523	0.00369	-0.00040	-0.00380
1.000	0.00101	0.00100	0.00100	0.00099	0.00077	0.00089	0.00085
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-98
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$

CONFIGURATION

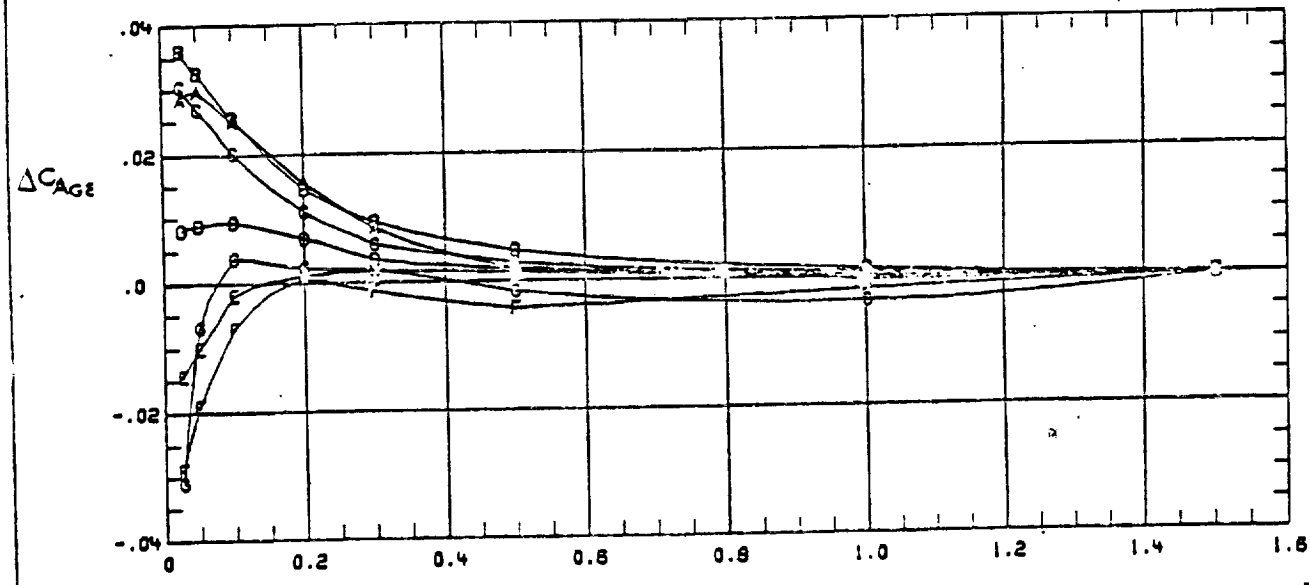
BASELINE ORBITER VEHICLE

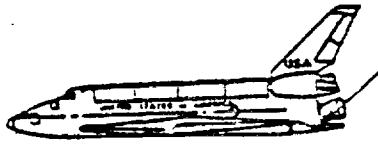
CENTER OF GRAVITY
OR
MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA	2690.000 ft²
SPAN	78.056 ft
MAC	39.560 ft
BODY LENGTH	1296.300 in

$\delta_e = -5.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL





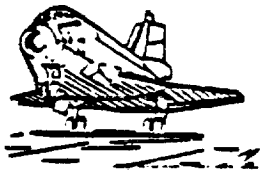
Reference Point
for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.02855	0.03610	0.03032	0.00817	-0.01454	-0.02899	-0.03100
0.050	0.02969	0.03240	0.02698	0.00889	-0.01014	-0.01922	-0.00697
0.100	0.02502	0.02550	0.02000	0.00918	-0.00197	-0.00727	0.00361
0.200	0.01546	0.01440	0.01092	0.00670	0.00110	0.00045	0.00214
0.300	0.00828	0.00920	0.00582	0.00332	0.00167	-0.00153	0.00178
0.500	0.00180	0.00450	0.00277	0.00172	0.00122	-0.00430	-0.00171
1.000	0.00058	0.00100	0.00050	0.00008	-0.00048	-0.00207	-0.00393
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JB
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-49
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$

CONFIGURATION

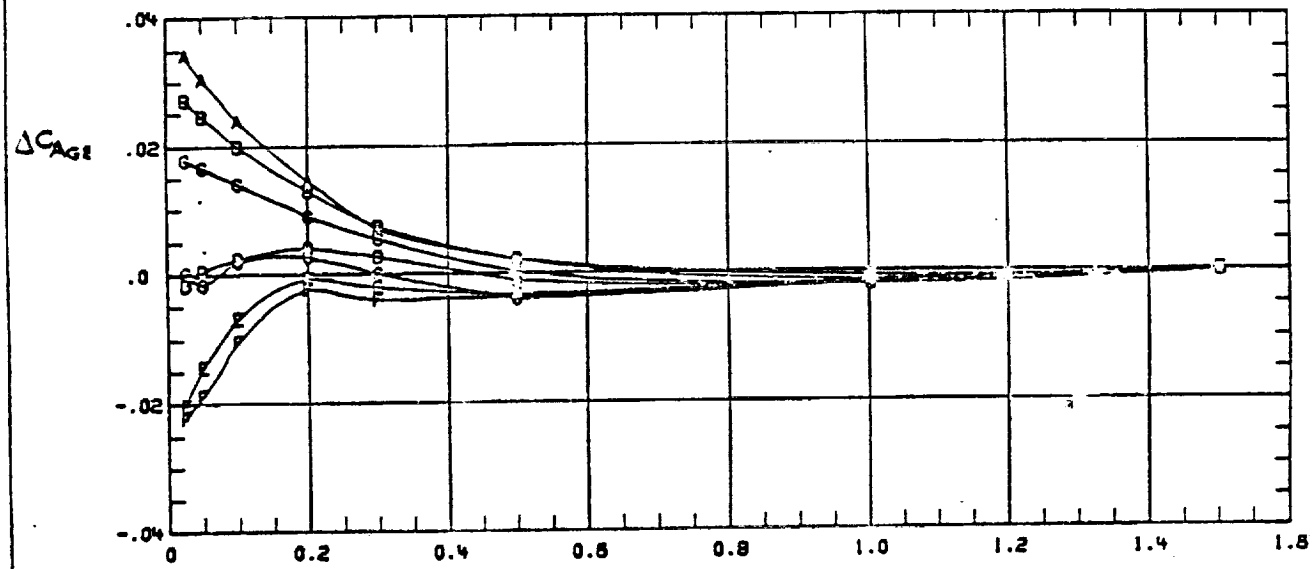
BASELINE ORBITER VEHICLE

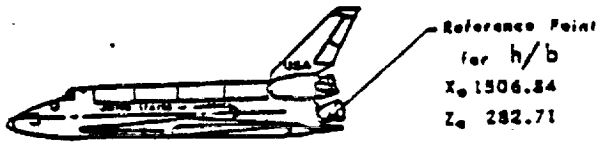
CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = FS 1076.70, Y_{cg} = BL 0.00, Z_{cg} = WBL 375.00

REFERENCE DIMENSIONS

AREA S_{ref} = 2690.000 ft²
SPAN b_{ref} = 78.056 ft
MAC $\bar{c}_{ref}$ = 39.560 ft
BODY LENGTH L_B = 1296.300 in

$\delta_e = 0.0$ $\delta_{sf} = -11.7°$ $\delta_{sb} = ALL$



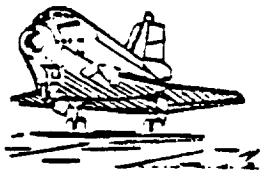


HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.03413	0.02720	0.01778	-0.00187	-0.02019	-0.02232	0.00020
0.050	0.03049	0.02460	0.01651	0.00034	-0.01453	-0.01884	-0.00170
0.100	0.02391	0.01990	0.01393	0.00227	-0.00694	-0.01039	0.00173
0.200	0.01441	0.01270	0.00887	0.00388	-0.00086	-0.00248	0.00241
0.300	0.00665	0.00720	0.00523	0.00244	-0.00221	-0.00411	-0.00006
0.500	0.00193	0.00190	0.00006	-0.00122	-0.00351	-0.00367	-0.00403
1.000	-0.00085	-0.00150	-0.00200	-0.00198	-0.00188	-0.00158	-0.00205
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: B³
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-100
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$

CONFIGURATION

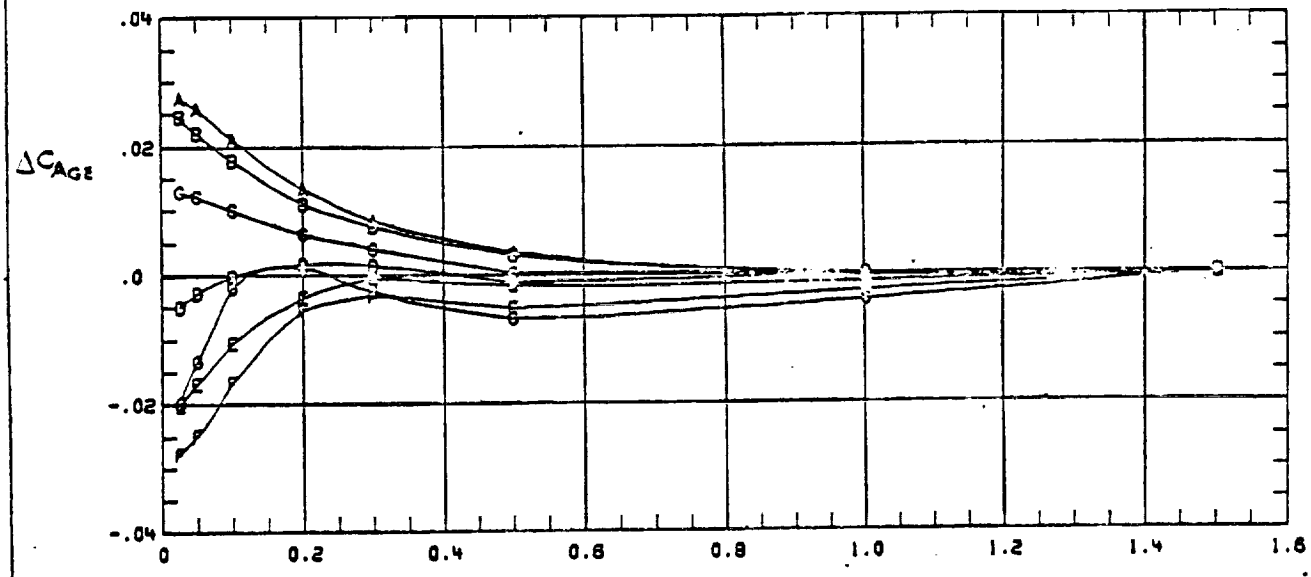
BASELINE ORBITER VEHICLE

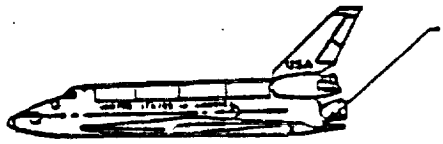
CENTER OF GRAVITY	X_{cg} = FS	1076.70
OR	Y_{cg} = BL	0.00
MOMENT REFERENCE	Z_{cg} = WL	375.00

REFERENCE DIMENSIONS

AREA	S_{ref} =	2690.000 ft²
SPAN	b_{ref} =	78.056 ft
MAC	$\bar{c}_{ref}$ =	35.560 ft
BODY LENGTH	L_B =	1290.300 in

$\delta_e = 5.000$ $\quad \delta_{BF} = -11.7°$ $\quad \delta_{SB} = ALL$



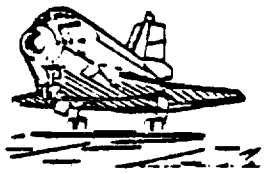


HEIGHT / SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.02735	0.02450	0.01283	-0.00505	-0.02026	-0.02783	-0.01988
0.050	0.02565	0.02190	0.01198	-0.00288	-0.01699	-0.02497	-0.01341
0.100	0.02096	0.01770	0.00986	-0.00028	-0.01073	-0.01687	-0.00203
0.200	0.01317	0.01090	0.00619	0.00164	-0.00366	-0.00563	0.00116
0.300	0.00833	0.00740	0.00398	0.00140	-0.00050	-0.00343	-0.00281
0.500	0.00332	0.00290	0.00013	-0.00119	-0.00186	-0.00524	-0.00693
1.000	-0.00028	0.0	0.0	-0.00028	-0.00125	-0.00276	-0.00410
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-101
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = FS 1078.70, Y_{cg} = BL 0.00, Z_{cg} = WBL 375.00

REFERENCE DIMENSIONS

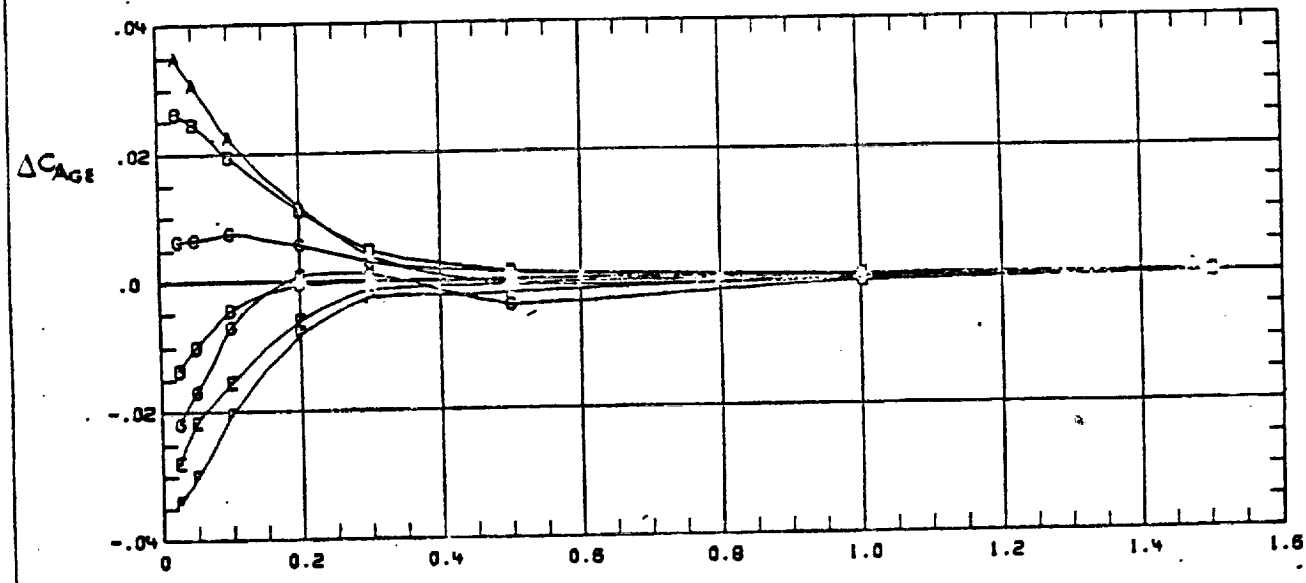
AREA S_{ref} = 2690.000 ft²

SPAN b_{ref} = 78.056 ft

MAC $\bar{c}_{ref}$ = 39.560 ft

BODY LENGTH L_B = 1296.300 in

$\delta_e = 10.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL



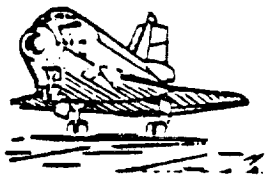
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.03492	0.02620	0.00625	-0.01368	-0.02801	-0.03411	-0.02189
0.050	0.03068	0.02460	0.00655	-0.01013	-0.02168	-0.03017	-0.01704
0.100	0.02238	0.01930	0.00742	-0.00456	-0.01549	-0.02048	-0.00718
0.200	0.01151	0.01090	0.00541	-0.00087	-0.00612	-0.00844	0.00074
0.300	0.00355	0.00460	0.00278	-0.00024	-0.00143	-0.00269	0.00080
0.500	-0.00109	0.00110	0.00083	-0.00027	-0.00090	-0.00225	-0.00418
1.000	-0.00098	0.0	0.0	0.0	-0.00021	-0.00055	-0.00103
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

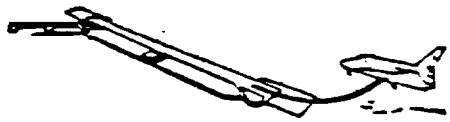
ENGINEER: JJ
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-102
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$



CONFIGURATION

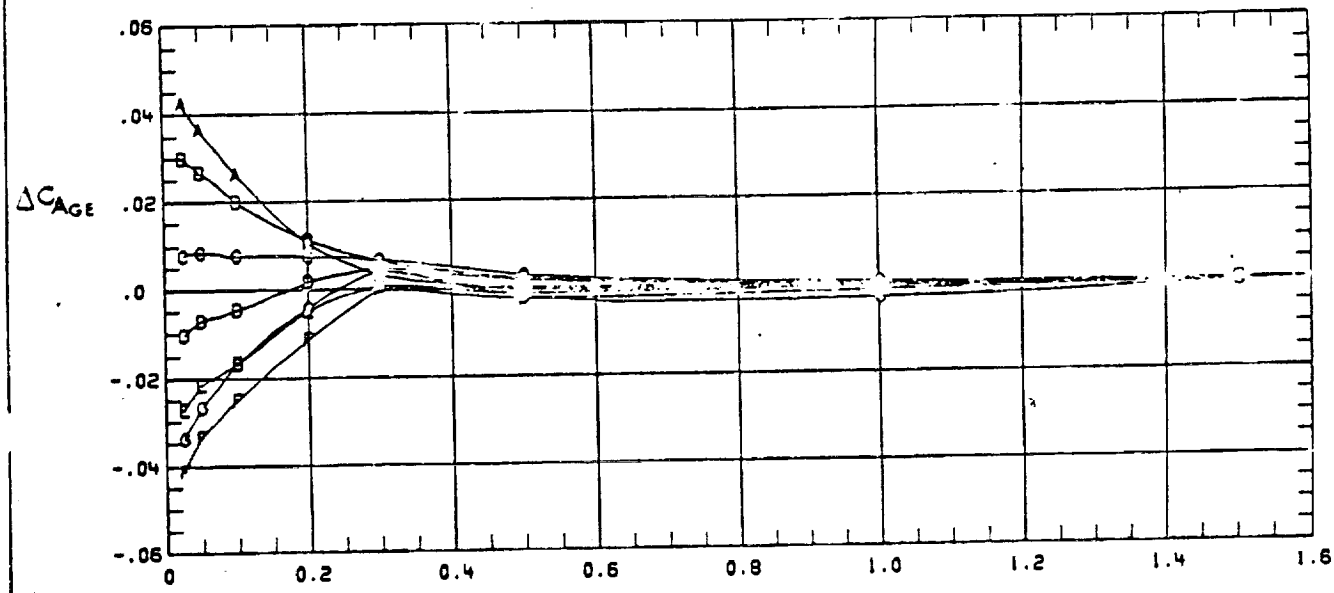
BASELINE ORBITER VEHICLE

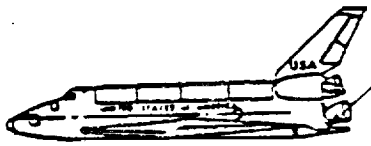
CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = FS 1076.70, Y_{cg} = BL 0.00, Z_{cg} = WBL 375.00

REFERENCE DIMENSIONS

AREA S_{ref} = 2690.000 ft²
SPAN b_{ref} = 78.056 ft
MAC c_{ref} = 39.560 ft
BODY LENGTH L_B = 1290.300 in

$\delta_e = 15.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



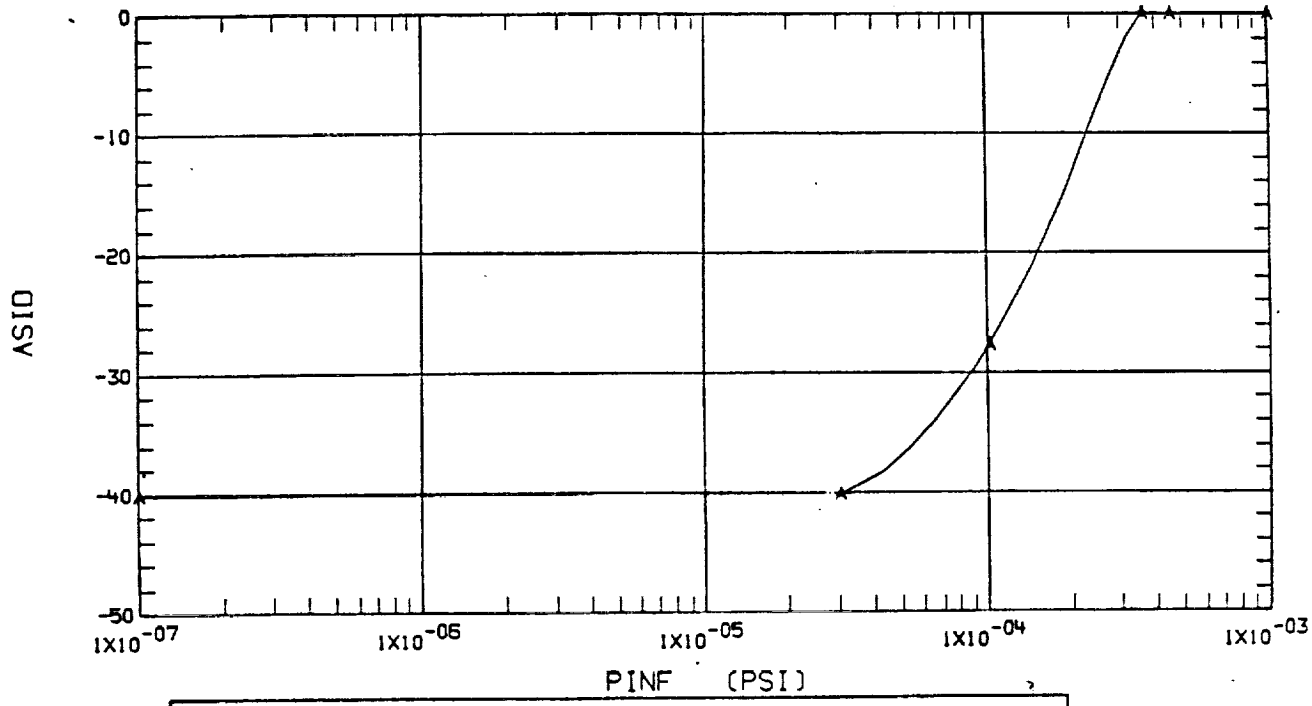


Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A −4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.04254	0.02990	0.00769	-0.01052	-0.02743	-0.04123	-0.03412
0.050	0.03647	0.02670	0.00834	-0.00731	-0.02176	-0.03376	-0.02692
0.100	0.02632	0.01990	0.00755	-0.00487	-0.01666	-0.02506	-0.01696
0.200	0.01042	0.01100	0.00739	0.00142	-0.00497	-0.01145	-0.00424
0.300	0.00306	0.00630	0.00655	0.00466	0.00036	-0.00018	0.00407
0.500	-0.00069	0.00190	0.00263	0.00155	-0.00151	-0.00275	-0.00232
1.000	-0.00070	0.0	0.00014	0.0	-0.00062	-0.00165	-0.00342
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: H³
DATE 10-19-77
REVISED:

Figure 4.1.1.2-103
GROUND EFFECT

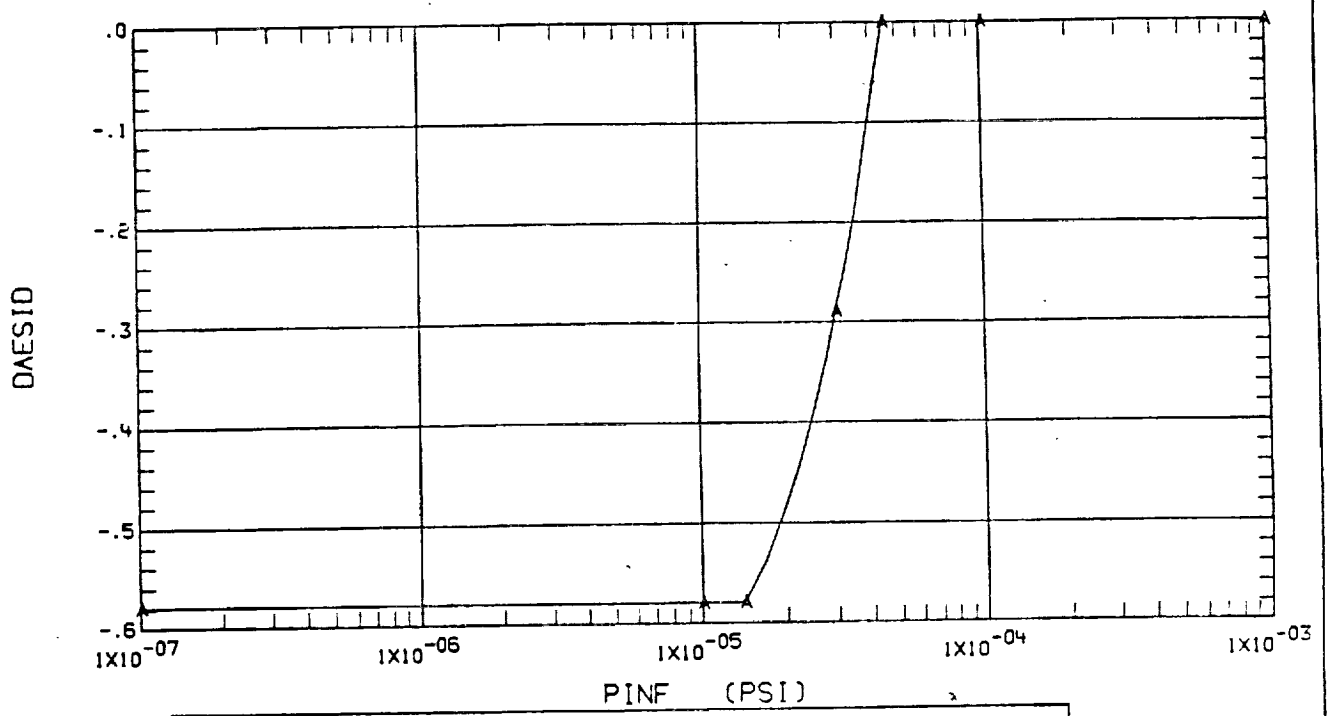


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	A_{SURF} ~ IMP lb/n AXIAL FORC
1.000E-07	-40.186
3.000E-05	-40.186
1.000E-04	-27.818
3.600E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

ENGINEER
DATE 10/4/78

FIGURE 4.1.1.2-104
AXIAL FORCE SURFACE IMPINGEMENT, DOWN-FIRING

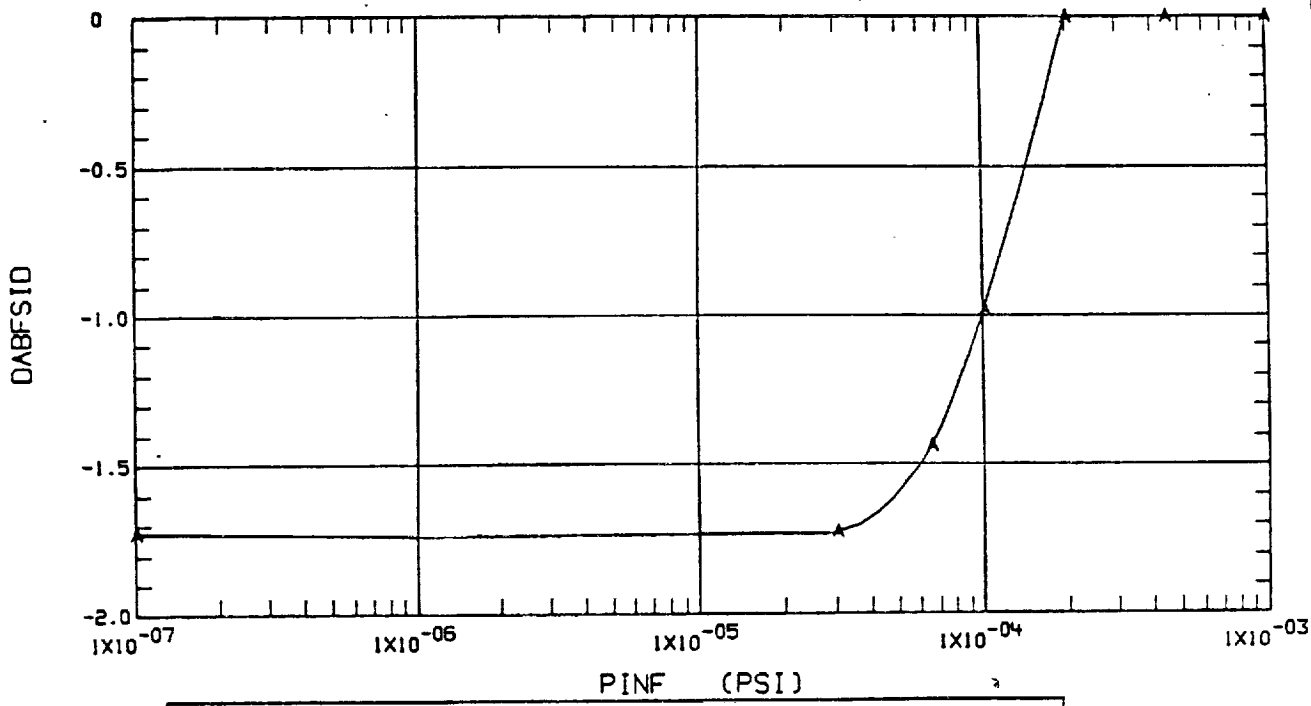


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$\frac{\partial A}{\partial \delta_e} \sim \frac{lb}{n\text{-}deg}$ DE AXIAL F
1.000E-07	-0.580
1.000E-05	-0.580
1.400E-05	-0.580
3.000E-05	-0.290
4.500E-05	0.0
1.000E-04	0.0
1.000E-03	0.0

ENGINEER [signature]
DATE 10/4/82

FIGURE 4.1.1.2-105
ELEVON AXIAL FORCE SURFACE IMPINGEMENT, DOWN-FIRING

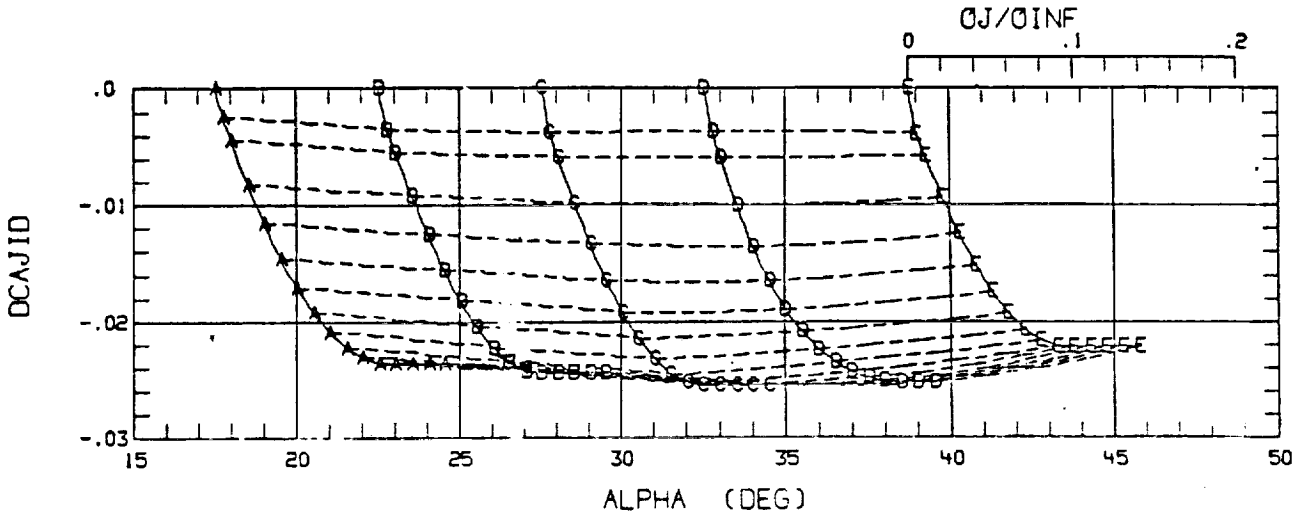


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$\frac{\partial A}{\partial \delta_{BF}} \sim \frac{lb}{n\text{-}deg}$ DBF AXIAL
1.000E-07	-1.730
3.000E-05	-1.730
6.500E-05	-1.440
1.000E-04	-0.980
2.000E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

ENGINEER HJD
DATE 10/4/78

FIGURE 4.1.1.2-106
BODYFLAP AXIAL FORCE SURFACE IMPINGEMENT, DOWN-FIRING



QJ/QINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	AXIAL FORCE JET DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00246	-0.00353	-0.00380	-0.00368	-0.00390
0.0100	-0.00451	-0.00550	-0.00591	-0.00598	-0.00580
0.0200	-0.00830	-0.00921	-0.00985	-0.01011	-0.00932
0.0300	-0.01168	-0.01260	-0.01340	-0.01361	-0.01245
0.0400	-0.01464	-0.01564	-0.01654	-0.01655	-0.01516
0.0500	-0.01717	-0.01828	-0.01925	-0.01897	-0.01746
0.0600	-0.01930	-0.02051	-0.02150	-0.02092	-0.01932
0.0700	-0.02100	-0.02227	-0.02327	-0.02244	-0.02073
0.0800	-0.02228	-0.02354	-0.02454	-0.02357	-0.02169
0.0900	-0.02315	-0.02409	-0.02528	-0.02437	-0.02217
0.1000	-0.02360	-0.02447	-0.02547	-0.02489	-0.02217
0.1100	-0.02360	-0.02447	-0.02547	-0.02516	-0.02217
0.1200	-0.02360	-0.02447	-0.02547	-0.02526	-0.02217
0.1300	-0.02360	-0.02447	-0.02547	-0.02525	-0.02217
0.1400	-0.02360	-0.02447	-0.02547	-0.02525	-0.02217

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

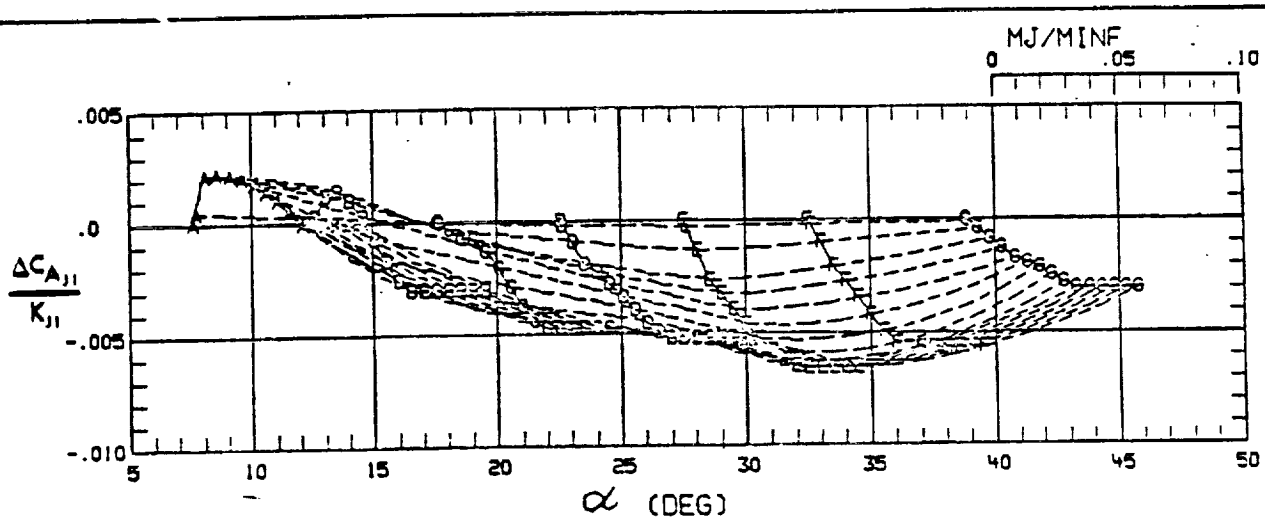
$$\Delta C_{A_{jj}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	AXIAL FORCE JET DF					
17.500	-0.0003	-0.4420	2.0900	0.0	0.0050	0.1000
22.500	-0.0015	-0.4130	1.2600	5.7300	0.0050	0.1000
27.500	-0.0016	-0.4480	1.7100	3.8300	0.0050	0.1000
32.500	-0.0012	-0.5130	3.5400	-7.7900	0.0050	0.1200
38.750	-0.0019	-0.4090	1.8500	2.1300	0.0050	0.1000

ENGINEER [signature]
DATE 10/4/78

FIGURE 4.1.1.2-107
AXIAL FORCE JET INTERACTION, DOWN-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	AXIAL FORCE JI.SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.00042	0.00023	-0.00007	-0.00019	-0.00027	-0.00021	-0.00009
0.005	0.00211	0.00117	-0.00036	-0.00096	-0.00133	-0.00104	-0.00043
0.010	0.00214	0.00137	-0.00072	-0.00193	-0.00266	-0.00209	-0.00086
0.015	0.00208	0.00100	-0.00083	-0.00227	-0.00329	-0.00274	-0.00129
0.020	0.00193	0.00023	-0.00133	-0.00277	-0.00397	-0.00349	-0.00172
0.025	0.00170	-0.00075	-0.00208	-0.00337	-0.00464	-0.00427	-0.00191
0.030	0.00138	-0.00175	-0.00293	-0.00398	-0.00528	-0.00497	-0.00216
0.035	0.00098	-0.00259	-0.00376	-0.00455	-0.00593	-0.00550	-0.00246
0.040	0.00048	-0.00308	-0.00442	-0.00500	-0.00626	-0.00578	-0.00278
0.045	-0.00010	-0.00304	-0.00478	-0.00526	-0.00653	-0.00569	-0.00309
0.050	-0.00010	-0.00304	-0.00478	-0.00526	-0.00658	-0.00569	-0.00309
0.055	-0.00010	-0.00304	-0.00478	-0.00526	-0.00658	-0.00569	-0.00309
0.060	-0.00010	-0.00304	-0.00478	-0.00526	-0.00658	-0.00569	-0.00309
0.065	-0.00010	-0.00304	-0.00478	-0.00526	-0.00658	-0.00569	-0.00309
0.070	-0.00010	-0.00304	-0.00478	-0.00526	-0.00658	-0.00569	-0.00309

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-5}\left(\frac{v_\infty}{q_\infty}\right)$$

$$\frac{\Delta C_{A_{JI}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

ALPHA (DEG)	AOO3.MIN.MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	AXIAL FORCE JI.SF					
7.500	0.00200	0.03140	-1.73290	0.0	0.00500	0.04500
12.500	0.00020	0.28190	-18.95050	246.34760	0.00500	0.04500
17.500	-0.00220	0.29000	-16.00000	184.00000	0.01000	0.04500
22.500	-0.00200	0.07150	-7.36000	92.50000	0.01000	0.05000
27.500	-0.00170	-0.06740	-3.42000	56.30000	0.01000	0.05000
32.500	-0.00150	0.00670	-7.80000	124.00000	0.01000	0.04500
38.750	-0.00210	0.08000	-3.67000	31.20000	0.02000	0.04500

$K_{JI} = 1.0$

Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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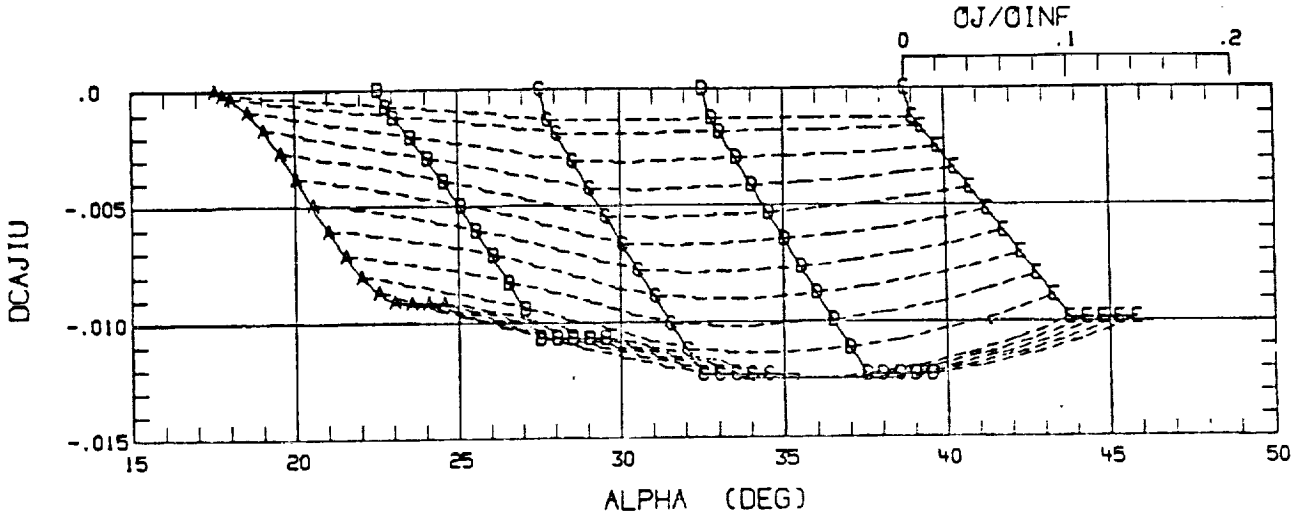
FIGURE 4.1.1.2- 108
AXIAL FORCE JET INTERACTION.SIDE-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	AXIAL FORCE JET, CF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00019	-0.00073	-0.00131	-0.00128	-0.00123
0.0100	-0.00036	-0.00116	-0.00191	-0.00185	-0.00166
0.0200	-0.00092	-0.00206	-0.00312	-0.00300	-0.00253
0.0300	-0.00173	-0.00300	-0.00431	-0.00416	-0.00342
0.0400	-0.00272	-0.00398	-0.00549	-0.00532	-0.00431
0.0500	-0.00362	-0.00500	-0.00665	-0.00648	-0.00521
0.0600	-0.00497	-0.00606	-0.00781	-0.00764	-0.00613
0.0700	-0.00610	-0.00716	-0.00995	-0.00881	-0.00705
0.0800	-0.00714	-0.00830	-0.01006	-0.00997	-0.00798
0.0900	-0.00804	-0.00947	-0.01121	-0.01114	-0.00893
0.1000	-0.00872	-0.01069	-0.01231	-0.01231	-0.00988
0.1100	-0.00912	-0.01069	-0.01231	-0.01231	-0.00988
0.1200	-0.00918	-0.01069	-0.01231	-0.01231	-0.00988
0.1300	-0.00918	-0.01069	-0.01231	-0.01231	-0.00988
0.1400	-0.00918	-0.01069	-0.01231	-0.01231	-0.00988

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{A_{JI}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	AXIAL FORCE JET, CF					
17.500	-0.0001	-0.0082	-1.8700	10.9000	0.0050	0.1200
22.500	-0.0003	-0.0841	-0.1980	0.0	0.0050	0.1000
27.500	-0.0007	-0.1220	0.0586	0.0	0.0050	0.1000
32.500	-0.0007	-0.1150	-0.0115	0.0	0.0050	0.1000
38.750	-0.0008	-0.0657	-0.0509	0.0	0.0050	0.1000

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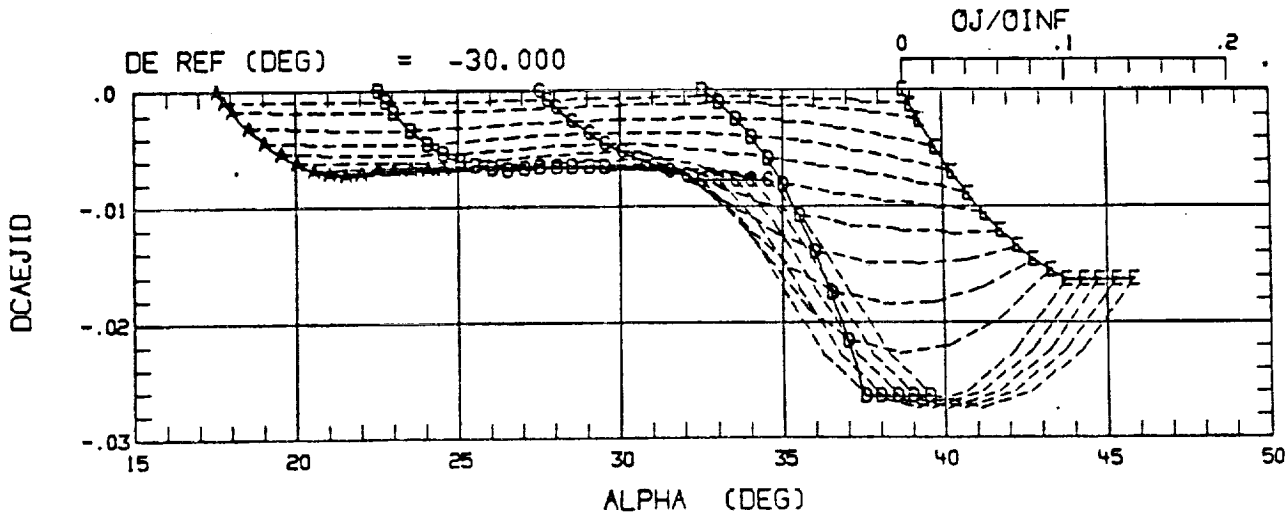
FIGURE 4.1.1.2-109
AXIAL FORCE JET INTERACTION, UP-FIRING



DJ/DINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE AXIAL FORCE JET				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00089	-0.00098	-0.00075	-0.00054	-0.00134
0.0100	-0.00172	-0.00187	-0.00144	-0.00112	-0.00262
0.0200	-0.00320	-0.00338	-0.00267	-0.00246	-0.00499
0.0300	-0.00445	-0.00456	-0.00372	-0.00406	-0.00712
0.0400	-0.00548	-0.00545	-0.00461	-0.00596	-0.00902
0.0500	-0.00627	-0.00609	-0.00535	-0.00822	-0.01072
0.0600	-0.00684	-0.00651	-0.00599	-0.01088	-0.01221
0.0700	-0.00718	-0.00673	-0.00653	-0.01399	-0.01351
0.0800	-0.00728	-0.00681	-0.00700	-0.01760	-0.01464
0.0900	-0.00716	-0.00676	-0.00743	-0.02174	-0.01561
0.1000	-0.00680	-0.00663	-0.00783	-0.02648	-0.01643
0.1100	-0.00680	-0.00663	-0.00783	-0.02648	-0.01643
0.1200	-0.00680	-0.00663	-0.00783	-0.02648	-0.01643
0.1300	-0.00680	-0.00663	-0.00783	-0.02648	-0.01643
0.1400	-0.00680	-0.00663	-0.00783	-0.02648	-0.01643

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{A_{\delta_{e_{REF}} = -30°}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE AXIAL FORCE JET					
17.500	0.0	-0.1830	1.1500	0.0	0.0050	0.1000
22.500	0.0	-0.2060	1.9700	-5.7300	0.0050	0.1000
27.500	0.0	-0.1550	1.1500	-3.8300	0.0050	0.1000
32.500	0.0	-0.1030	-0.8390	-7.7900	0.0050	0.1000
38.750	0.0	-0.2750	1.3200	-2.1300	0.0050	0.1000

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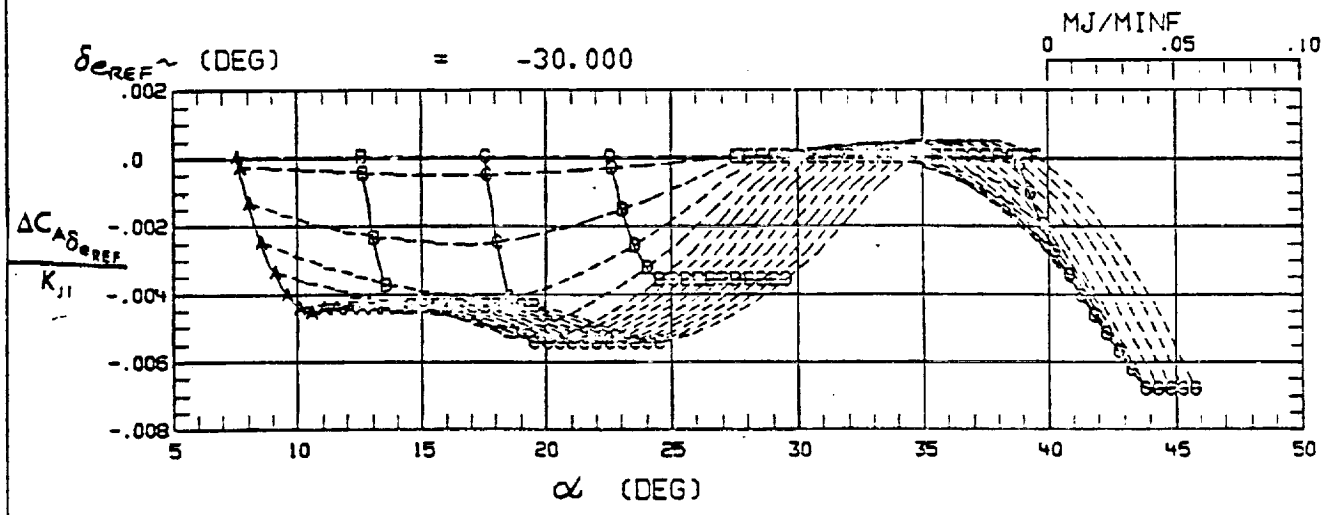
FIGURE 4.1.1.2-110
ELEVON AXIAL FORCE JET INTERACTION, DOWN-FIRING



MJ/MINF	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE AXIAL FORCE J1,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00027	-0.00047	-0.00060	-0.00030	0.0	0.0	-0.00021
0.005	-0.00137	-0.00235	-0.00260	-0.00151	0.0	0.0	-0.00105
0.010	-0.00250	-0.00375	-0.00414	-0.00257	0.0	0.0	-0.00198
0.015	-0.00338	-0.00439	-0.00508	-0.00324	0.0	0.0	-0.00277
0.020	-0.00402	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00346
0.025	-0.00441	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00407
0.030	-0.00455	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00464
0.035	-0.00445	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00517
0.040	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00569
0.045	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00624
0.050	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00682
0.055	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00682
0.060	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00682
0.065	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00682
0.070	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00682

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{a_\infty}\right) \qquad \frac{\Delta C_{A\delta_{e_{REF}}}}{K_{J1}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$K_{J1} = 1.0$

ALPHA (DEG)	A003,MIN,MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE AXIAL FORCE J1,SF					
7.500	0.0	-0.29910	4.91370	0.0	0.00500	0.03560
12.500	0.0	-0.57620	22.58200	-246.37460	0.00500	0.01500
17.500	0.0	-0.59300	19.70000	-184.00000	0.00500	0.02000
22.500	0.0	-0.35300	10.50000	-92.50000	0.00500	0.02000
27.500	0.0	0.0	0.0	0.0	0.00500	0.05000
32.500	0.0	0.0	0.0	0.0	0.00500	0.05000
38.750	0.0	-0.22900	3.43000	-31.60001	0.00500	0.05000

Interpolate for α's not shown *after* calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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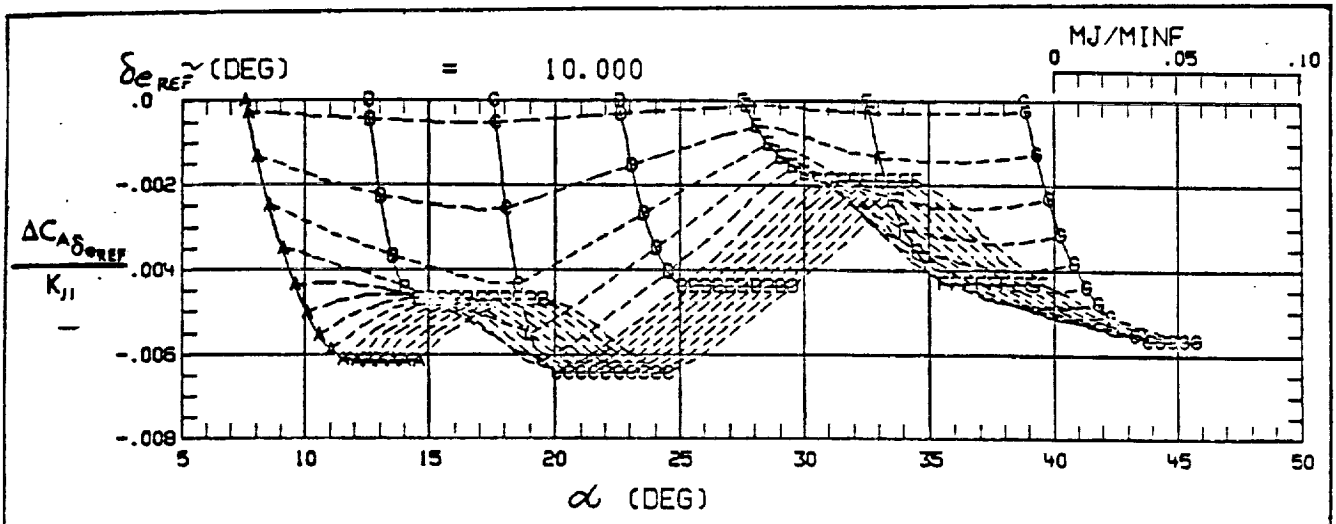
DATE 4/3/79

FIGURE 4.1.1.2-111
ELEVON AXIAL FORCE JET INTERACTION, SIDE-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE AXIAL FORCE J1,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00027	-0.00046	-0.00052	-0.00031	-0.00012	-0.00027	-0.00025
0.005	-0.00134	-0.00228	-0.00258	-0.00154	-0.00060	-0.00137	-0.00127
0.010	-0.00251	-0.00371	-0.00437	-0.00258	-0.00103	-0.00235	-0.00232
0.015	-0.00352	-0.00445	-0.00553	-0.00350	-0.00134	-0.00305	-0.00317
0.020	-0.00437	-0.00471	-0.00617	-0.00405	-0.00156	-0.00355	-0.00365
0.025	-0.00505	-0.00471	-0.00645	-0.00442	-0.00174	-0.00394	-0.00439
0.030	-0.00557	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00480
0.035	-0.00593	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00511
0.040	-0.00612	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00534
0.045	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00552
0.050	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00567
0.055	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00567
0.060	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00557
0.065	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00567
0.070	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00557

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_{\infty}}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-4}\left(\frac{v_{\infty}}{a_\infty}\right)$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{A\delta_{e_{REF}}}}{K_{J1}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003,MIN,MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE AXIAL FORCE J1,SF					
7.500	0.0	-0.28410	3.27690	0.0	0.00500	0.04330
12.500	0.0	-0.55530	20.92740	-246.34760	0.00500	0.02000
17.500	0.0	-0.60300	18.39999	-184.00000	0.00500	0.02500
22.500	0.0	-0.35200	9.32000	-92.50000	0.00500	0.02500
27.500	0.0	-0.14000	4.22000	-56.30000	0.00500	0.03000
32.500	0.0	-0.31900	9.55000	-124.00000	0.00500	0.03000
38.750	0.0	-0.27700	4.85000	-31.60001	0.00500	0.05000

$K_{J1} = 1.0$

Interpolate for α's not shown *after* calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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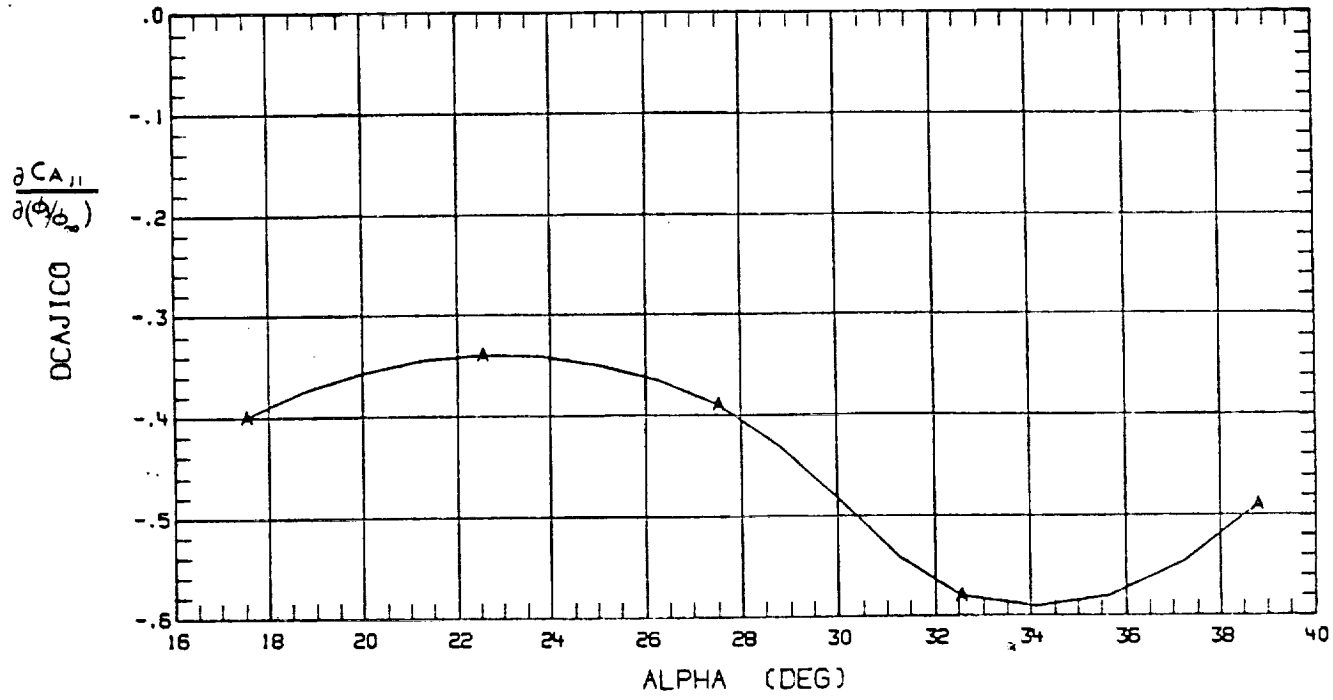
DATE 4/5/79

FIGURE 4.1.1.2-112
ELEVON AXIAL FORCE JET INTERACTION.SIDE-FIRING



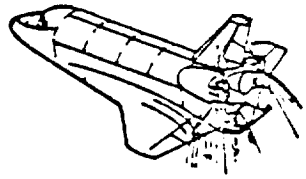
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

$\frac{\partial C_{A_{JI}}}{\partial(\phi_j/\phi_\infty)} = 0$ if down firing jet group is inoperative on one side.

ALPHA (DEG)	$\frac{\partial C_{A_{JI}}}{\partial(\phi_j/\phi_\infty)}$ AXIAL FORC
17.500	-0.40000
22.500	-0.34000
27.500	-0.39000
32.500	-0.58000
38.750	-0.49000

$$\left(\frac{\overline{\phi_j}}{\phi_\infty}\right) = \frac{1}{2}\left[\left(\frac{\phi_j}{\phi_\infty}\right)_{(H_D} + \left(\frac{\phi_j}{\phi_\infty}\right)_{RH_D}\right]$$

$$0 < \left(\frac{\overline{\phi_j}}{\phi_\infty}\right) \leq 0.03$$

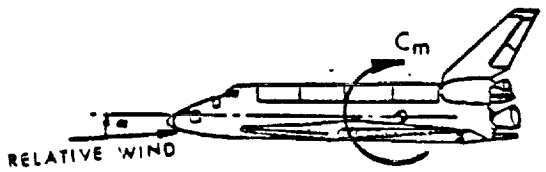


ENGINEER JHD
DATE 9/26/78

FIGURE 4.1.1.2-113
AXIAL FORCE JET INTERACTION CARRYOVER, DOWN-FIRING

SD[illegible]-[illegible]-0[illegible]C IM

4.1.1.3 PITCHING MOMENT COEFFICIENT. The Orbiter Vehicle aerodynamic pitching moment coefficient is defined in this section. The basic aerodynamic pitching moment coefficient data are presented in three forms: 1) as function of angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty^1$) from 0.005 (equivalent to M = 13.6) through 0.8 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet through 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.1.1.3]. Uncertainties associated with the pitching moment characteristics are available in Section 6.0.



The RCS flow field interaction data are presented as a contribution to the total pitching moment (M) rather than the coefficient (C_m) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where RCS is used in conjunction with the aerodynamic pitching moment (cf. Section 3.6); i.e., the aerodynamic pitching moment coefficient must be converted to a dimensional moment *before* adding the RCS flow field interaction effect (see also Appendix B).

The total pitching moment is:

$$M_{TOTAL} = \bar{q}\, S\bar{c}\, C_{m_{\substack{TOTAL \\ AERO}}} + M_{RCS}$$

*The total aerodynamic pitching moment coefficient about 65 percent of the body length (FS 1076.7, WL 375.0, BL 0.0) is obtained by the following equation:

$$C_{m_{\substack{TOTAL \\ AERO_{0.65L_B}}}} = C_{m_{BASIC}} + [\Delta C_{m_{ELEVATOR}} + \Delta C_{m_{AILERON}}]_{ELEVON} + \Delta C_{m_{\substack{BODY \\ FLAP}}} + \Delta C_{m_{RUDDER}} + \Delta C_{m_{\substack{SPEED \\ BRAKE}}}$$

$$+ C_{m_{\dot{\alpha}}} \frac{\dot{\alpha}\bar{c}}{2V} + [C_{m_{\hat{q}}} + \Delta C_{m_{\hat{q}_{\substack{SB \\ BF}}}}] \frac{q\bar{c}}{2V} + \Delta C_{m_{FLEX}} + \Delta C_{m_{\substack{LANDING \\ GEAR}}} + \Delta C_{m_{\substack{GROUND \\ EFFECT}}} + \Delta C_{m_{\substack{SILTS \\ POD}}}$$

*Refer to Appendix D when using digitized data.

NOTE: The increment presented in Appendix E should be added to the total from above calculations to account for OV102 manufacturing misalignment.

where,

$C_{m_{BASIC}}$ = Basic, full-scale, freestream, rigid-body pitching moment coefficient about $0.65L_B$ (Figures 4.1.1.3-1 through -6)

NOTE: 1. All control surfaces neutral *except* $\delta_{SB} = 25°$.

2. For Moment Reference Center other than $0.65L_B$,

$$C_{m_{MRC}} = C_{m_{0.65L_B}} + \frac{\Delta x}{\bar{c}} C_N - \frac{\Delta z}{\bar{c}} C_A$$

where $\Delta x = x_{MRC} - 1076.7 \text{inches}$

$\Delta z = z_{MRC} - 375 \text{inches}$

3. Moment transfer of (2) applies to all following increments and/or slopes except as noted.

$\Delta C_{m_{ELEVATOR}}$ = Change in pitching moment coefficient due to elevon (elevator) deflection, δ_e, when inboard and outboard angles are equal. (Figures 4.1.1.3-7 through -37)

NOTE: 1. Partial span factor, K_m, to be used for elevon-body flap interconnect flight system where δ_e is limited to ±5° and inboard and outboard angles are not equal. (Figure 4.1.1.3-38)

$$\Delta C_{m_{e_{\delta_{e_i} \neq \delta_{e_o}}}} = K_m \Delta C_{m_{e_{\delta_e = \delta_{e_i}}}} + (1 - K_m) \Delta C_{m_{e_{\delta_e = \delta_{e_o}}}}$$

$\Delta C_{m_{AILERON}}$ = Change in pitching moment coefficient due to aileron deflection, δ_a.

$$= \frac{1}{2}\left[K_{m_{(\delta_{e_L})}} \Delta C_{m_{e_{L_I}}} + (1 - K_{m_{(\delta_{e_L})}}) \Delta C_{m_{e_{L_O}}} + K_{m_{(\delta_{e_R})}} \Delta C_{m_{e_{R_I}}} + (1 - K_{m_{(\delta_{e_R})}}) \Delta C_{m_{e_{R_O}}}\right] - \Delta C_{m_{ELEVATOR}}$$

$\Delta C_{m_{BODY\ FLAP}}$ = Change in pitching moment coefficient due to body flap deflection, δ_{BF} (Figures 4.1.1.3-39 through -72)

$\Delta C_{m_{RUDDER}}$ = Change in pitching moment coefficient due to rudder deflection, δ_r. (Assume zero)

$\Delta C_{m_{\substack{SPEED\\BRAKE}}}$ = Change in pitching moment coefficient due to speed brake deflection, δ_{SB}. (Figures 4.1.1.3-73 through -99)

$C_{m_{\dot{\alpha}}}$ = Change in pitching moment coefficient due to rate of change of angle of attack, $\dot{\alpha}$, (per radian).* (see NOTE 1, C_{m_q})

$C_{m_{\hat{q}}}$ = Change in pitching moment coefficient due to pitch rate, q, (per radian).* (Figures 4.1.1.3-100 through -101)

NOTE: 1. As presented herein, $C_{m_q} \equiv C_{m_q} + C_{m_{\dot{\alpha}}}$ and should be treated as C_{m_q}.

$\Delta C_{m_{\substack{\hat{q}_{SB}\\BF}}}$ = Incremental effect of speed brake/body flap on pitch damping. (Figure 4.1.1.3-102)

$$= \left[K_{SB}\left(\frac{\delta_{SB}-25}{75}\right) + \left(1-K_{SB}\right)\left(\frac{\delta_{BF}}{13.75}\right)\right]\Delta C_{m_{q_{\substack{SB=100\\BF=13.75}}}}$$

NOTE: 1. For normal simulations, use $K_{SB} = 0.5$

2. For sensitivity studies, assume K_{SB} can be either 0 or 1.

$\Delta C_{m_{FLEX}}$ = Change in pitching moment coefficient due to aeroelastic deformation.

$$= \Delta C^{F}_{m_o} - (1-\eta_N)(C_m - C_{m_o})^{R}_{BASIC} - \left(\frac{\Delta x_{AC}}{\bar{c}}\right)^{F} \eta_N (C_N - C_{N_o})^{R}_{BASIC}$$

$$- (1-\eta_{M_e})\left(\Delta C^{R}_{m_e} + \Delta C_{m_{AILERON}}\right) - (1-\eta_{M_{BF}})\,\Delta C^{R}_{m_{BF}}$$

$$- (1-\eta_{M_{SB}})\,\Delta C^{R}_{m_{SB}} - (1-\eta_{M_q})\,C^{R}_{m_{\hat{q}}}\,\frac{q\bar{c}}{2V}$$

where the flexible (F) to rigid (R) ratios are

η_N = basic normal force (Figure 4.1.1.3-103)

η_{M_e} = elevon (Figure 4.1.1.3-104)

*For rotary derivative transfer equations see NASA SP -3070, "Summary of Transformation Equations and Equations of Motion Used in Free Flight and Wind Tunnel Data Reduction and Analysis," Gainer, T. G., and S. Hoffman, Langley Research Center, Hampton, Virginia (1972).

$\eta_{M_{BF}}$ = body flap (Figure 4.1.1.3-106)

$\eta_{M_{SB}}$ = speed brake (Assume 1.0)

η_{M_q} = pitch rate (Figure 4.1.1.3-106)

and, $\Delta C^f_{m_o}$ = flexible intercept at $\alpha = 0°$ (Figure 4.1.1.3-107)

$\left(\frac{\Delta X_{AC}}{\bar{c}}\right)^f$ = shift in aerodynamic center due to aeroelasticity. (Figure 4.1.1.3-108)

NOTE: 1. Detailed discussion of aeroelasticity may be obtained from Appendix A.

$\Delta C_{m_{\substack{LANDING\\GEAR}}}$ = Change in pitching moment coefficient due to extension of landing gear. (Figure 4.1.1.3-109)

$\Delta C_{m_{\substack{GROUND\\EFFECT}}}$ = Change in pitching moment coefficient due to proximity of ground, f(h/b). (Figures 4.1.1.3-110 through -119)

$\Delta C_{m_{\substack{SILTS\\POD}}}$ = Change in pitching moment coefficient due to addition of SILTS pod.

= $-0.000635152 + 0.000881151\ M - 0.000173119\ M^2$ for $M \leq 6.0$

= zero for $M > 6.0$

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

The effect of the RCS may be described as a dimensional pitching moment (foot-pounds) in terms of the significant contributing elements by:

$$M_{RCS} = M_{JT} + [M_{SURF} + \Delta M_{ELEVON} + \Delta M_{\substack{BODY\\FLAP}}]_{IMP} + \bar{q}\, S\bar{c}[\Delta C_m + \Delta C_{m_{ELEVON}} + \Delta C_{m_{\substack{BODY\\FLAP}}} + \Delta C_{m_{\substack{DOWN\ FIRING\\CARRYOVER\\2\ SIDES}}}]_{JI}$$

where,

M_{JT} = Pitching moment resulting from number (n) of jets being fired (Reference data only). (cf. Appendix B)

$$= \sum_{OJG} [M_{JET} \cdot n] \sim \text{ft-lb}$$

NOTE: 1. OJG = operating jet group (cf. Figure B-1)

$M_{SURF_{IMP}}$ = Pitching moment resulting from jet impingement on Orbiter Vehicle surfaces (s) (Figure 4.1.1.3-120)

$$= \sum_{OJG} [M_{SURF_{IMP}} \cdot n] \sim \text{ft-lb}$$

$\Delta M_{ELEVON_{IMP}}$ = Change in pitching moment due to effect of impingement on elevon effectiveness. (Figure 4.1.1.3-121)

$$= \sum_{OJG} \left[\frac{\partial M}{\partial \delta_e} \cdot n \cdot \delta_e\right] \sim \text{ft-lb}$$

$\Delta M_{BODY\ FLAP}$ = Change in pitching moment due to effect of impingement on body flap effectiveness. (Figure 4.1.1.3-122)

$$= \sum_{OJG} \left[\frac{\partial M}{\partial \delta_{BF}} \cdot n \cdot \delta_{BF}\right] \sim \text{ft-lb}$$

$\Delta C_{m_{JI}}$ = Change in pitching moment coefficient due to jet interaction. (Figures 4.1.1.3-123 through -125)

$$= \sum_{OJG} [\Delta C_{m_{JI}}]$$

$\Delta C_{m_{ELEVON_{JI}}}$ = Change in pitching moment coefficient due to jet interaction effect on elevon effectiveness.

$$= \sum_{OJG} \left[(\Delta C_m)_{\delta_{e_{REF}}} \cdot (\delta_e/\delta_{e_{REF}})^{0.75}\right]$$

NOTE: 1. Down-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.3-126)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.3-127)

2. Side-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.3-128)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.3-129)

3. Up-firing jets (No effect)

$\Delta C_{m_{\substack{\text{BODY} \\ \text{FLAP}}}}$ = Change in pitching moment coefficient due to jet interaction effect on body flap effectiveness.

$$= \sum_{CJG} \left[(\Delta C_m)_{\delta_{BF_{REF}}} (\delta_{BF}/\delta_{BF_{REF}})^{0.75} \right]$$

NOTE: 1. Down-firing jets

$\delta_{BF} < 0°$, $\delta_{BF_{REF}} = -14.25°$ (Figure 4.1.1.3-130)

$\delta_{BF} > 0°$ (No effect)

2. Side-firing jets (No effect)

3. Up-firing jets (No effect)

$\Delta C_{m_{\substack{\text{DOWN} \\ \text{FIRING} \\ \text{CARRYOVER} \\ \text{JI} \\ \text{2 SIDES}}}}$ = Effect of carry-over between left- and right-down firing jet groups due to jet interaction. (Figure 4.1.1.3-131)

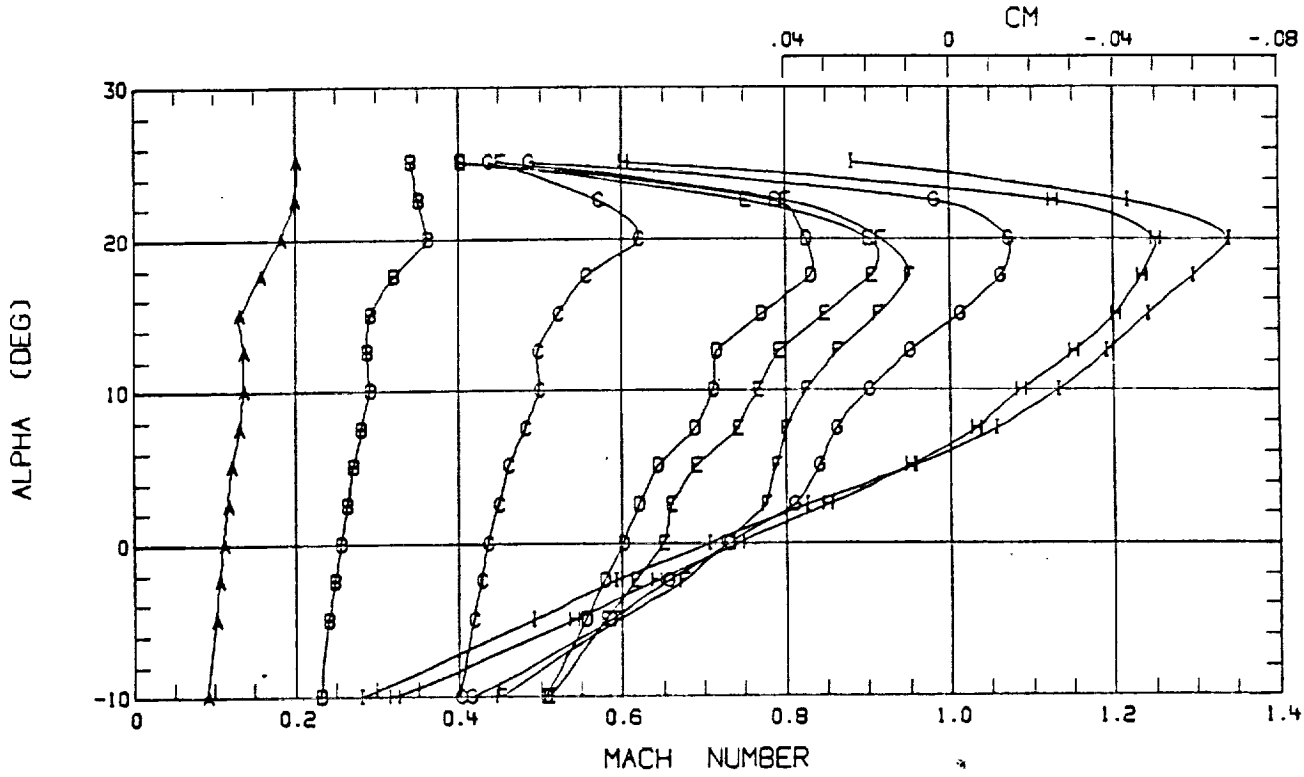
$$= \left[\frac{\partial C_{m_{JI}}}{\partial (\phi_j/\phi_\infty)} \right] \left[\overline{(\phi_j/\phi_\infty)} \right]$$

NOTE: 1. $\phi_j/\phi_\infty = (0.1543/\sqrt{q_\infty})n$

2. This term is zero when down-firing jet group is inoperative on one side.

3. $\overline{(\phi_j/\phi_\infty)} = \frac{1}{2} \left[(\phi_j/\phi_\infty)_{LD} + (\phi_j/\phi_\infty)_{RD} \right]$

where: $0 < \overline{(\phi_j/\phi_\infty)} < 0.03$



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	0.250 A	0.400 B	0.600 C	0.800 D	0.850 E	0.900 F	0.920 G	0.950 H	0.980 I
ALPHA (DEG)	PITCHING MOMENT COEFFICIENT								
-10.000	0.03200	0.03400	0.04000	0.05900	0.06800	0.09000	0.10100	0.12600	0.14000
-5.000	0.03000	0.03200	0.03650	0.04900	0.05400	0.06100	0.06700	0.08200	0.09800
-2.500	0.02900	0.03050	0.03470	0.04450	0.04700	0.04500	0.05300	0.06200	0.07800
0.0	0.02800	0.02900	0.03300	0.04000	0.04000	0.03500	0.03800	0.04200	0.05500
2.500	0.02700	0.02750	0.03050	0.03600	0.03800	0.02500	0.02200	0.02000	0.03100
5.000	0.02600	0.02600	0.02900	0.03150	0.03200	0.02250	0.01600	0.0	0.00500
7.500	0.02400	0.02400	0.02400	0.02250	0.02200	0.02000	0.01200	-0.01600	-0.01500
10.000	0.02300	0.02200	0.02050	0.01800	0.01700	0.01500	0.00400	-0.02700	-0.03000
12.500	0.02300	0.02250	0.02100	0.01700	0.01200	0.00750	-0.00600	-0.04000	-0.04200
15.000	0.02400	0.02200	0.01600	0.00600	0.00050	-0.00250	-0.01800	-0.05000	-0.05200
17.500	0.01900	0.01600	0.00900	-0.00600	-0.01100	-0.01000	-0.02800	-0.05650	-0.06300
20.000	0.01400	0.00800	-0.00400	-0.00500	-0.01000	-0.00300	-0.03000	-0.06000	-0.07200
22.500	0.01050	0.01000	0.00600	0.00260	0.02000	0.02000	-0.01200	-0.03500	-0.04700
25.000	0.01000	0.01200	0.03300	0.08000	0.09000	0.09000	0.08700	0.07000	0.02000
30.000	**********	**********	**********	**********	**********	**********	**********	**********	**********
35.000	**********	**********	**********	**********	**********	**********	**********	**********	**********
40.000	**********	**********	**********	**********	**********	**********	**********	**********	**********
45.000	**********	**********	**********	**********	**********	**********	**********	**********	**********
50.000	**********	**********	**********	**********	**********	**********	**********	**********	**********
55.000	**********	**********	**********	**********	**********	**********	**********	**********	**********
60.000	**********	**********	**********	**********	**********	**********	**********	**********	**********

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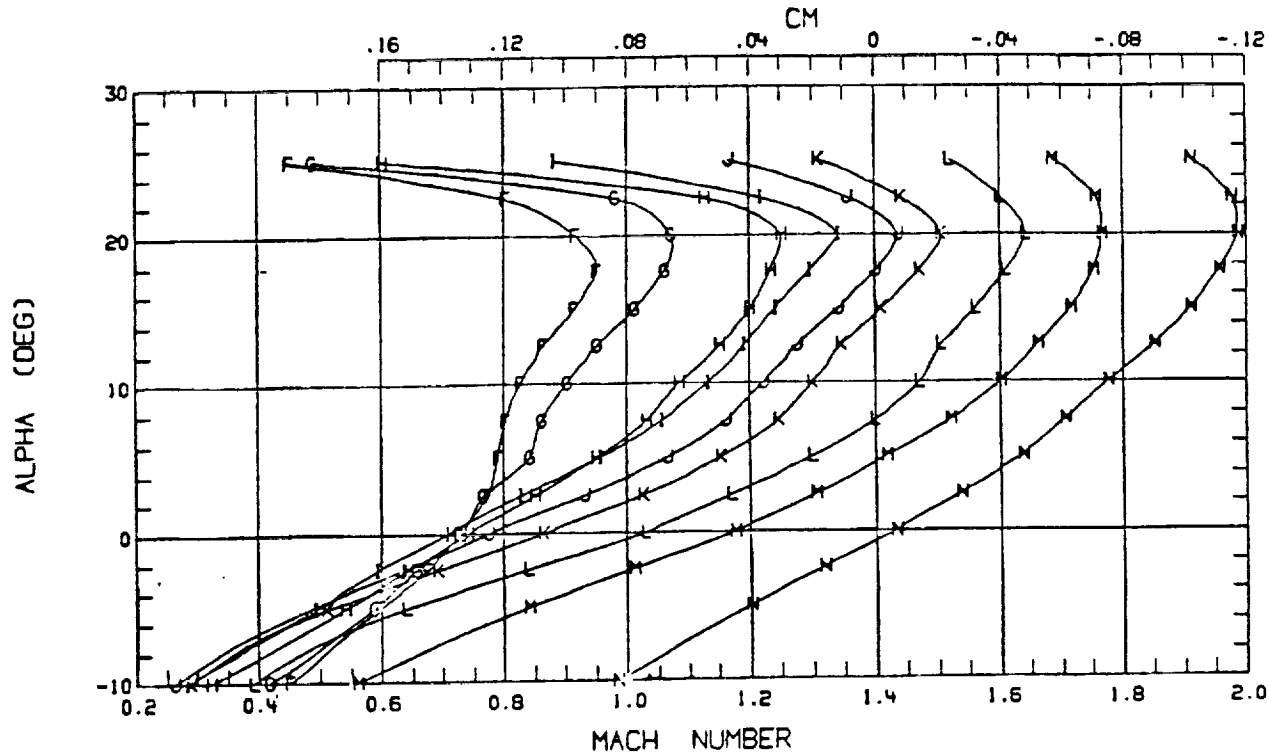
FIGURE 4.1.1.3-- 1
BASIC PITCHING MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

ALPHA (DEG)	MACH NUMBER 0.900 F	0.920 G	0.950 H	0.980 I	1.050 J	1.100 K	1.200 L	1.300 M	1.500 N
	PITCHING MOMENT COEFFICIENT								
-10.000	0.09000	0.10100	0.12600	0.14000	0.15800	0.16250	0.16200	0.14800	0.10300
-5.000	0.06100	0.06700	0.08200	0.09800	0.11400	0.11800	0.11200	0.09200	0.06000
-2.500	0.04500	0.05300	0.06200	0.07800	0.08400	0.08200	0.07200	0.05800	0.03700
0.0	0.03500	0.03800	0.04200	0.05500	0.05500	0.04700	0.03400	0.02500	0.01400
2.500	0.02500	0.02200	0.02000	0.03100	0.02400	0.01500	0.00600	-0.00100	-0.00700
5.000	0.02250	0.01600	0.0	0.00500	-0.00300	-0.01050	-0.02000	-0.02350	-0.02500
7.500	0.02000	0.01200	-0.01600	-0.01500	-0.02200	-0.02900	-0.04000	-0.04400	-0.04100
10.000	0.01500	0.00400	-0.02700	-0.03000	-0.03400	-0.04000	-0.05400	-0.06000	-0.05500
12.500	0.00750	-0.00600	-0.04000	-0.04200	-0.04500	-0.04900	-0.06100	-0.07200	-0.07000
15.000	-0.00250	-0.01800	-0.05000	-0.05200	-0.05800	-0.06200	-0.07200	-0.08300	-0.08200
17.500	-0.01000	-0.02800	-0.05650	-0.06300	-0.07000	-0.07400	-0.08200	-0.09000	-0.09100
20.000	-0.00300	-0.03000	-0.06000	-0.07200	-0.07700	-0.08100	-0.08800	-0.09300	-0.09700
22.500	0.02000	-0.01200	-0.03500	-0.04700	-0.06100	-0.06800	-0.08000	-0.09100	-0.09500
25.000	0.09000	0.08700	0.07000	0.02000	-0.02300	-0.04200	-0.06400	-0.07700	-0.08200
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

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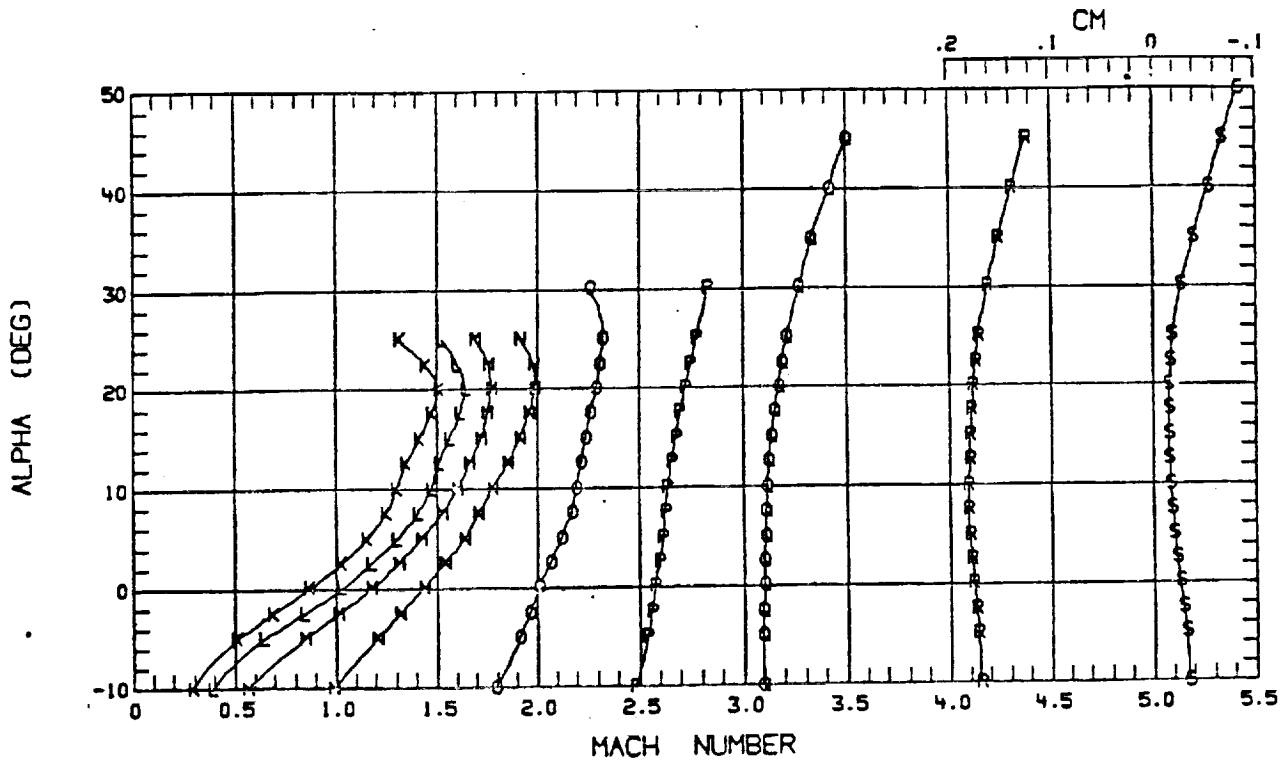
FIGURE 4.1.1.3-- 2
BASIC PITCHING MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	1.100 K	1.200 L	1.300 M	1.500 N	2.000 O	2.500 P	3.000 Q	4.000 R	5.000 S
ALPHA (DEG)	PITCHING MOMENT COEFFICIENT								
-10.000	0.16250	0.16200	0.14800	0.10300	0.04200	0.00450	-0.01800	-0.02940	-0.03370
-5.000	0.11800	0.11200	0.09200	0.06000	0.01750	-0.00800	-0.01800	-0.02700	-0.03070
-2.500	0.08200	0.07200	0.05800	0.03700	0.00800	-0.01144	-0.01850	-0.02550	-0.02800
0.0	0.04700	0.03400	0.02500	0.01400	-0.00130	-0.01480	-0.01900	-0.02310	-0.02480
2.500	0.01500	0.00600	-0.00100	-0.00700	-0.01300	-0.01940	-0.01970	-0.02100	-0.02200
5.000	-0.01050	-0.02000	-0.02350	-0.02500	-0.02380	-0.02300	-0.02050	-0.01880	-0.02000
7.500	-0.02900	-0.04000	-0.04400	-0.04100	-0.03360	-0.02480	-0.02150	-0.01820	-0.01810
10.000	-0.04000	-0.05400	-0.06000	-0.05500	-0.03650	-0.02740	-0.02250	-0.01830	-0.01660
12.500	-0.04900	-0.06100	-0.07200	-0.07000	-0.04300	-0.03100	-0.02400	-0.01910	-0.01560
15.000	-0.06200	-0.07200	-0.08300	-0.08200	-0.04720	-0.03510	-0.02700	-0.02010	-0.01520
17.500	-0.07400	-0.08200	-0.09000	-0.09100	-0.05160	-0.03950	-0.03000	-0.02150	-0.01510
20.000	-0.08100	-0.08800	-0.09300	-0.09700	-0.05810	-0.04440	-0.03400	-0.02310	-0.01550
22.500	-0.06800	-0.08000	-0.09100	-0.09500	-0.06150	-0.05000	-0.03700	-0.02500	-0.01700
25.000	-0.04200	-0.06400	-0.07700	-0.08200	-0.06490	-0.05530	-0.04200	-0.02780	-0.01840
30.000	.....	.....	.....	.....	-0.05180	-0.06640	-0.05400	-0.03720	-0.02700
35.000	.....	.....	.....	.....	.....	.....	-0.06600	-0.04850	-0.03940
40.000	.....	.....	.....	.....	.....	.....	-0.08300	-0.06140	-0.05300
45.000	.....	.....	.....	.....	.....	.....	-0.10000	-0.07580	-0.06750
50.000	.....	.....	.....	.....	.....	.....	.....	.....	-0.08330

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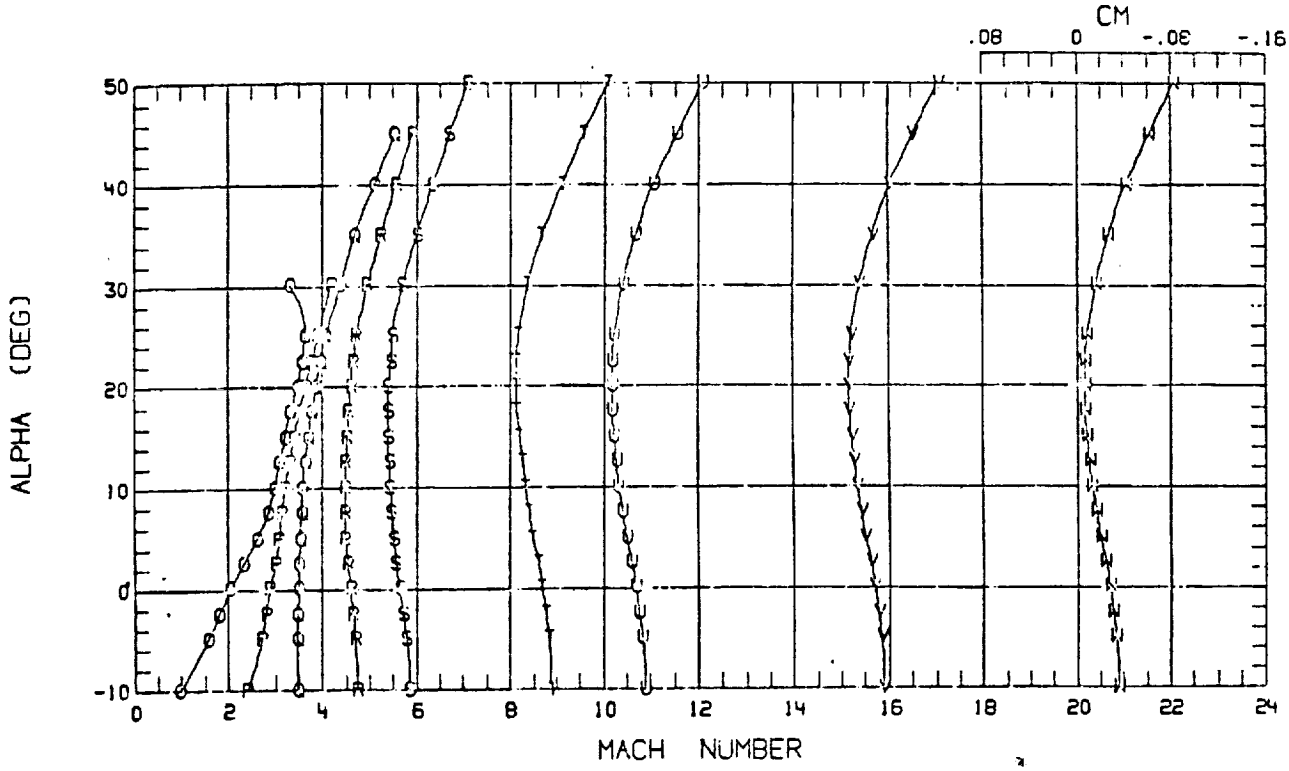
DATE 3/12/75

FIGURE 4.1.1.3-- 3
BASIC PITCHING MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

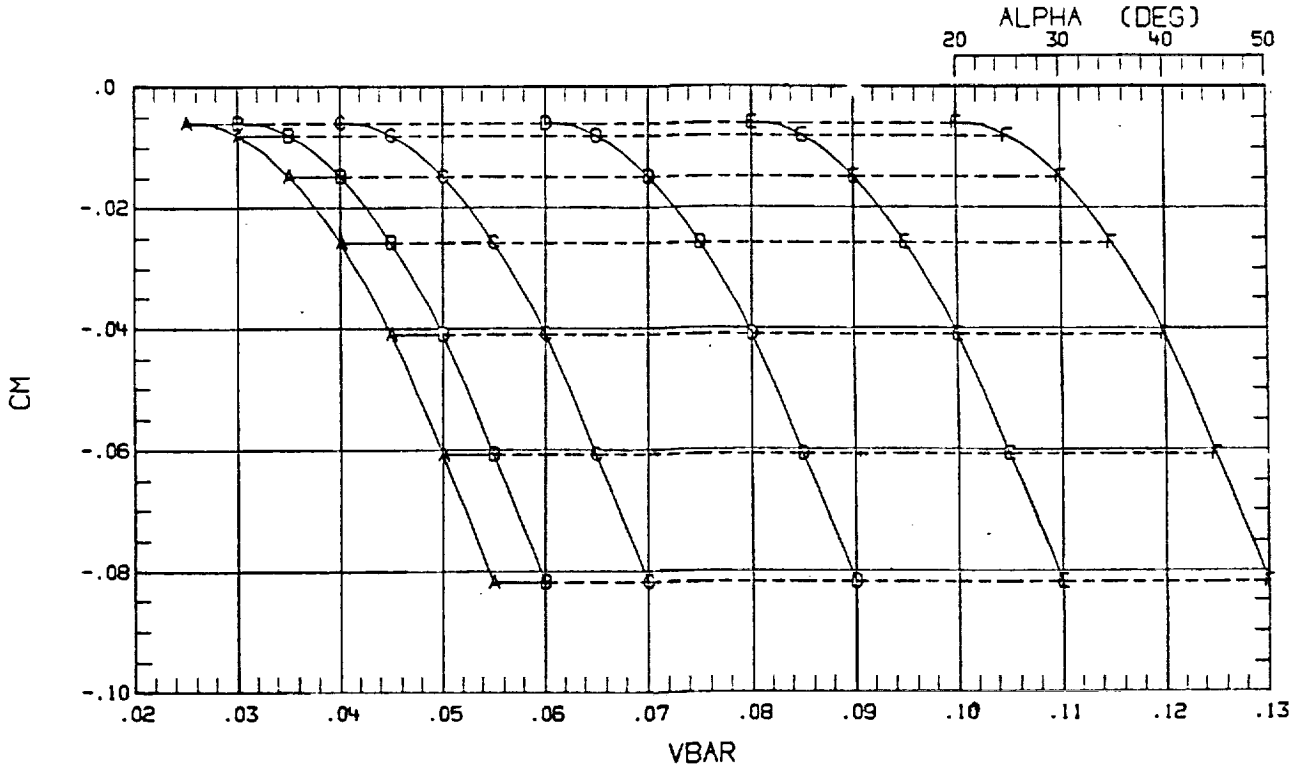
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	2.000 Q	2.500 P	3.000 O	4.000 R	5.000 S	6.000 T	10.000 U	15.000 V	20.000 W
ALPHA (DEG)	PITCHING MOMENT COEFFICIENT								
-10.000	0.04200	0.00450	-0.01800	-0.02910	-0.03570	-0.03500	-0.03500	-0.03500	-0.03500
-5.000	0.01750	-0.00800	-0.01800	-0.02700	-0.03070	-0.03280	-0.03280	-0.03280	-0.03280
-2.500	0.00800	-0.01144	-0.01850	-0.02550	-0.02800	-0.03000	-0.03000	-0.03000	-0.03000
0.0	-0.00130	-0.01480	-0.01900	-0.02310	-0.02480	-0.02700	-0.02700	-0.02700	-0.02700
2.500	-0.01300	-0.01940	-0.01970	-0.02100	-0.02200	-0.02350	-0.02350	-0.02350	-0.02350
5.000	-0.02380	-0.02300	-0.02050	-0.01880	-0.02000	-0.01900	-0.01900	-0.01900	-0.01900
7.500	-0.03350	-0.02480	-0.02150	-0.01820	-0.01810	-0.01560	-0.01550	-0.01560	-0.01560
10.000	-0.03850	-0.02740	-0.02250	-0.01830	-0.01660	-0.01250	-0.01200	-0.01200	-0.01200
12.500	-0.04300	-0.03100	-0.02400	-0.01910	-0.01560	-0.00950	-0.00970	-0.00970	-0.00970
15.000	-0.04720	-0.03510	-0.02700	-0.02010	-0.01520	-0.00725	-0.00780	-0.00780	-0.00780
17.500	-0.05160	-0.03950	-0.03000	-0.02150	-0.01510	-0.00493	-0.00600	-0.00600	-0.00600
20.000	-0.05810	-0.04440	-0.03400	-0.02310	-0.01550	-0.00330	-0.00600	-0.00600	-0.00600
22.500	-0.06150	-0.05000	-0.03700	-0.02500	-0.01700	-0.00400	-0.00620	-0.00620	-0.00620
25.000	-0.06490	-0.05530	-0.04200	-0.02780	-0.01840	-0.00590	-0.00800	-0.00800	-0.00800
30.000	-0.05180	-0.06640	-0.05400	-0.03720	-0.02700	-0.01350	-0.01500	-0.01500	-0.01500
35.000	.....	.....	-0.06600	-0.04850	-0.03940	-0.02570	-0.02600	-0.02600	-0.02600
40.000	.....	.....	-0.08300	-0.06140	-0.05300	-0.04290	-0.04100	-0.04100	-0.04100
45.000	.....	.....	-0.10000	-0.07560	-0.06750	-0.06150	-0.06100	-0.06100	-0.06100
50.000	.....	.....	.....	.....	-0.08330	-0.09190	-0.08200	-0.08200	-0.08200

ENGINEER [signature]
DATE 4-27-77

FIGURE 4.1.1.3-- 4
BASIC PITCHING MOMENT COEFFICIENT



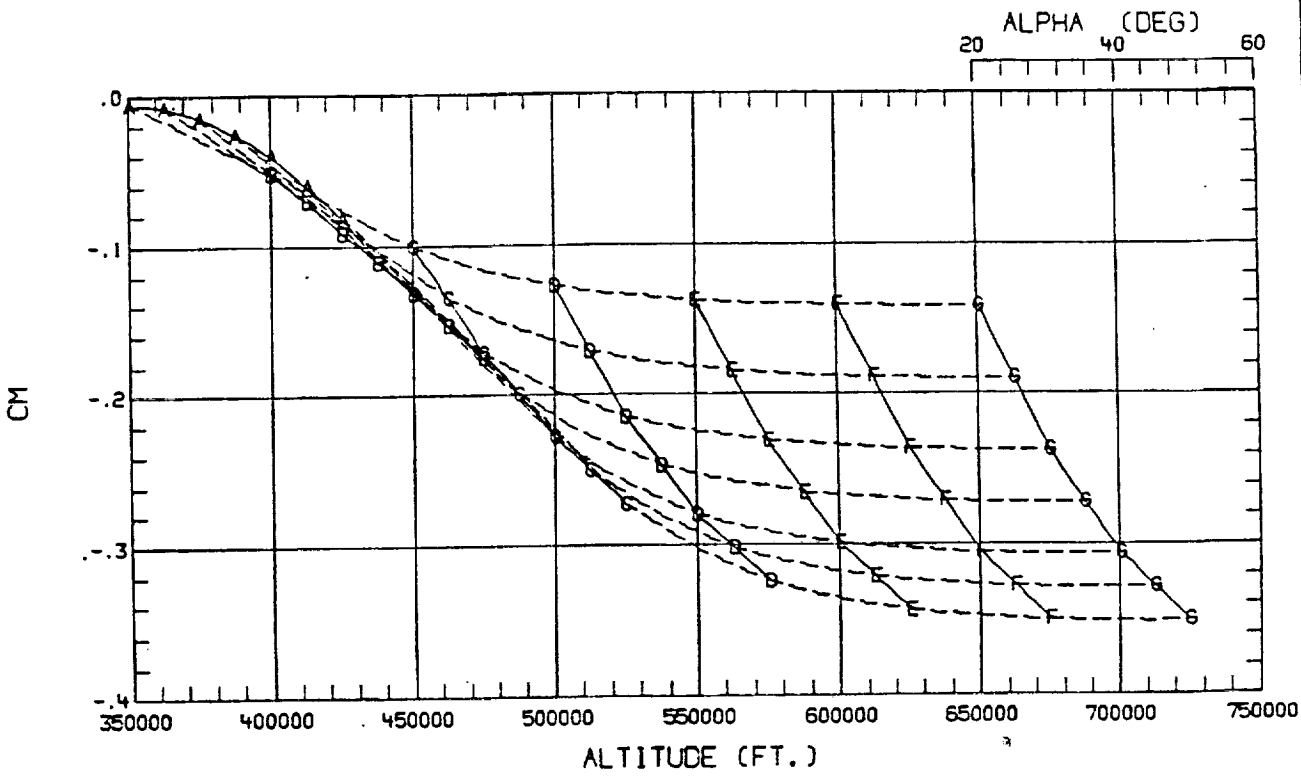
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	VBAR					
	0.005 A	0.010 B	0.020 C	0.040 D	0.060 E	0.080 F
ALPHA (DEG)	VIS. PITCHING MOMENT COEFFICIENT					
20.000	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600
25.000	-0.00800	-0.00800	-0.00800	-0.00800	-0.00800	-0.00800
30.000	-0.01500	-0.01500	-0.01500	-0.01500	-0.01500	-0.01500
35.000	-0.02600	-0.02600	-0.02600	-0.02600	-0.02600	-0.02600
40.000	-0.04100	-0.04100	-0.04100	-0.04100	-0.04100	-0.04100
45.000	-0.06100	-0.06100	-0.06100	-0.06100	-0.06100	-0.06100
50.000	-0.08200	-0.08200	-0.08200	-0.08200	-0.08200	-0.08200

ENGINEER NASA
DATE

FIGURE 4.1.1.3-5
BASIC PITCHING MOMENT COEFFICIENT

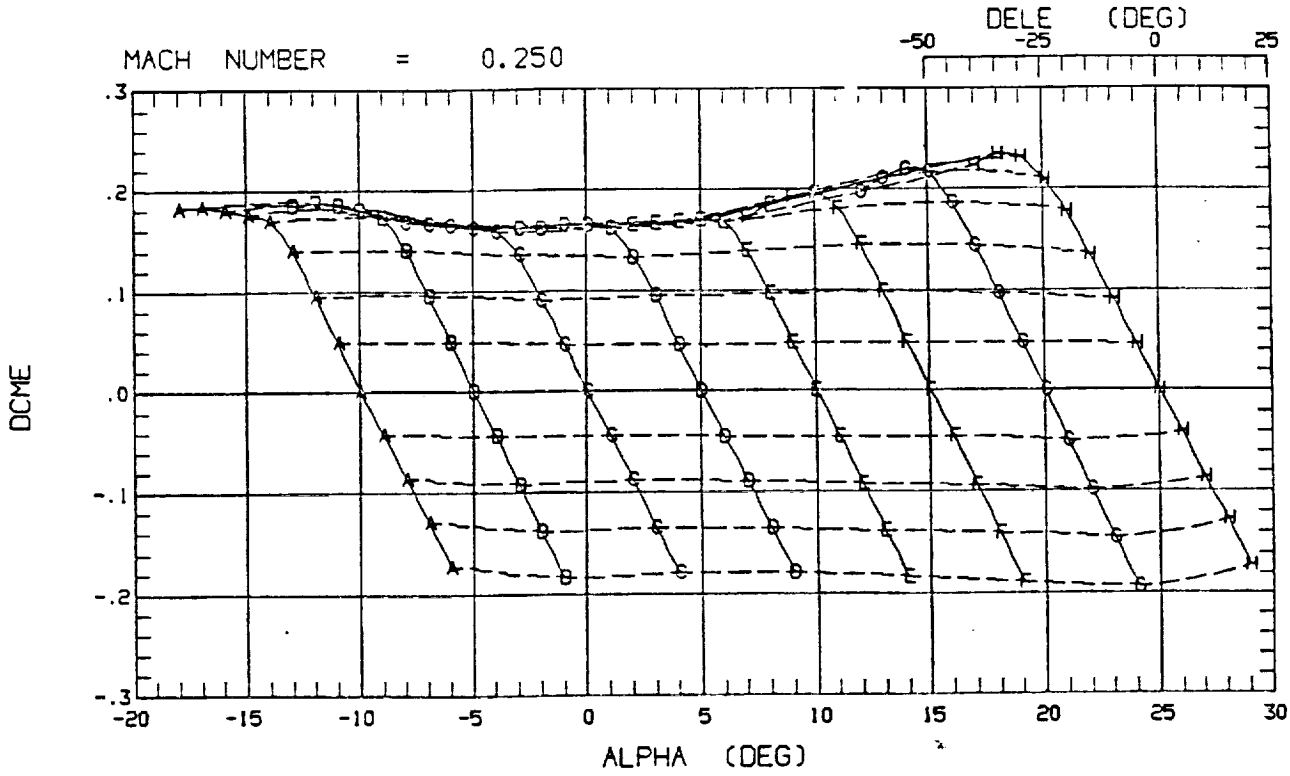


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE PITCHING MOMENT CO						
20.000	-0.00600	-0.05300	-0.10200	-0.12821	-0.13813	-0.14126	-0.14175
25.000	-0.00800	-0.07087	-0.13640	-0.17145	-0.18471	-0.18891	-0.18956
30.000	-0.01500	-0.09200	-0.17226	-0.21519	-0.23143	-0.23657	-0.23737
35.000	-0.02600	-0.11120	-0.20002	-0.24752	-0.26549	-0.27118	-0.27206
40.000	-0.04100	-0.13302	-0.22893	-0.28024	-0.29965	-0.30579	-0.30674
45.000	-0.06100	-0.15384	-0.25062	-0.30239	-0.32197	-0.32817	-0.32913
50.000	-0.08200	-0.17532	-0.27251	-0.32464	-0.34433	-0.35056	-0.35152

ENGINEER NASA
DATE

FIGURE 4.1.1.3-6
BASIC PITCHING MOMENT COEFFICIENT



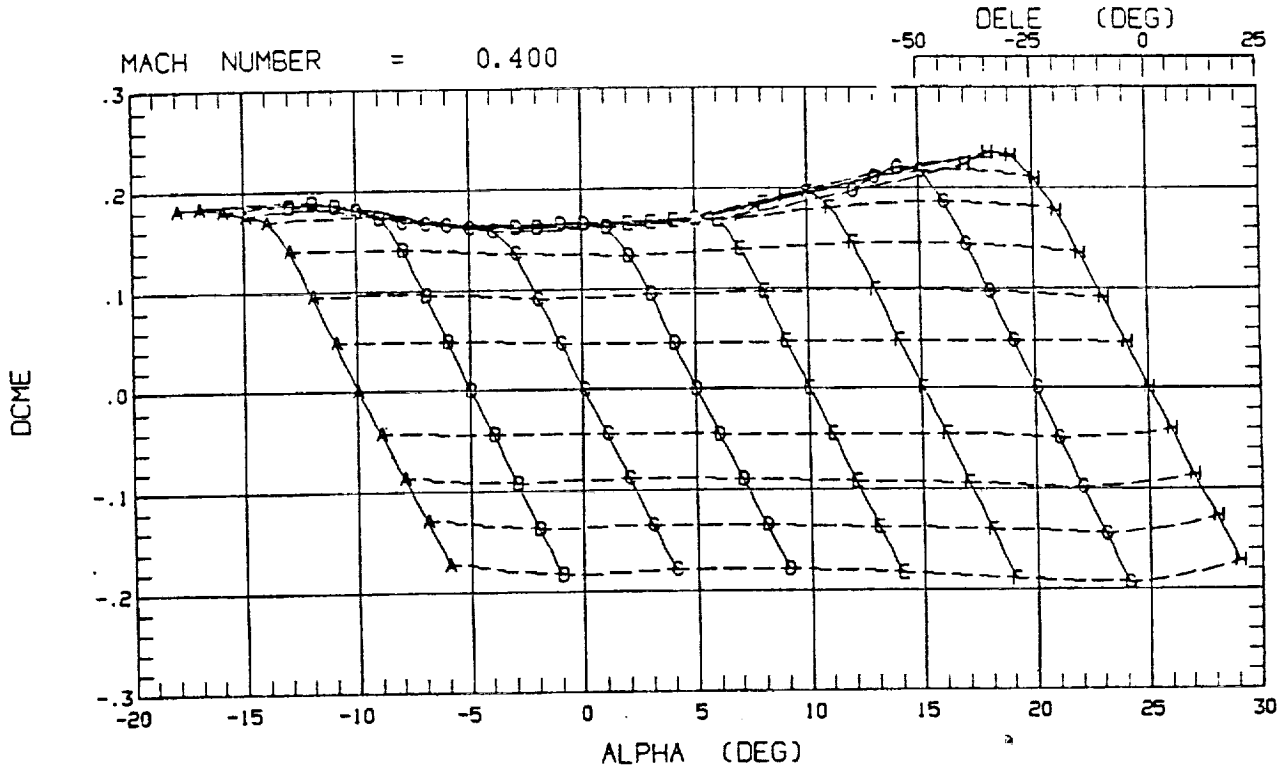
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.18130	0.18430	0.16800	0.16100	0.16400	0.17270	0.19590	0.22280
-35.000	0.18280	0.18680	0.16600	0.16200	0.16600	0.18380	0.21010	0.23390
-30.000	0.17970	0.18480	0.16400	0.16510	0.16800	0.19240	0.21920	0.23140
-25.000	0.17570	0.18030	0.16200	0.16500	0.16900	0.19540	0.21670	0.20810
-20.000	0.16910	0.17220	0.15800	0.16100	0.16800	0.18030	0.18580	0.17720
-15.000	0.13970	0.14000	0.13500	0.13300	0.13800	0.14430	0.14380	0.13400
-10.000	0.09420	0.09500	0.09000	0.09370	0.09600	0.09700	0.09570	0.09000
-5.000	0.04810	0.04910	0.04600	0.04500	0.04660	0.04760	0.04760	0.04510
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04300	-0.04410	-0.04410	-0.04510	-0.04510	-0.04500	-0.05010	-0.04150
10.000	-0.08750	-0.09220	-0.08900	-0.08960	-0.09220	-0.09470	-0.09920	-0.08660
15.000	-0.12950	-0.13870	-0.13500	-0.13570	-0.13870	-0.14100	-0.14580	-0.12860
20.000	-0.17300	-0.18430	-0.18000	-0.17970	-0.18430	-0.19040	-0.19440	-0.17420

ENGINEER DCO
DATE 9/13/88

FIGURE 4.1.1.3- 7
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



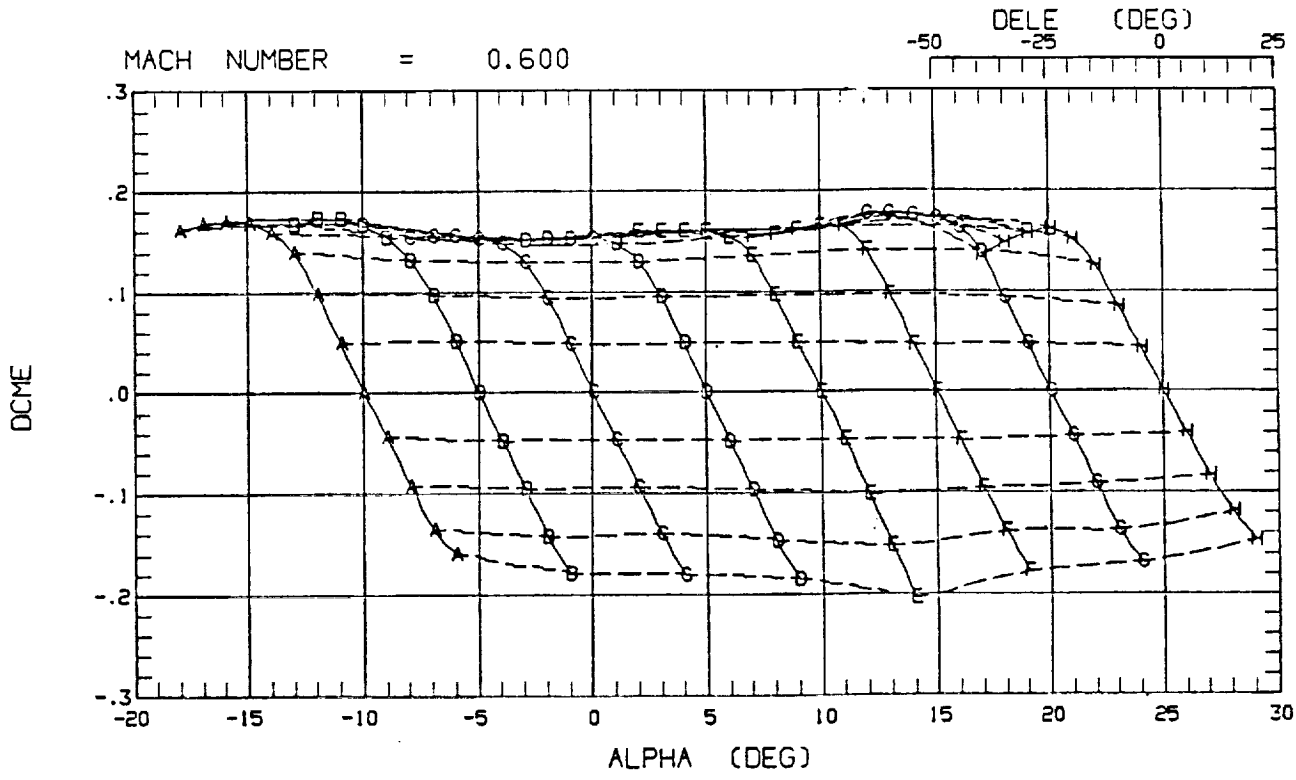
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.18130	0.18430	0.16800	0.16100	0.16400	0.17270	0.19590	0.22280
-35.000	0.18280	0.18680	0.16600	0.16200	0.16600	0.18380	0.21010	0.23390
-30.000	0.17970	0.18480	0.16400	0.16510	0.16800	0.19240	0.21920	0.23140
-25.000	0.17570	0.18030	0.16200	0.16500	0.16900	0.19540	0.21670	0.20810
-20.000	0.16910	0.17220	0.15800	0.16100	0.16800	0.18030	0.18580	0.17720
-15.000	0.13970	0.14000	0.13500	0.13300	0.13800	0.14430	0.14380	0.13400
-10.000	0.09420	0.09500	0.09000	0.09370	0.09600	0.09700	0.09570	0.09000
-5.000	0.04810	0.04910	0.04600	0.04500	0.04660	0.04760	0.04760	0.04510
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04300	-0.04410	-0.04410	-0.04510	-0.04510	-0.04500	-0.05010	-0.04150
10.000	-0.08750	-0.09220	-0.08900	-0.08960	-0.09220	-0.09470	-0.09920	-0.08660
15.000	-0.12950	-0.13870	-0.13500	-0.13570	-0.13870	-0.14100	-0.14580	-0.12860
20.000	-0.17300	-0.18430	-0.18000	-0.17970	-0.19430	-0.19040	-0.19440	-0.17420

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.1.3-8
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



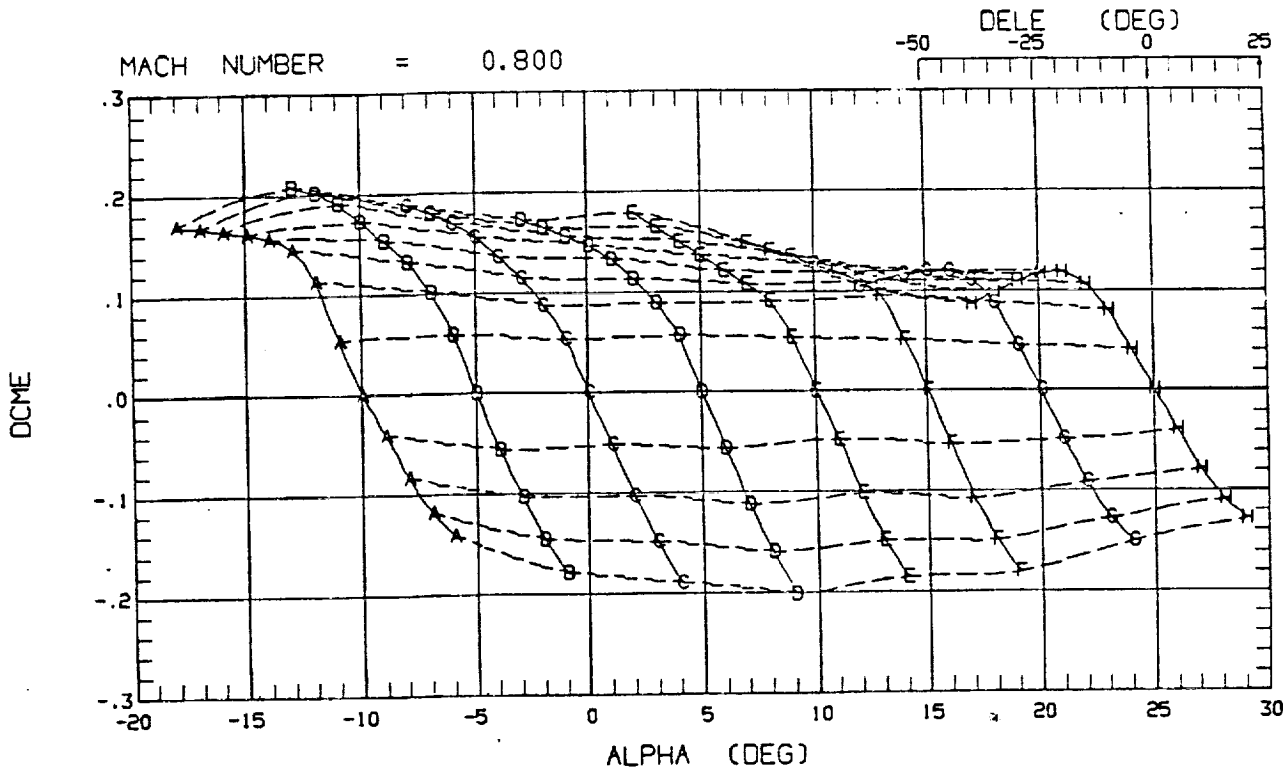
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.16140	0.16610	0.15350	0.15100	0.15950	0.15400	0.17610	0.13600
-35.000	0.16700	0.17190	0.15580	0.15210	0.16000	0.15750	0.17660	0.14770
-30.000	0.16950	0.17150	0.15500	0.15300	0.16000	0.16150	0.17560	0.15740
-25.000	0.16750	0.16550	0.15300	0.15300	0.15920	0.16450	0.17210	0.16090
-20.000	0.15890	0.15330	0.14700	0.14700	0.15400	0.16400	0.16350	0.15130
-15.000	0.13860	0.13150	0.12900	0.12950	0.13620	0.14000	0.13860	0.12540
-10.000	0.09750	0.09650	0.09350	0.09400	0.09600	0.09590	0.09240	0.08400
-5.000	0.04870	0.05000	0.04750	0.04800	0.04900	0.04600	0.04700	0.04200
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04370	-0.04800	-0.04700	-0.04800	-0.04700	-0.04800	-0.04470	-0.04180
10.000	-0.09240	-0.09550	-0.09450	-0.09700	-0.10200	-0.09600	-0.09190	-0.08310
15.000	-0.13550	-0.14300	-0.14000	-0.14700	-0.15300	-0.13800	-0.13760	-0.11940
20.000	-0.15990	-0.17900	-0.18100	-0.18600	-0.20400	-0.17800	-0.16830	-0.14820

ENGINEER GCO
DATE 9/13/78

FIGURE 4.1.1.3-9
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



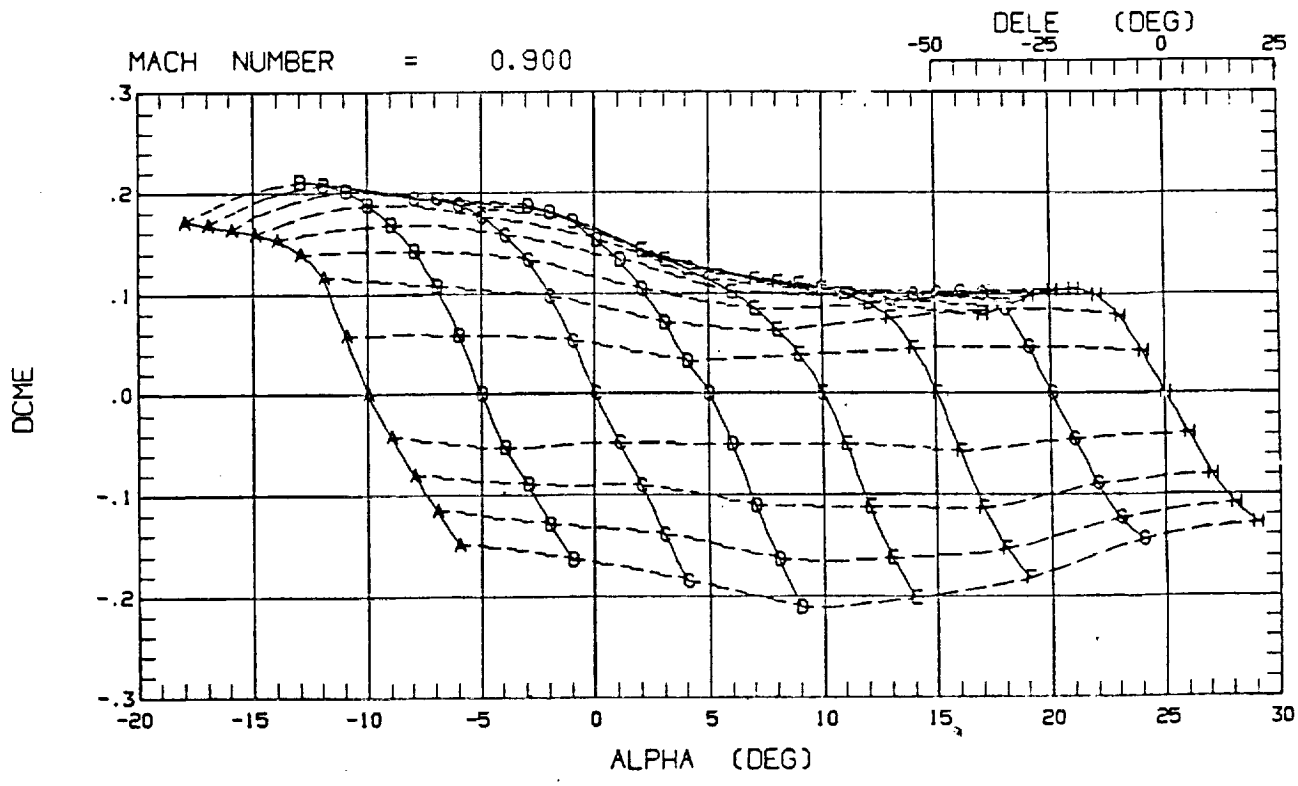
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.16840	0.20700	0.18750	0.17180	0.17800	0.14750	0.10360	0.08590
-35.000	0.16650	0.20100	0.17950	0.16430	0.16400	0.14080	0.10980	0.09720
-30.000	0.16370	0.19000	0.16950	0.15600	0.15000	0.13400	0.11500	0.10760
-25.000	0.16030	0.17150	0.15560	0.14600	0.13500	0.12600	0.11850	0.11550
-20.000	0.15590	0.15250	0.13600	0.13200	0.12000	0.11800	0.11940	0.11790
-15.000	0.14490	0.13100	0.11420	0.11230	0.10640	0.10880	0.10970	0.10520
-10.000	0.11310	0.10000	0.08700	0.08800	0.08950	0.09420	0.08700	0.07950
-5.000	0.05380	0.05800	0.05300	0.05580	0.05300	0.05000	0.04480	0.03970
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04080	-0.05600	-0.05250	-0.05600	-0.04800	-0.05400	-0.04900	-0.03990
10.000	-0.08450	-0.10320	-0.10400	-0.11300	-0.10250	-0.10800	-0.09200	-0.07900
15.000	-0.11870	-0.14650	-0.15000	-0.15960	-0.15000	-0.14950	-0.12760	-0.10900
20.000	-0.14140	-0.18030	-0.19100	-0.20200	-0.18610	-0.18150	-0.15080	-0.12960

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.1.3-10
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



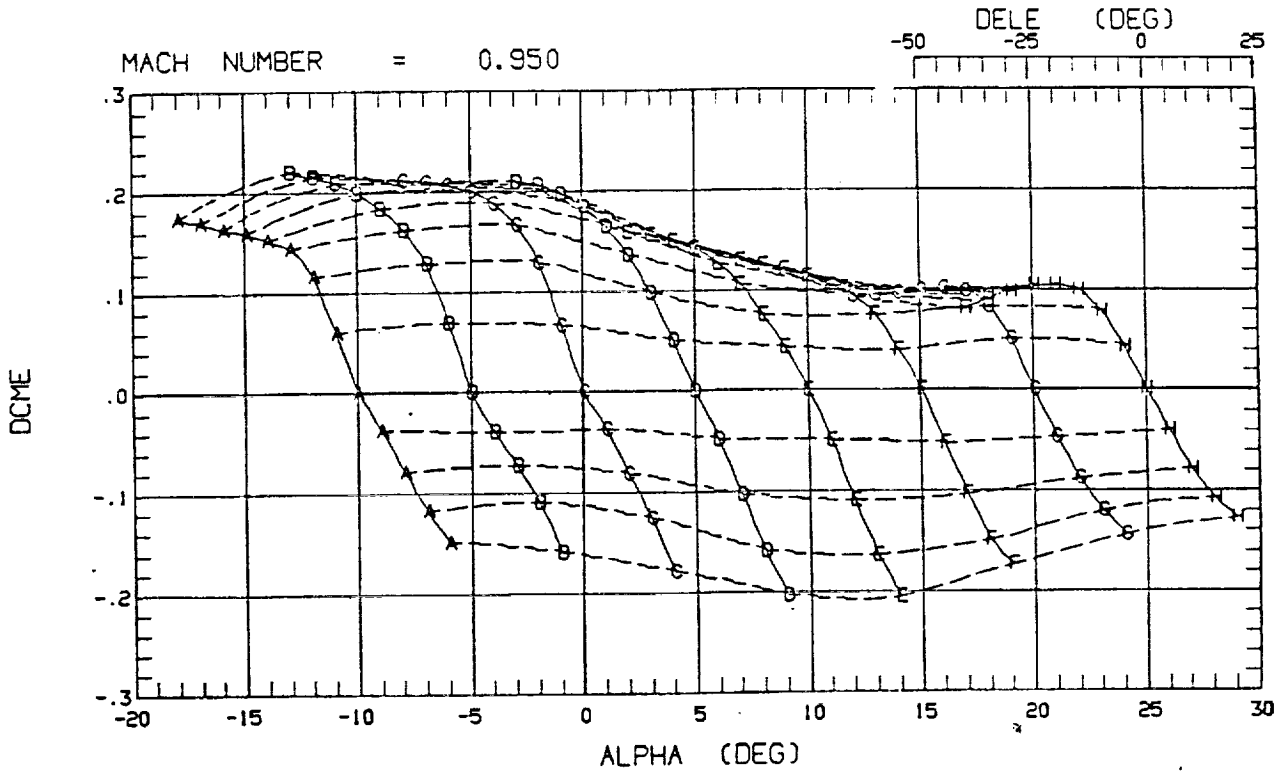
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17100	0.21000	0.19380	0.18600	0.14150	0.11200	0.08990	0.07730
-35.000	0.16690	0.20770	0.19280	0.18000	0.13250	0.11000	0.09360	0.08650
-30.000	0.16350	0.20100	0.18700	0.17000	0.12350	0.10800	0.09680	0.09530
-25.000	0.15780	0.18770	0.17580	0.15250	0.11200	0.10420	0.09950	0.10150
-20.000	0.15180	0.16800	0.15700	0.13200	0.10000	0.09820	0.10070	0.10370
-15.000	0.13920	0.14150	0.13230	0.10300	0.08420	0.08900	0.09880	0.09680
-10.000	0.11510	0.10600	0.09600	0.07000	0.06300	0.07500	0.08430	0.07670
-5.000	0.05760	0.05800	0.05150	0.03200	0.03800	0.04400	0.04640	0.04100
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04290	-0.05400	-0.04800	-0.05100	-0.05000	-0.05800	-0.04500	-0.03990
10.000	-0.08120	-0.09000	-0.09150	-0.11100	-0.11300	-0.11400	-0.09030	-0.08030
15.000	-0.11550	-0.12900	-0.13950	-0.16400	-0.16350	-0.15400	-0.12410	-0.10940
20.000	-0.14930	-0.16400	-0.18600	-0.21200	-0.20200	-0.18200	-0.14420	-0.12900

ENGINEER CCO
DATE 9/13/78

FIGURE 4.1.1.3-11
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



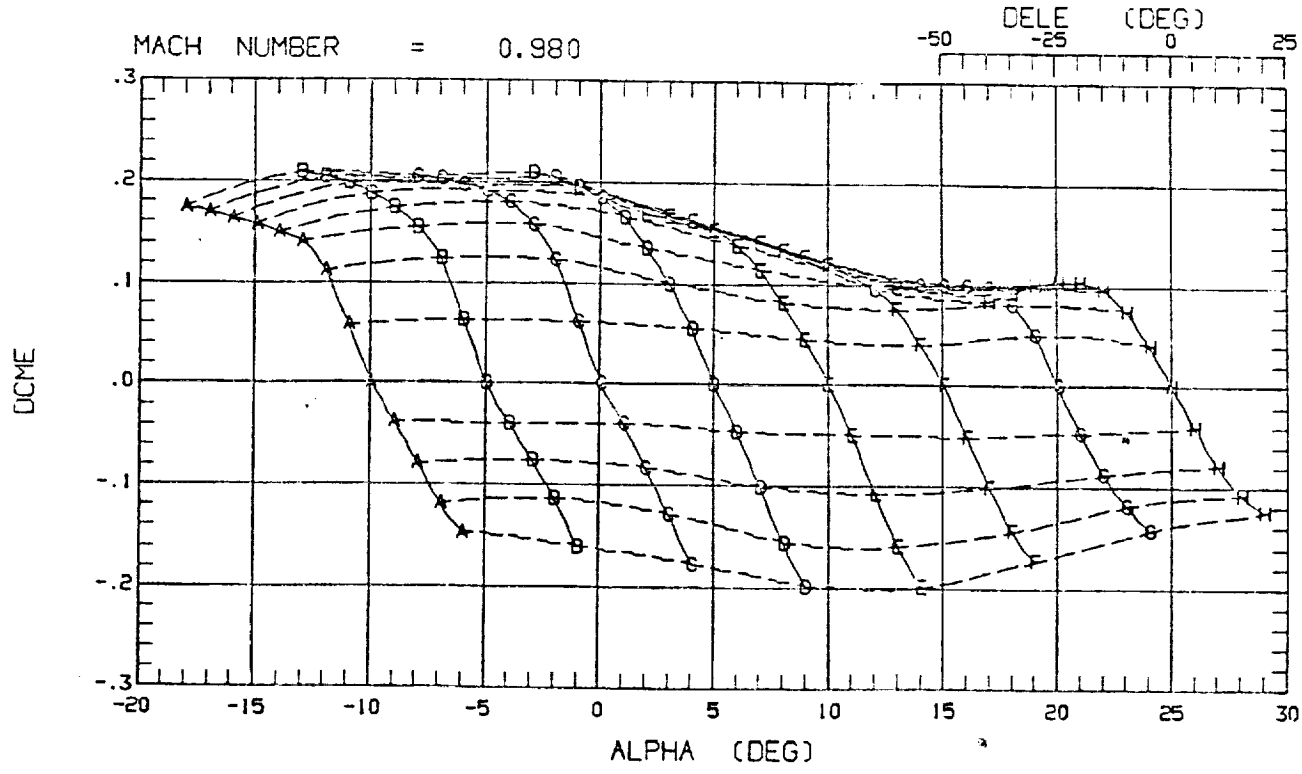
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17350	0.21900	0.21000	0.20900	0.15900	0.13000	0.09230	0.08070
-35.000	0.16870	0.21400	0.20900	0.20500	0.15500	0.12500	0.09450	0.09050
-30.000	0.16340	0.20800	0.20500	0.19700	0.15000	0.12000	0.09670	0.09820
-25.000	0.15810	0.19830	0.19950	0.18450	0.14150	0.11300	0.09840	0.10290
-20.000	0.15170	0.18250	0.18800	0.16400	0.12700	0.10400	0.10010	0.10360
-15.000	0.14340	0.16150	0.16550	0.13500	0.10550	0.09400	0.09820	0.09970
-10.000	0.11500	0.12800	0.12850	0.09700	0.07500	0.07500	0.08290	0.07740
-5.000	0.06000	0.06900	0.06500	0.05000	0.04200	0.04000	0.05000	0.04190
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03740	-0.04000	-0.03800	-0.04800	-0.05000	-0.05300	-0.04700	-0.04040
10.000	-0.07890	-0.07300	-0.08200	-0.10400	-0.11000	-0.10400	-0.08840	-0.07940
15.000	-0.11780	-0.11000	-0.12700	-0.16000	-0.16400	-0.14900	-0.11980	-0.10830
20.000	-0.14870	-0.16000	-0.18000	-0.20400	-0.20600	-0.17400	-0.14470	-0.12760

ENGINEER CCO
DATE 9/13/78

FIGURE 4.1.1.3-12
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17369	0.20695	0.20433	0.20888	0.16744	0.13949	0.09486	0.08346
-35.000	0.16903	0.20345	0.20203	0.20354	0.16549	0.13323	0.09649	0.09296
-30.000	0.16308	0.19725	0.19713	0.19505	0.16146	0.12677	0.09830	0.09991
-25.000	0.15729	0.18807	0.19075	0.18355	0.15288	0.11848	0.09943	0.10373
-20.000	0.14911	0.17386	0.17897	0.16520	0.13662	0.10790	0.09961	0.10335
-15.000	0.14008	0.15440	0.15744	0.13347	0.11292	0.09614	0.09674	0.09656
-10.000	0.11155	0.12366	0.12175	0.09951	0.08021	0.07436	0.08146	0.07409
-5.000	0.05822	0.06297	0.06064	0.05408	0.04347	0.03935	0.05058	0.04010
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03789	-0.04001	-0.03891	-0.04701	-0.05000	-0.05119	-0.04647	-0.04065
10.000	-0.07653	-0.07649	-0.08434	-0.10270	-0.10820	-0.10164	-0.08766	-0.07901
15.000	-0.11904	-0.11483	-0.12936	-0.15744	-0.15970	-0.14508	-0.11891	-0.10764
20.000	-0.14834	-0.16150	-0.17872	-0.19884	-0.19999	-0.17323	-0.14289	-0.12563

ENGINEER DCO
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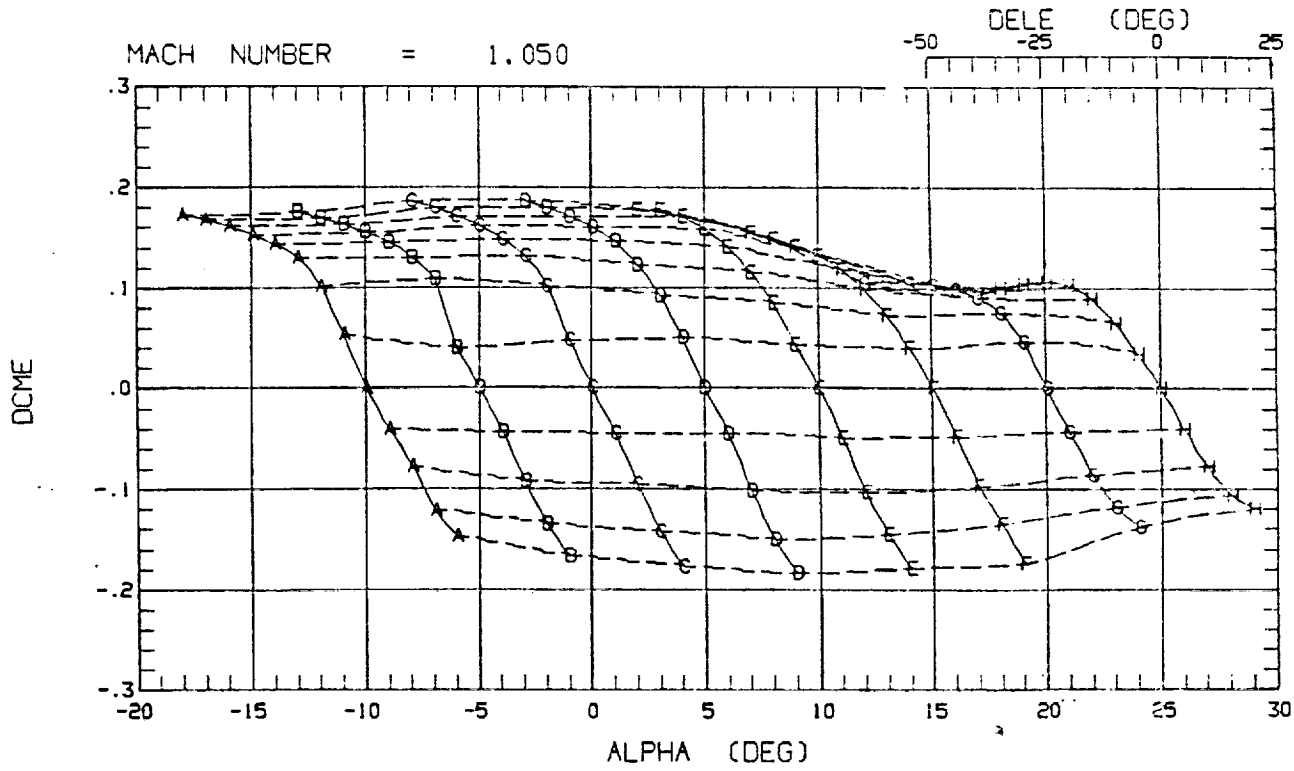
FIGURE 4.1.1.3- 13
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17250	0.17450	0.18600	0.18650	0.17700	0.15450	0.10430	0.09280
-35.000	0.16730	0.16880	0.17950	0.17950	0.17600	0.14800	0.10460	0.09910
-30.000	0.16100	0.16250	0.17100	0.17050	0.17000	0.14000	0.10430	0.10380
-25.000	0.15270	0.15470	0.16100	0.16000	0.15800	0.13150	0.10210	0.10560
-20.000	0.14240	0.14500	0.14800	0.14550	0.13970	0.11750	0.09780	0.10180
-15.000	0.12970	0.12970	0.13100	0.12200	0.11450	0.09750	0.09000	0.09800
-10.000	0.10080	0.10750	0.10100	0.09200	0.08400	0.07160	0.07520	0.06420
-5.000	0.05290	0.04000	0.04650	0.04950	0.04300	0.03900	0.04640	0.03390
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04140	-0.04400	-0.04550	-0.04550	-0.05000	-0.04800	-0.04390	-0.04090
10.000	-0.07820	-0.09300	-0.09600	-0.10200	-0.10400	-0.09800	-0.08630	-0.07820
15.000	-0.12110	-0.13600	-0.14300	-0.15050	-0.14600	-0.13500	-0.11810	-0.10610
20.000	-0.14750	-0.16600	-0.17800	-0.18500	-0.18000	-0.17500	-0.13840	-0.11990

ENGINEER EGO
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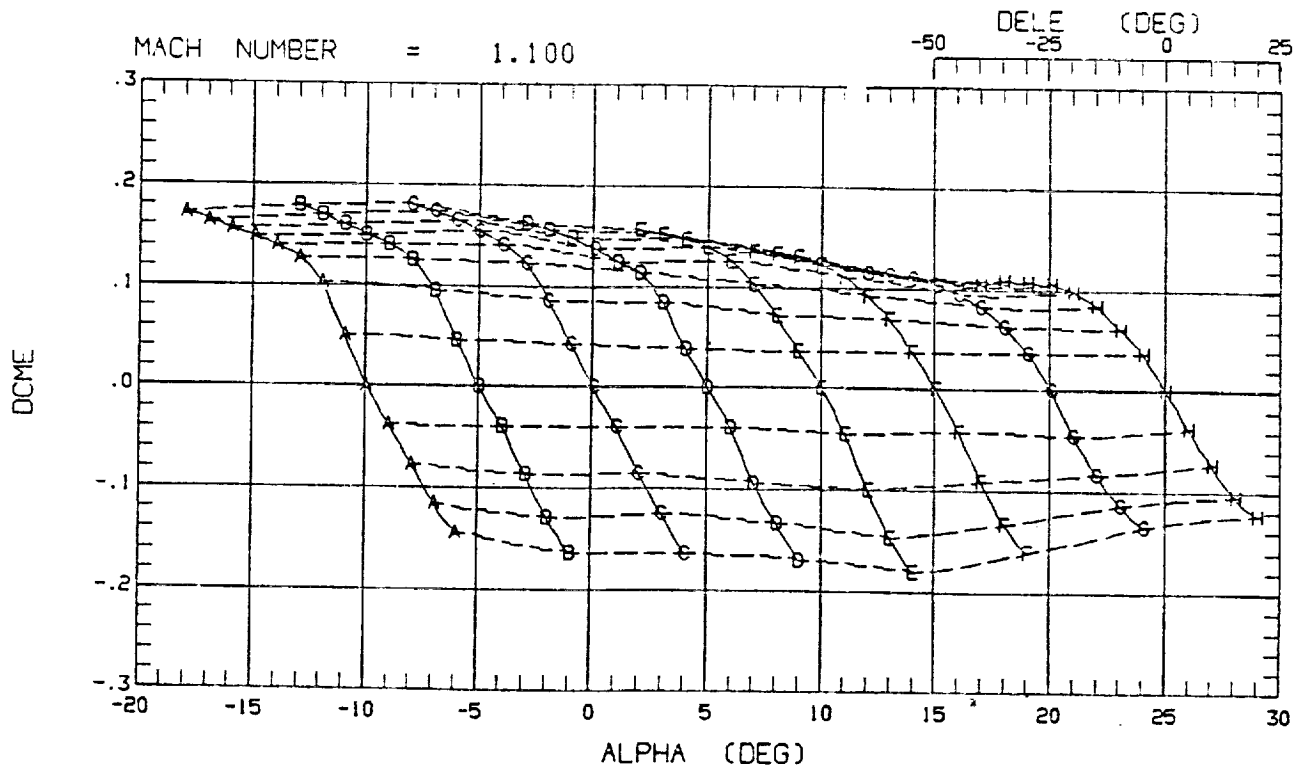
FIGURE 4.1.1.3-14
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17110	0.17820	0.18020	0.16150	0.15500	0.13400	0.11430	0.10420
-35.000	0.16330	0.16940	0.17290	0.15550	0.15100	0.13200	0.11260	0.10760
-30.000	0.15560	0.15960	0.16470	0.14700	0.14600	0.12900	0.10940	0.10650
-25.000	0.14730	0.14990	0.15440	0.13700	0.13800	0.12200	0.10370	0.10450
-20.000	0.13850	0.14000	0.14050	0.12400	0.12500	0.11000	0.09440	0.09800
-15.000	0.12670	0.12520	0.12230	0.11250	0.10200	0.09200	0.08210	0.08350
-10.000	0.10170	0.09500	0.08550	0.08300	0.07200	0.06900	0.06270	0.06150
-5.000	0.05080	0.04630	0.04200	0.03850	0.03600	0.03600	0.03700	0.03670
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03870	-0.04000	-0.04000	-0.04000	-0.04600	-0.04200	-0.04600	-0.03770
10.000	-0.07700	-0.08700	-0.08600	-0.09400	-0.10000	-0.09200	-0.08400	-0.07330
15.000	-0.11600	-0.13000	-0.12550	-0.13450	-0.14750	-0.13350	-0.11400	-0.10540
20.000	-0.14500	-0.16400	-0.16450	-0.17000	-0.18100	-0.16200	-0.13550	-0.12330

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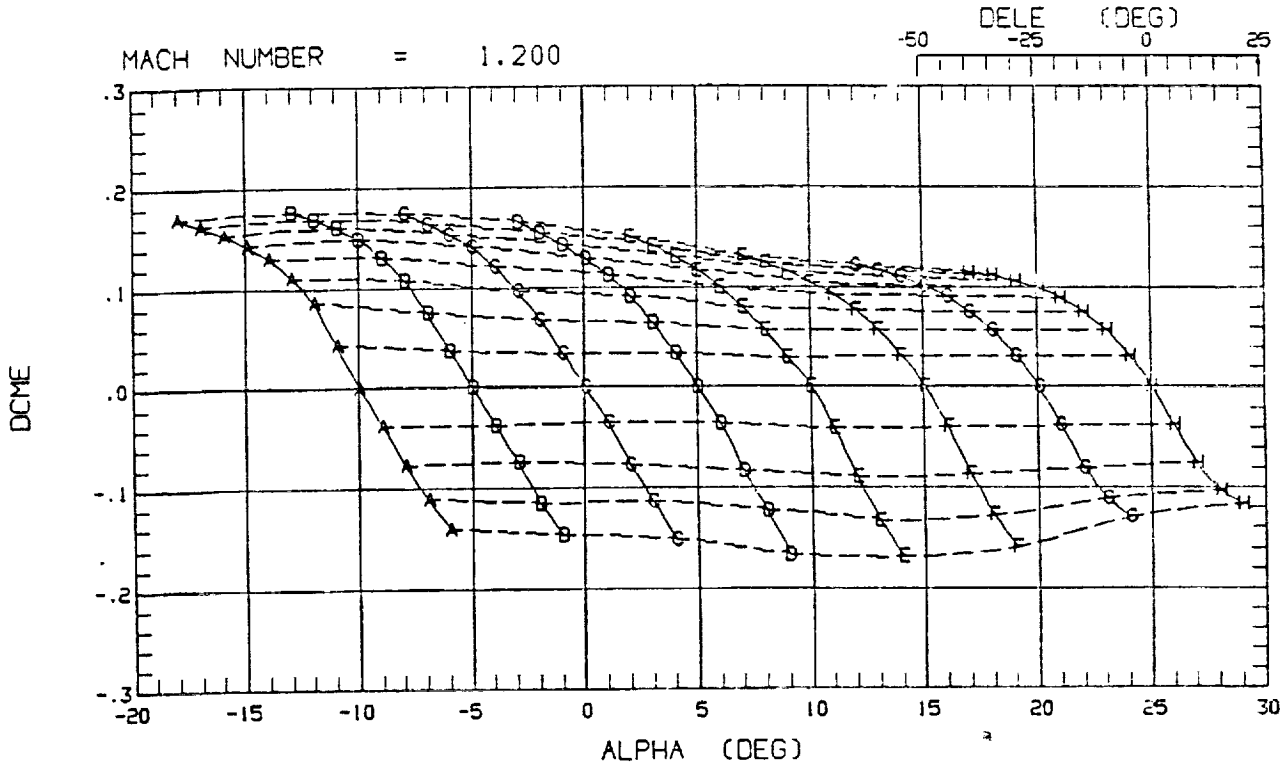
FIGURE 4.1.1.3-15
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.16880	0.17500	0.17290	0.16500	0.14910	0.13020	0.12060	0.11340
-35.000	0.16110	0.16820	0.16360	0.15360	0.14030	0.12300	0.11540	0.11050
-30.000	0.15280	0.15940	0.15280	0.14120	0.12990	0.11470	0.10910	0.10510
-25.000	0.14200	0.14810	0.13940	0.12730	0.11610	0.10390	0.10030	0.09820
-20.000	0.12910	0.12960	0.12000	0.11130	0.09870	0.09200	0.09000	0.08830
-15.000	0.11020	0.10610	0.09540	0.09040	0.07870	0.07610	0.07400	0.07460
-10.000	0.08460	0.07400	0.06690	0.06330	0.05570	0.05570	0.05570	0.05570
-5.000	0.04280	0.03620	0.03370	0.03370	0.02860	0.03110	0.03110	0.03110
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03770	-0.03750	-0.03500	-0.03650	-0.04150	-0.04000	-0.03880	-0.03880
10.000	-0.07750	-0.07500	-0.07750	-0.08350	-0.09000	-0.08700	-0.08010	-0.07600
15.000	-0.11100	-0.11500	-0.11450	-0.12300	-0.13400	-0.12800	-0.11170	-0.10290
20.000	-0.14140	-0.14700	-0.15200	-0.16700	-0.16950	-0.16000	-0.13010	-0.11690

ENGINEER Dco
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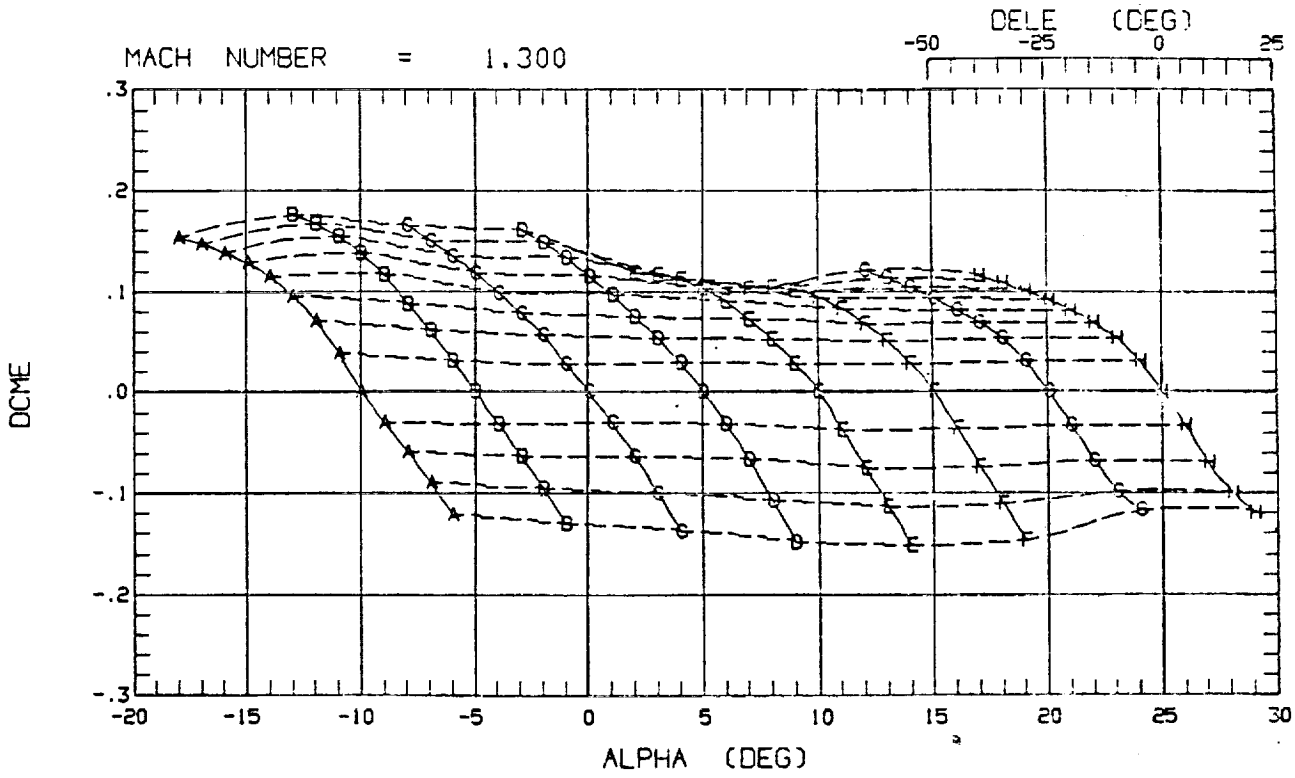
FIGURE 4.1.1.3-16
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.15300	0.17500	0.16400	0.16000	0.11800	0.10200	0.12040	0.11480
-35.000	0.14610	0.16600	0.15000	0.14750	0.11600	0.10390	0.11200	0.10800
-30.000	0.13770	0.15350	0.13400	0.13200	0.11180	0.10050	0.10310	0.10010
-25.000	0.12730	0.13650	0.11750	0.11450	0.10190	0.09350	0.09270	0.09120
-20.000	0.11390	0.11570	0.09800	0.09600	0.08950	0.08250	0.08070	0.08130
-15.000	0.09490	0.08700	0.07750	0.07450	0.07200	0.06750	0.06880	0.06880
-10.000	0.07050	0.06100	0.05570	0.05350	0.05200	0.04960	0.05290	0.05340
-5.000	0.03800	0.03000	0.02700	0.02850	0.02800	0.02750	0.03000	0.03000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03000	-0.03210	-0.03100	-0.03200	-0.03800	-0.03650	-0.03350	-0.03300
10.000	-0.05990	-0.06350	-0.06350	-0.06700	-0.07550	-0.07450	-0.06800	-0.07050
15.000	-0.09040	-0.09650	-0.10050	-0.10770	-0.11350	-0.11150	-0.09890	-0.09990
20.000	-0.12190	-0.13100	-0.13800	-0.14850	-0.15250	-0.14700	-0.11790	-0.11990

ENGINEER DCO
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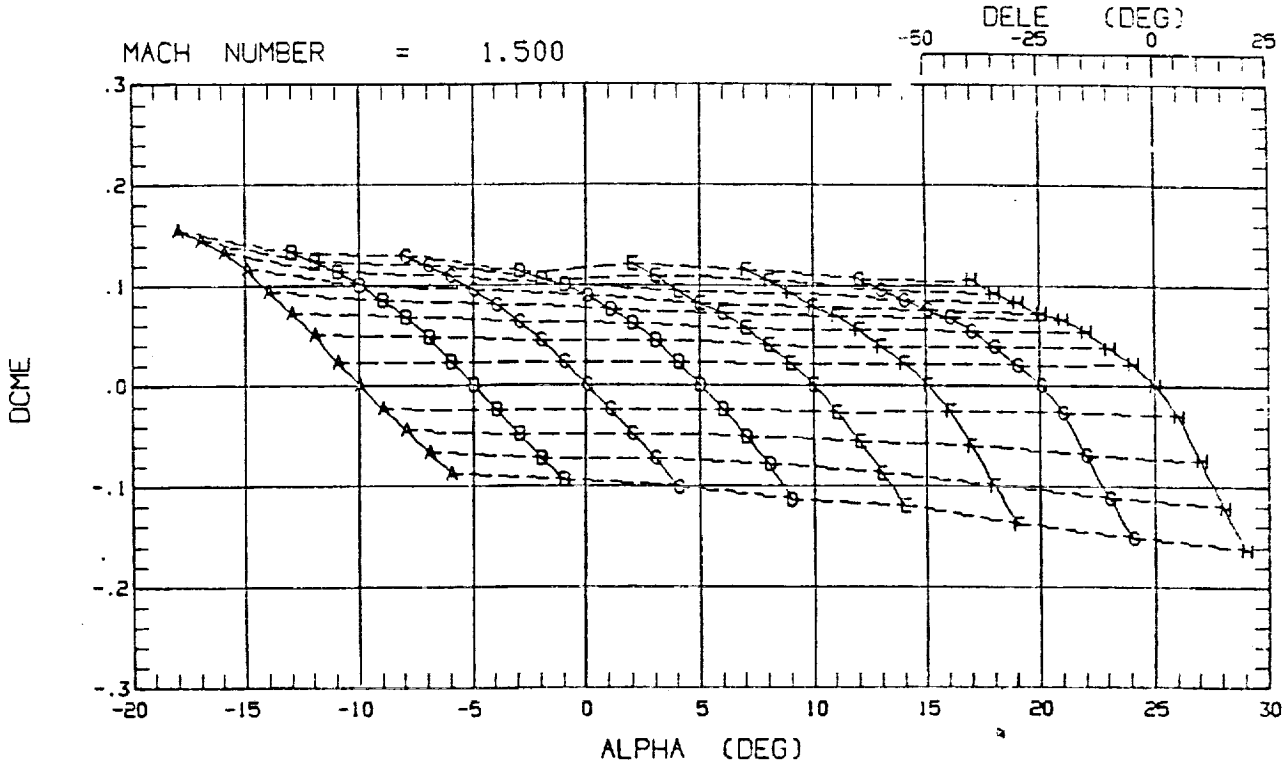
FIGURE 4.1.1.3-17
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.15421	0.13212	0.12756	0.11215	0.11979	0.11453	0.10569	0.10472
-35.000	0.14469	0.12319	0.11837	0.10562	0.10797	0.10348	0.09438	0.09210
-30.000	0.13203	0.11265	0.10759	0.09863	0.09303	0.09099	0.08438	0.08153
-25.000	0.11574	0.09920	0.09389	0.08853	0.08000	0.07773	0.07395	0.07148
-20.000	0.09231	0.08334	0.07965	0.07481	0.07118	0.06815	0.06697	0.06526
-15.000	0.07092	0.06755	0.06290	0.06054	0.05560	0.05448	0.05381	0.05297
-10.000	0.04979	0.04765	0.04415	0.04472	0.03929	0.03781	0.03764	0.03727
-5.000	0.02291	0.02344	0.02215	0.02231	0.02133	0.02165	0.02038	0.02090
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.02339	-0.02446	-0.02427	-0.02375	-0.02670	-0.02600	-0.02710	-0.03059
10.000	-0.04486	-0.04927	-0.04797	-0.05121	-0.05687	-0.06024	-0.06954	-0.07489
15.000	-0.06716	-0.07289	-0.07380	-0.07964	-0.08768	-0.10070	-0.11221	-0.12125
20.000	-0.08776	-0.09437	-0.10163	-0.11418	-0.12086	-0.13823	-0.15245	-0.16406

ENGINEER DCO
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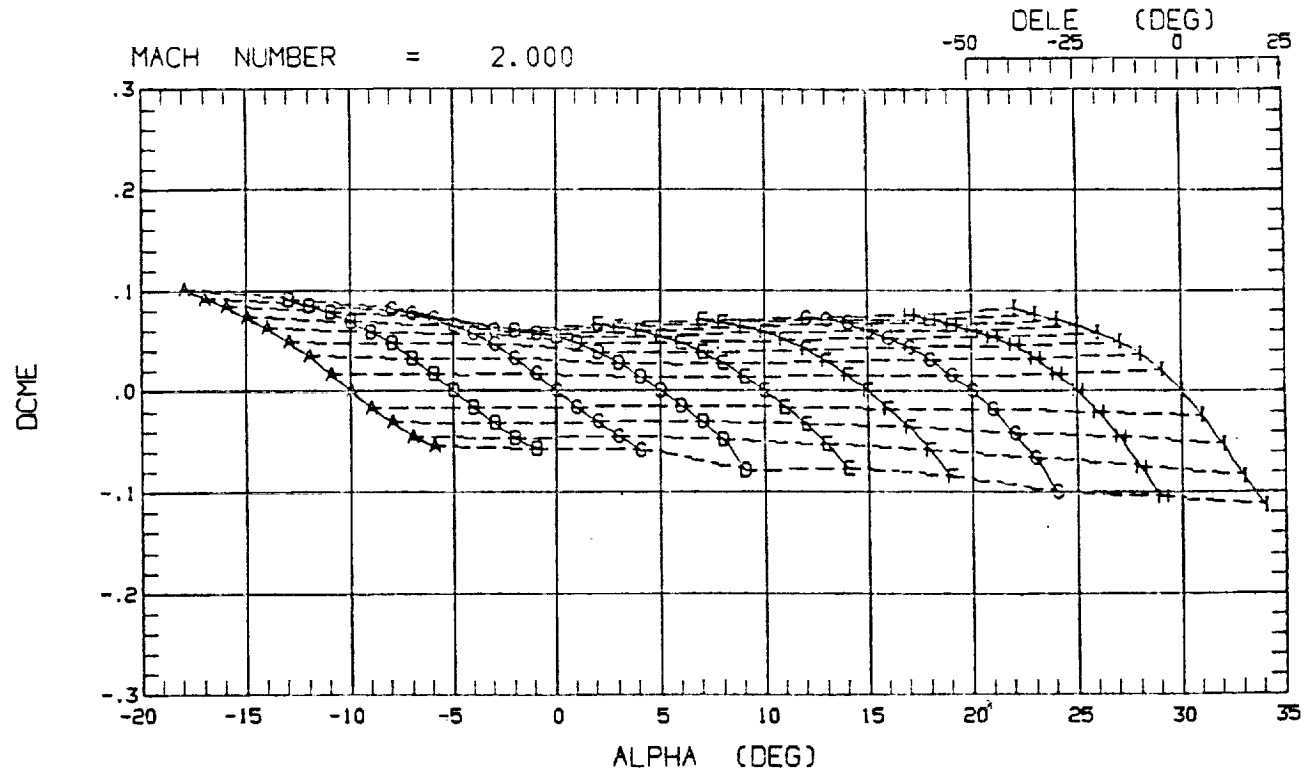
FIGURE 4.1.1.3-18
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



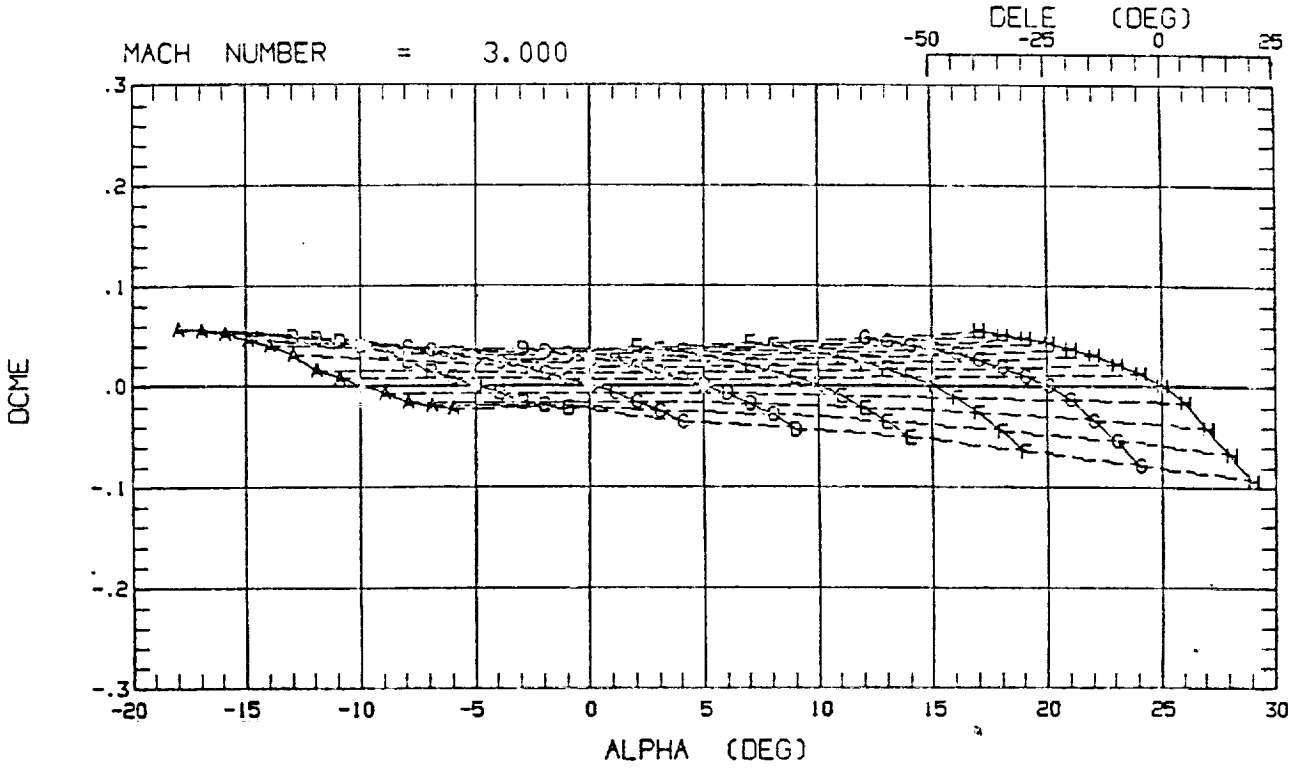
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT								
-40.000	0.10100	0.09010	0.08110	0.06000	0.06600	0.06950	0.07160	0.07530	0.08200
-35.000	0.09210	0.08400	0.07600	0.05900	0.06300	0.06700	0.07000	0.07070	0.07600
-30.000	0.08320	0.07700	0.07100	0.05700	0.05900	0.06300	0.06700	0.06600	0.07100
-25.000	0.07240	0.06800	0.06400	0.05300	0.05400	0.05800	0.05900	0.05970	0.06500
-20.000	0.06170	0.05800	0.05600	0.04700	0.04750	0.05000	0.05200	0.05330	0.05750
-15.000	0.04810	0.04700	0.04600	0.03800	0.03800	0.04100	0.04300	0.04500	0.04900
-10.000	0.03440	0.03200	0.03200	0.02700	0.02700	0.02900	0.03100	0.03250	0.03700
-5.000	0.01720	0.01600	0.01600	0.01400	0.01400	0.01500	0.01500	0.01700	0.02100
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01680	-0.01700	-0.01600	-0.01500	-0.01600	-0.01900	-0.01800	-0.02150	-0.02500
10.000	-0.03070	-0.03220	-0.03100	-0.03100	-0.03300	-0.03600	-0.04200	-0.04630	-0.05400
15.000	-0.04530	-0.04680	-0.04500	-0.04900	-0.05400	-0.06000	-0.06700	-0.07600	-0.08500
20.000	-0.05540	-0.05790	-0.05900	-0.07900	-0.07700	-0.08600	-0.10000	-0.10570	-0.11400

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.1.3- 19
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05700	0.04920	0.03850	0.03650	0.03750	0.04210	0.04700	0.05420
-35.000	0.05546	0.04670	0.03570	0.03370	0.03570	0.03930	0.04370	0.05090
-30.000	0.05160	0.04430	0.03130	0.03030	0.03300	0.03610	0.04000	0.04710
-25.000	0.04610	0.03930	0.02730	0.02630	0.02930	0.03250	0.03600	0.04260
-20.000	0.04030	0.03400	0.02300	0.02400	0.02500	0.02900	0.03130	0.03730
-15.000	0.02980	0.02480	0.01780	0.01780	0.01977	0.02258	0.02520	0.03050
-10.000	0.01590	0.01420	0.01220	0.01220	0.01400	0.01620	0.01780	0.02200
-5.000	0.00820	0.00740	0.00640	0.00640	0.00740	0.00870	0.00950	0.01180
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00712	-0.00712	-0.00712	-0.00812	-0.01020	-0.01200	-0.01400	-0.01750
10.000	-0.01630	-0.01630	-0.01630	-0.01830	-0.02230	-0.02770	-0.03450	-0.04250
15.000	-0.02000	-0.02050	-0.02550	-0.02950	-0.03650	-0.04575	-0.05550	-0.06900
20.000	-0.02340	-0.02350	-0.03650	-0.04350	-0.05250	-0.06550	-0.07950	-0.09400

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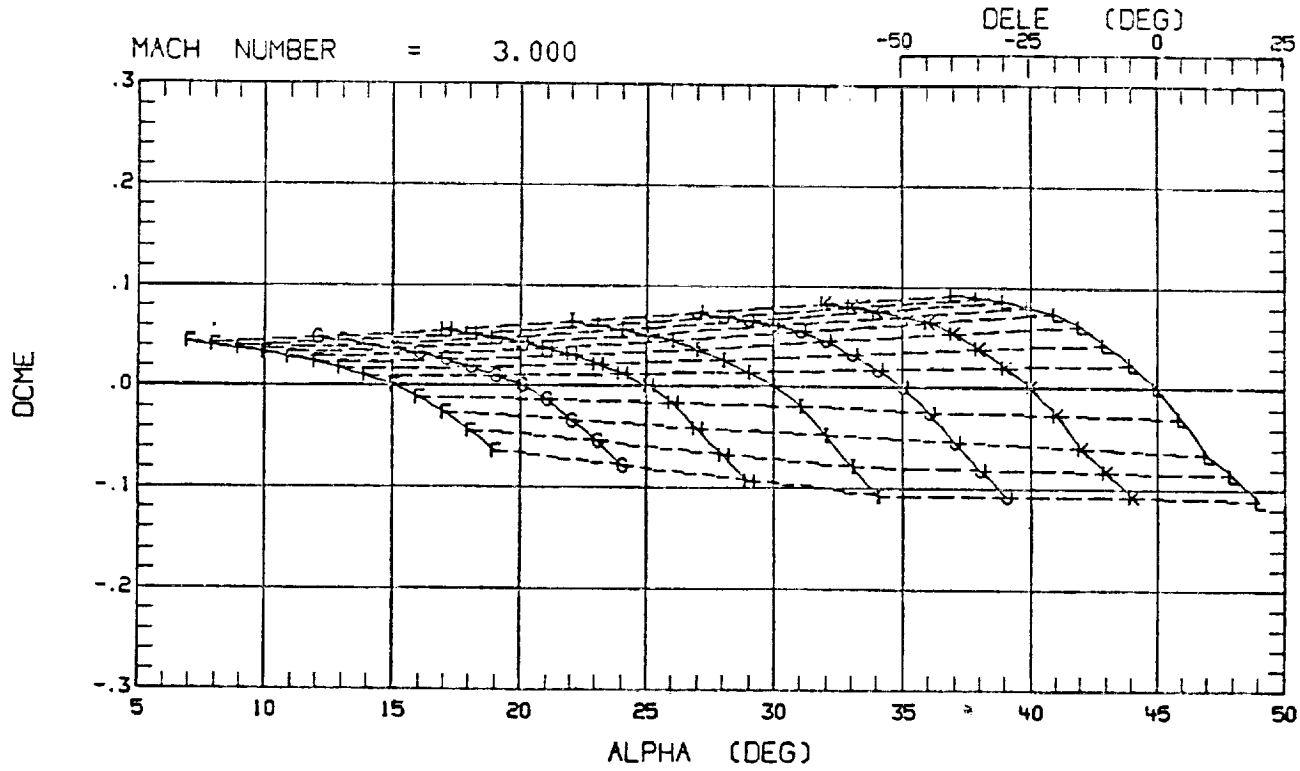
FIGURE 4.1.1.3-20
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT						
-40.000	0.04210	0.04700	0.05420	0.06330	0.07240	0.08180	0.09140
-35.000	0.03930	0.04370	0.05090	0.05960	0.06890	0.07860	0.08840
-30.000	0.03610	0.04000	0.04710	0.05560	0.06520	0.07510	0.08520
-25.000	0.03250	0.03600	0.04260	0.05080	0.06050	0.07000	0.07970
-20.000	0.02800	0.03130	0.03730	0.04500	0.05440	0.06390	0.07330
-15.000	0.02258	0.02520	0.03050	0.03660	0.04510	0.05360	0.06040
-10.000	0.01620	0.01780	0.02200	0.02620	0.03200	0.03790	0.04300
-5.000	0.00870	0.00950	0.01180	0.01430	0.01720	0.02030	0.02210
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01200	-0.01400	-0.01750	-0.02000	-0.02570	-0.02750	-0.03080
10.000	-0.02770	-0.03450	-0.04250	-0.04900	-0.05420	-0.06020	-0.06660
15.000	-0.04575	-0.05550	-0.06900	-0.07990	-0.08190	-0.08390	-0.08670
20.000	-0.06550	-0.07950	-0.09400	-0.10750	-0.10800	-0.10860	-0.11220

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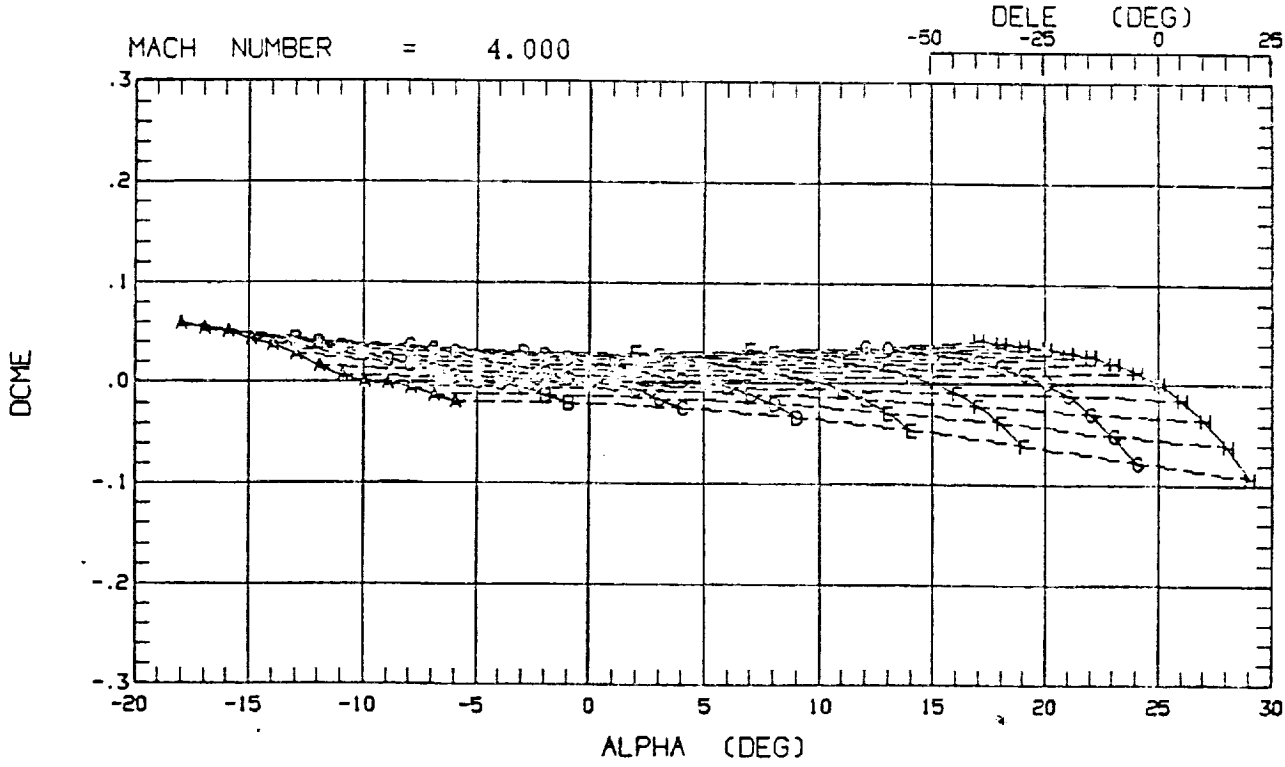
FIGURE 4.1.1.3-21
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05750	0.04230	0.03530	0.02930	0.02830	0.03170	0.03500	0.04260
-35.000	0.05380	0.03760	0.03160	0.02660	0.02560	0.02910	0.03300	0.04030
-30.000	0.05040	0.03320	0.02820	0.02320	0.02320	0.02660	0.03100	0.03770
-25.000	0.04310	0.02700	0.02300	0.01900	0.02000	0.02370	0.02840	0.03475
-20.000	0.03700	0.02200	0.01800	0.01600	0.01700	0.02050	0.02530	0.03110
-15.000	0.02720	0.01640	0.01340	0.01140	0.01340	0.01700	0.02150	0.02675
-10.000	0.01590	0.01030	0.00730	0.00630	0.00930	0.01275	0.01600	0.02020
-5.000	0.00570	0.00470	0.00270	0.00170	0.00470	0.00700	0.00900	0.01130
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00210	-0.00210	-0.00330	-0.00520	-0.00700	-0.01000	-0.01200	-0.01650
10.000	-0.00550	-0.00550	-0.00780	-0.01170	-0.01680	-0.02270	-0.03000	-0.03650
15.000	-0.01310	-0.01310	-0.01610	-0.02140	-0.02990	-0.04000	-0.05250	-0.06200
20.000	-0.02050	-0.02060	-0.02600	-0.03470	-0.04700	-0.06250	-0.07900	-0.09450

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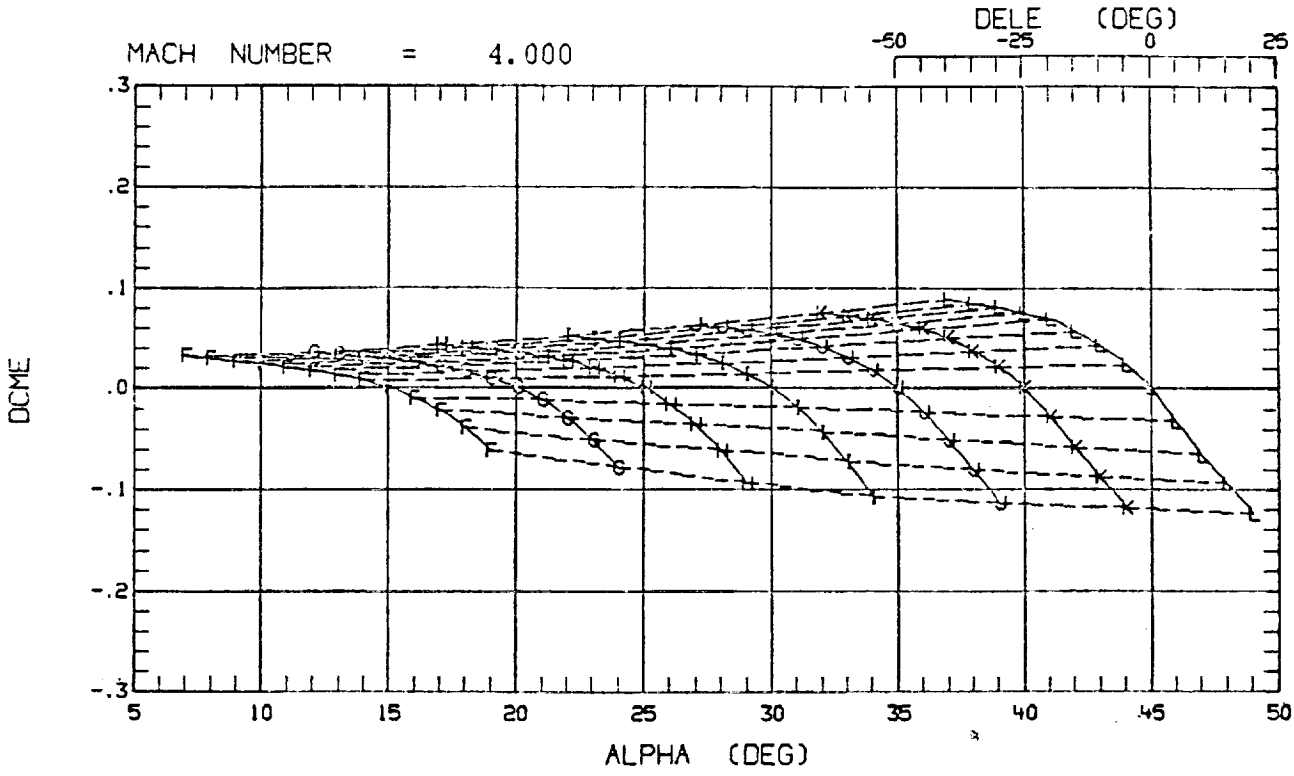
FIGURE 4.1.1.3-22
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT						
-40.000	0.03170	0.03500	0.04260	0.05180	0.06300	0.07520	0.08800
-35.000	0.02910	0.03300	0.04030	0.04920	0.06020	0.07210	0.08450
-30.000	0.02660	0.03100	0.03770	0.04660	0.05750	0.06900	0.08090
-25.000	0.02370	0.02840	0.03475	0.04320	0.05350	0.06420	0.07520
-20.000	0.02050	0.02530	0.03110	0.03900	0.04880	0.05880	0.06890
-15.000	0.01700	0.02150	0.02675	0.03310	0.04160	0.04960	0.05680
-10.000	0.01275	0.01600	0.02020	0.02500	0.03100	0.03690	0.04250
-5.000	0.00700	0.00900	0.01130	0.01425	0.01780	0.02130	0.02340
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01000	-0.01200	-0.01650	-0.01950	-0.02430	-0.02910	-0.03300
10.000	-0.02270	-0.03000	-0.03650	-0.04350	-0.05150	-0.05910	-0.06640
15.000	-0.04000	-0.05250	-0.06200	-0.07325	-0.08120	-0.08820	-0.09380
20.000	-0.06250	-0.07900	-0.09450	-0.10850	-0.11390	-0.11930	-0.12420

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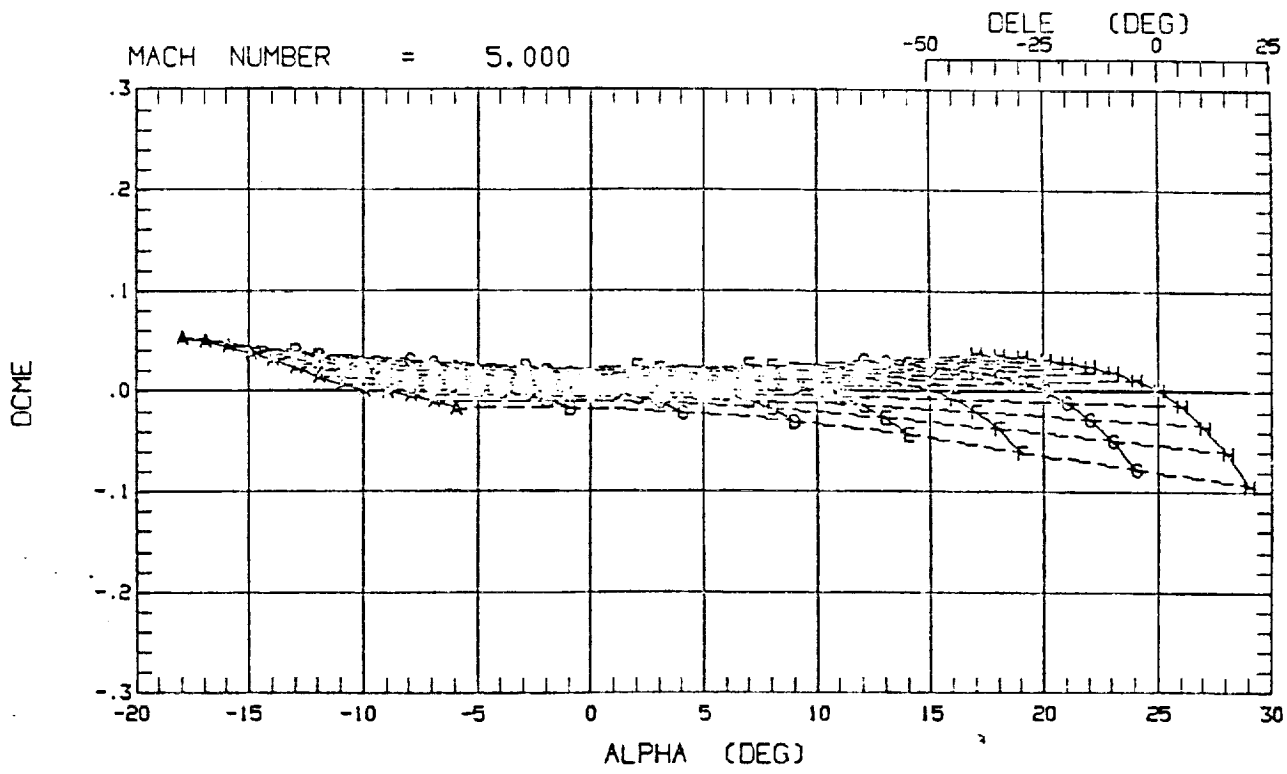
FIGURE 4.1.1.3- 23
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05250	0.03740	0.02940	0.02240	0.02240	0.02420	0.02860	0.03650
-35.000	0.04850	0.03300	0.02600	0.01900	0.02010	0.02220	0.02710	0.03440
-30.000	0.04350	0.02750	0.02150	0.01550	0.01750	0.02025	0.02560	0.03280
-25.000	0.03670	0.02180	0.01680	0.01180	0.01480	0.01810	0.02350	0.03050
-20.000	0.03000	0.01620	0.01220	0.00920	0.01220	0.01550	0.02110	0.02770
-15.000	0.02260	0.01230	0.00930	0.00730	0.00930	0.01275	0.01820	0.02410
-10.000	0.01340	0.00740	0.00640	0.00440	0.00640	0.00930	0.01410	0.01870
-5.000	0.00640	0.00440	0.00340	0.00240	0.00335	0.00510	0.00800	0.01060
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00110	-0.00130	-0.00300	-0.00420	-0.00600	-0.00850	-0.01200	-0.01510
10.000	-0.00530	-0.00530	-0.00740	-0.01070	-0.01530	-0.02150	-0.02850	-0.03600
15.000	-0.01060	-0.01060	-0.01280	-0.01880	-0.02760	-0.03875	-0.05050	-0.06200
20.000	-0.01780	-0.01780	-0.02260	-0.03140	-0.04450	-0.06200	-0.07900	-0.09550

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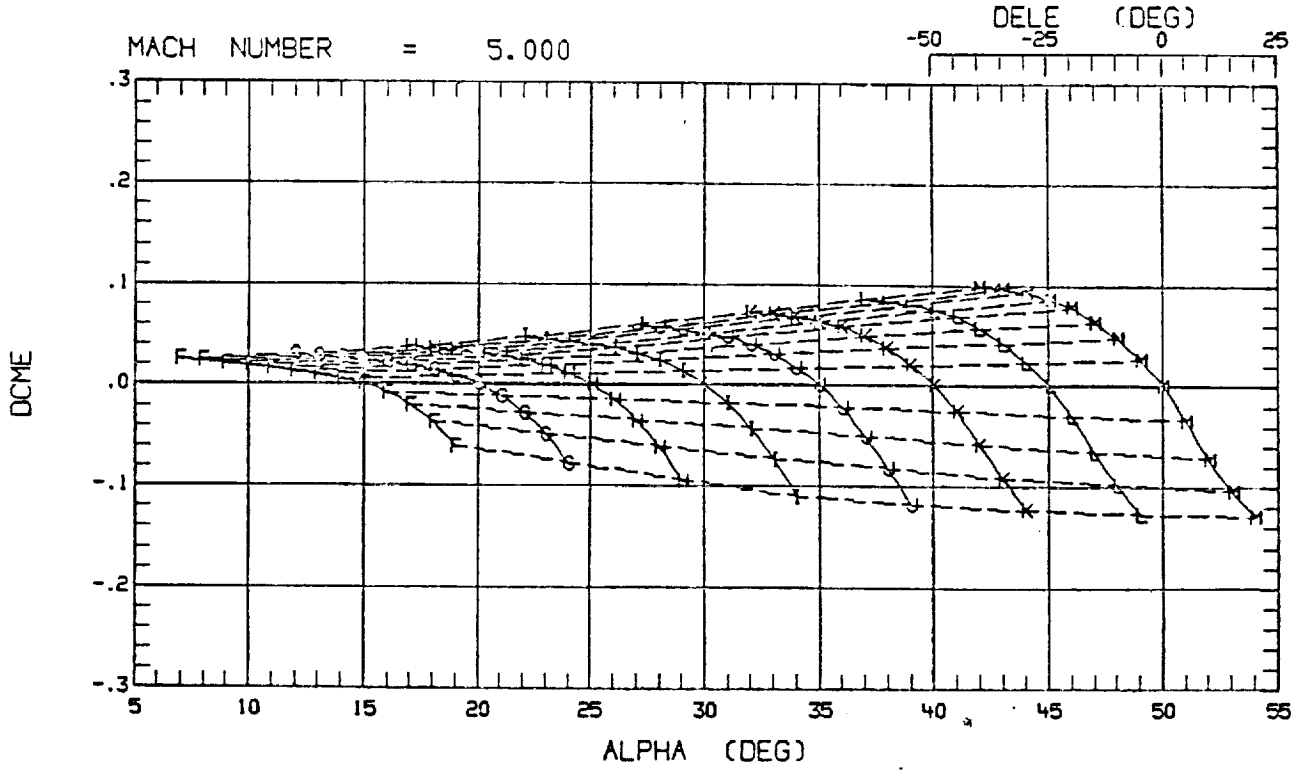
FIGURE 4.1.1.3-24
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.02420	0.02860	0.03650	0.04650	0.05680	0.07170	0.08480	0.09820
-35.000	0.02220	0.02710	0.03440	0.04440	0.05670	0.06950	0.08240	0.09560
-30.000	0.02025	0.02560	0.03280	0.04200	0.05440	0.06710	0.07980	0.09270
-25.000	0.01810	0.02350	0.03050	0.03920	0.05000	0.06250	0.07400	0.08540
-20.000	0.01550	0.02110	0.02770	0.03600	0.04680	0.05760	0.06790	0.07780
-15.000	0.01275	0.01820	0.02410	0.03120	0.03970	0.04820	0.05600	0.06300
-10.000	0.00930	0.01410	0.01870	0.02400	0.03030	0.03640	0.04170	0.04650
-5.000	0.00510	0.00800	0.01060	0.01370	0.01670	0.01970	0.02270	0.02570
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00850	-0.01200	-0.01510	-0.01850	-0.02250	-0.02650	-0.03080	-0.03540
10.000	-0.02150	-0.02850	-0.03600	-0.04370	-0.05190	-0.06010	-0.06710	-0.07340
15.000	-0.03875	-0.05050	-0.06200	-0.07400	-0.08377	-0.09270	-0.09950	-0.10470
20.000	-0.06200	-0.07900	-0.09550	-0.11100	-0.11870	-0.12390	-0.12750	-0.12940

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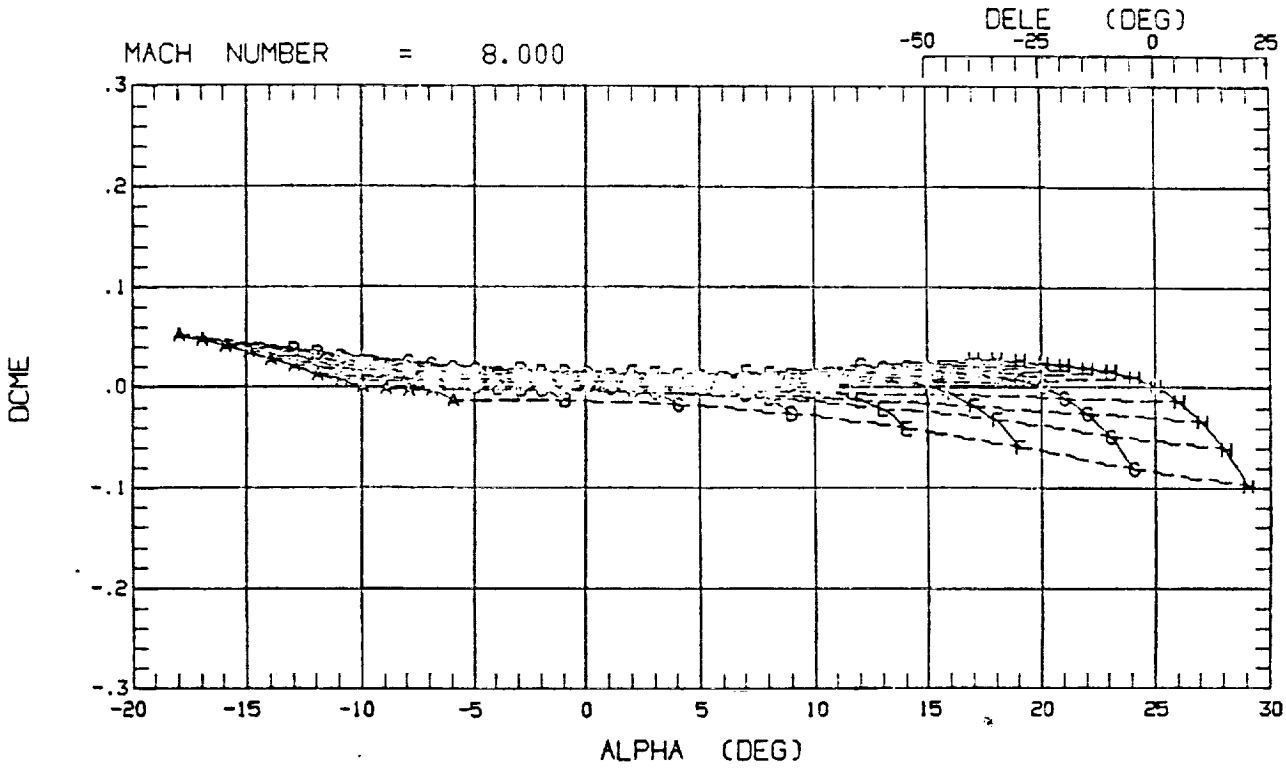
FIGURE 4.1.1.3-25
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05170	0.03720	0.02440	0.01650	0.01400	0.01390	0.02090	0.02800
-35.000	0.04680	0.03290	0.02180	0.01420	0.01220	0.01220	0.01900	0.02670
-30.000	0.04170	0.02850	0.01900	0.01330	0.01100	0.01100	0.01770	0.02540
-25.000	0.03460	0.02260	0.01620	0.01150	0.00910	0.01010	0.01620	0.02270
-20.000	0.02750	0.01710	0.01260	0.00990	0.00790	0.00990	0.01440	0.02170
-15.000	0.02090	0.01380	0.01100	0.00880	0.00700	0.00900	0.01230	0.01900
-10.000	0.01190	0.00760	0.00690	0.00620	0.00430	0.00620	0.00950	0.01510
-5.000	0.00730	0.00490	0.00450	0.00410	0.00320	0.00420	0.00580	0.00930
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00080	-0.00080	-0.00200	-0.00350	-0.00640	-0.00800	-0.01150	-0.01470
10.000	-0.00250	-0.00260	-0.00510	-0.00800	-0.01380	-0.02040	-0.02750	-0.03500
15.000	-0.00320	-0.00310	-0.00650	-0.01180	-0.02210	-0.03360	-0.04950	-0.06250
20.000	-0.01420	-0.01400	-0.01840	-0.02800	-0.04230	-0.06100	-0.08200	-0.09900

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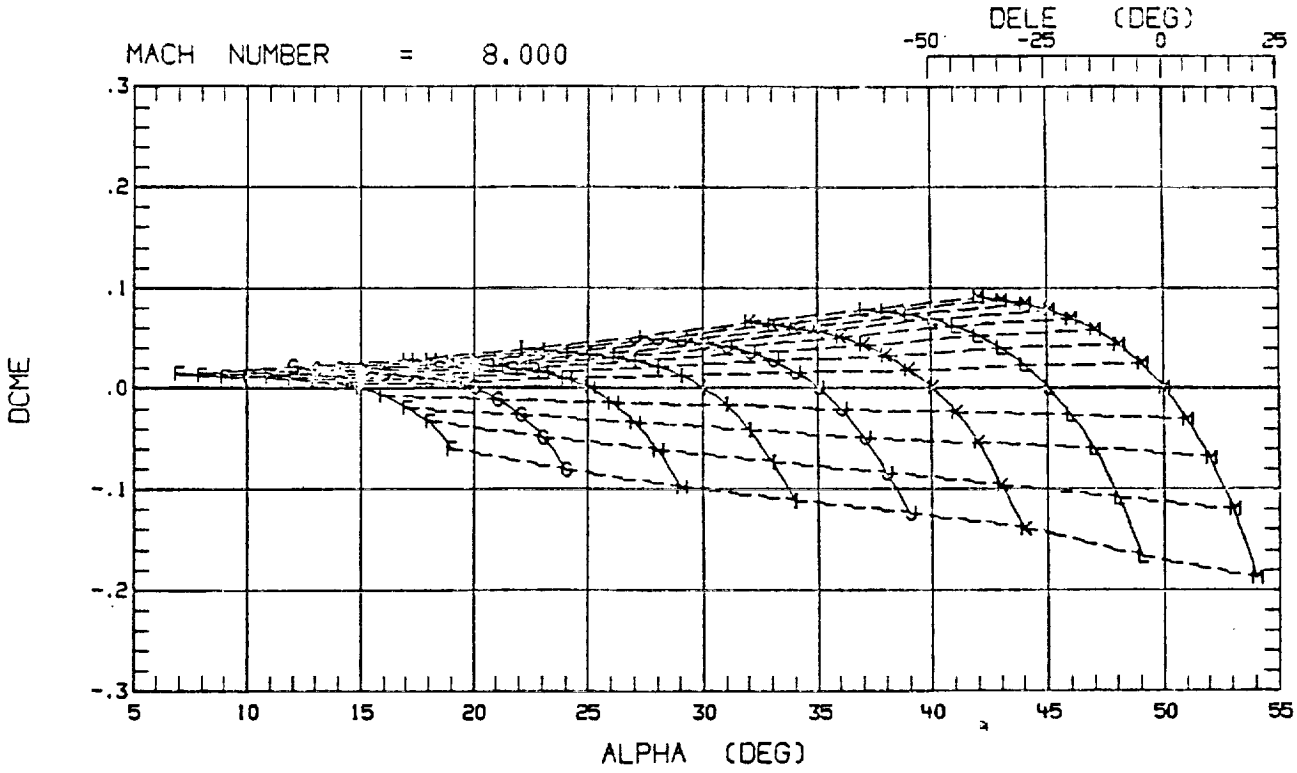
FIGURE 4.1.1.3-26
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.01390	0.02090	0.02800	0.03850	0.05070	0.06520	0.07820	0.09020
-35.000	0.01220	0.01900	0.02670	0.03700	0.04900	0.06260	0.07550	0.08750
-30.000	0.01100	0.01770	0.02540	0.03510	0.04675	0.05950	0.07250	0.08340
-25.000	0.01010	0.01620	0.02270	0.03300	0.04400	0.05570	0.06780	0.07730
-20.000	0.00990	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.06900
-15.000	0.00900	0.01230	0.01900	0.02680	0.03485	0.04250	0.05200	0.05780
-10.000	0.00620	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00420	0.00580	0.00930	0.01275	0.01560	0.01800	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00800	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02040	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.03360	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.06100	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.16750	-0.18850

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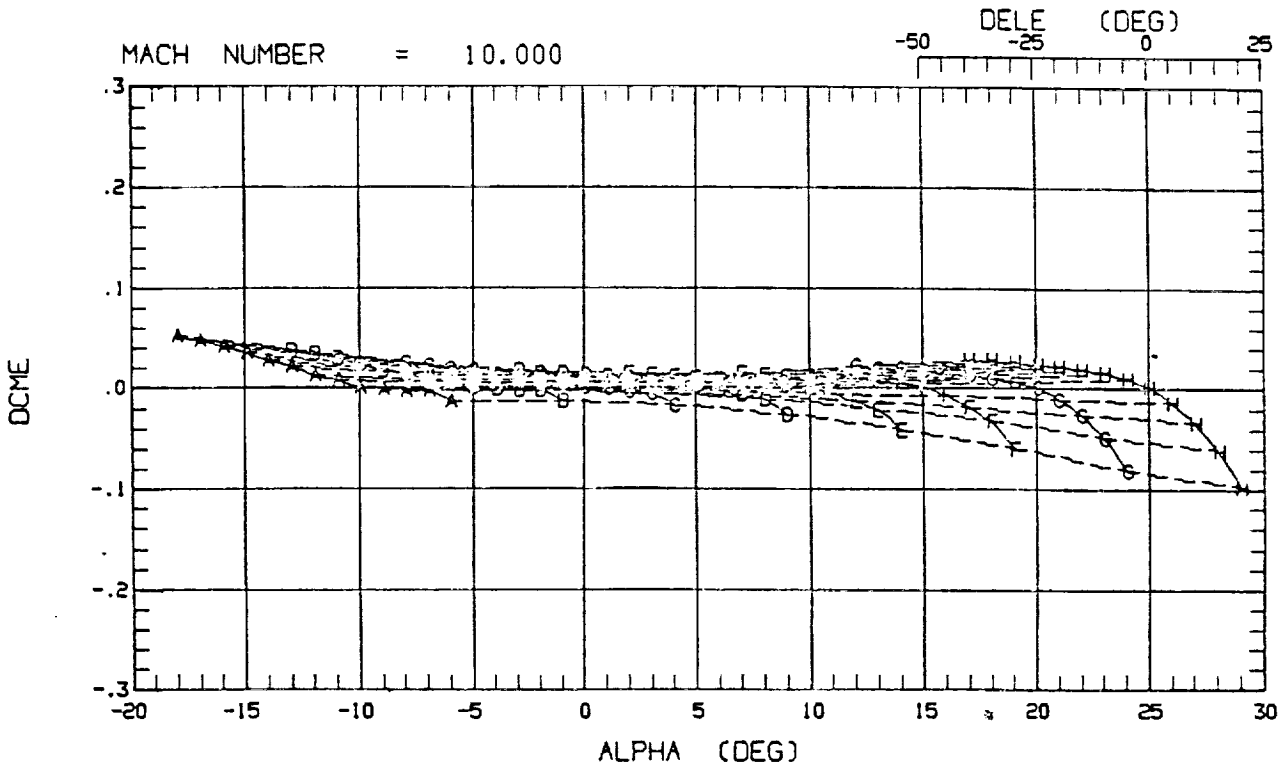
FIGURE 4.1.1.3-27
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



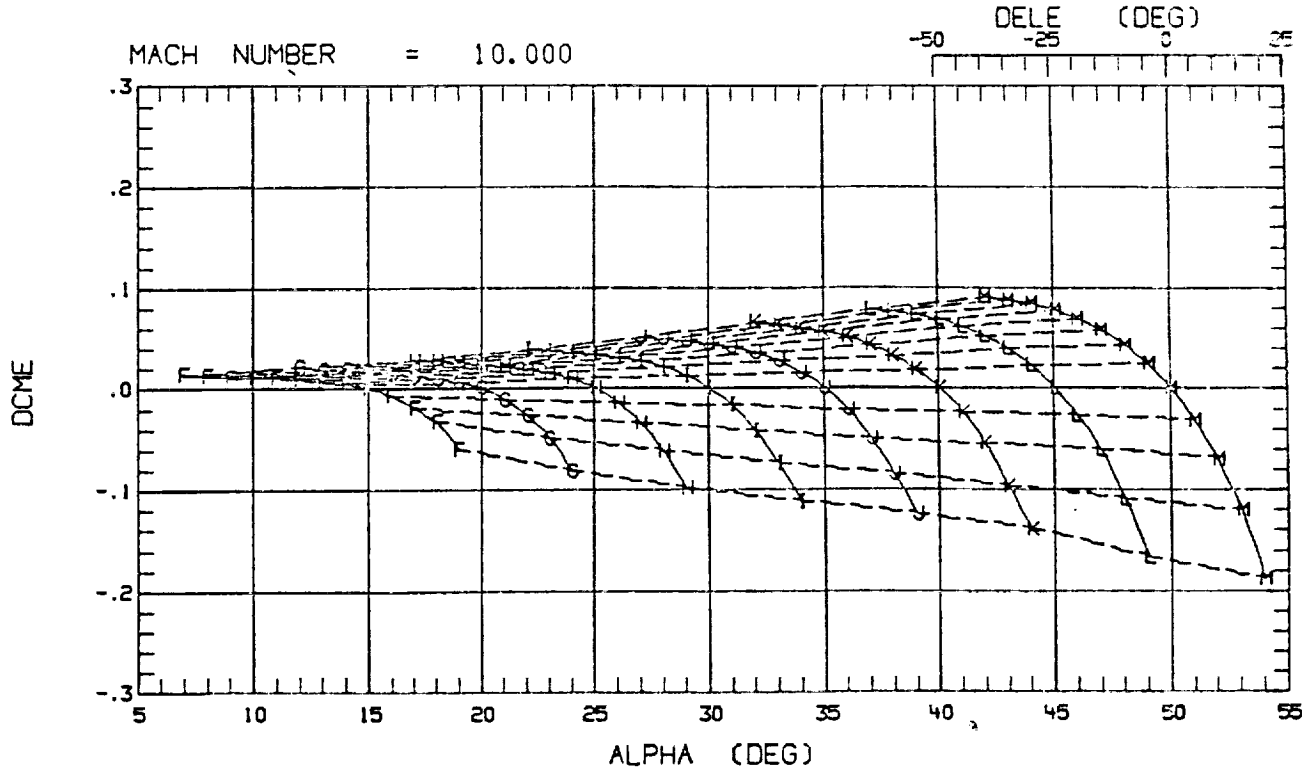
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05170	0.03720	0.02440	0.01650	0.01400	0.01390	0.02090	0.02900
-35.000	0.04680	0.03290	0.02180	0.01420	0.01220	0.01220	0.01900	0.02670
-30.000	0.04170	0.02850	0.01900	0.01330	0.01100	0.01100	0.01770	0.02540
-25.000	0.03460	0.02260	0.01620	0.01150	0.00910	0.01010	0.01620	0.02270
-20.000	0.02750	0.01710	0.01260	0.00990	0.00790	0.00990	0.01440	0.02170
-15.000	0.02090	0.01380	0.01100	0.00880	0.00700	0.00900	0.01230	0.01900
-10.000	0.01190	0.00760	0.00690	0.00620	0.00430	0.00620	0.00950	0.01510
-5.000	0.00730	0.00490	0.00450	0.00410	0.00320	0.00420	0.00580	0.00930
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00080	-0.00080	-0.00200	-0.00350	-0.00640	-0.00800	-0.01150	-0.01470
10.000	-0.00250	-0.00260	-0.00510	-0.00800	-0.01380	-0.02040	-0.02750	-0.03500
15.000	-0.00320	-0.00310	-0.00650	-0.01180	-0.02210	-0.03360	-0.04950	-0.06250
20.000	-0.01420	-0.01400	-0.01840	-0.02800	-0.04230	-0.06100	-0.08200	-0.09900

ENGINEER BCO
DATE 9/14/78

FIGURE 4.1.1.3-28
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



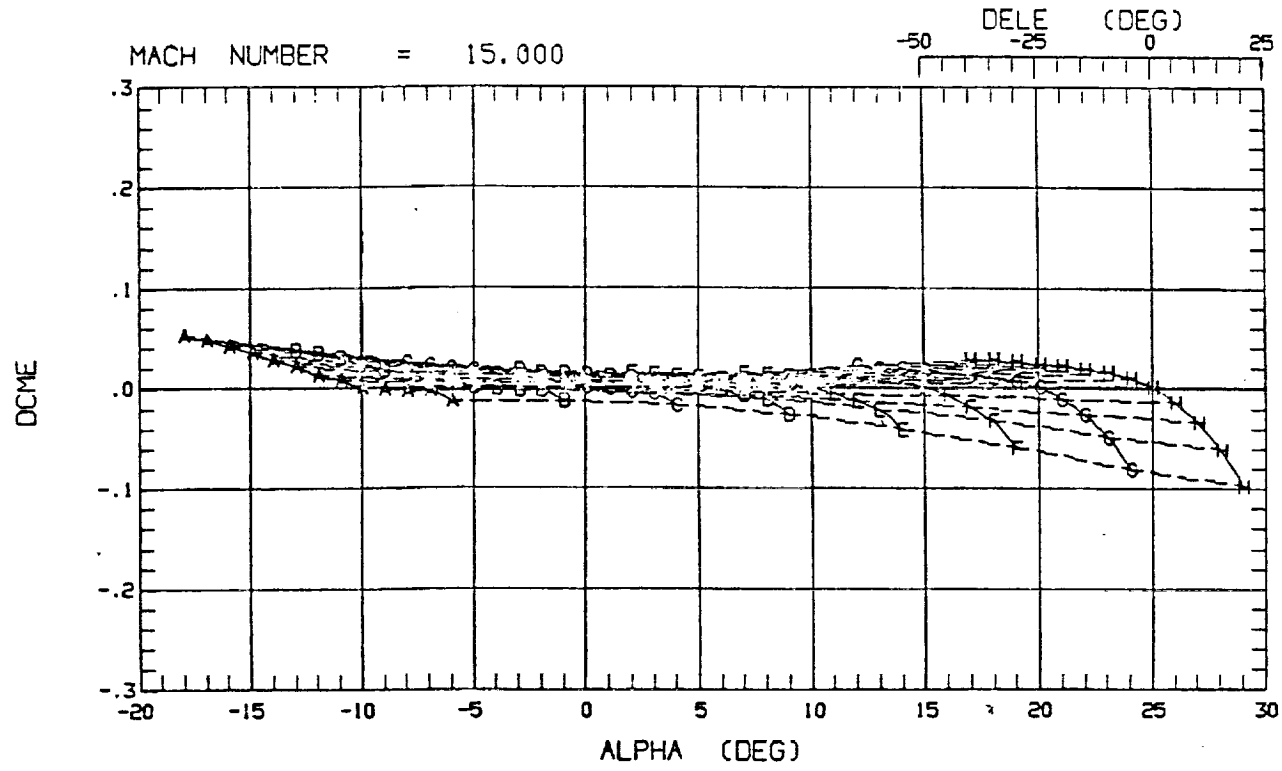
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.01390	0.02090	0.02800	0.03850	0.05070	0.06520	0.07820	0.09020
-35.000	0.01220	0.01900	0.02670	0.03700	0.04900	0.06260	0.07550	0.08750
-30.000	0.01100	0.01770	0.02540	0.03510	0.04675	0.05950	0.07250	0.08340
-25.000	0.01010	0.01620	0.02270	0.03300	0.04400	0.05570	0.06780	0.07730
-20.000	0.00990	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.06900
-15.000	0.00900	0.01230	0.01900	0.02680	0.03485	0.04250	0.05200	0.05780
-10.000	0.00620	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00420	0.00580	0.00930	0.01275	0.01560	0.01800	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00800	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02040	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.03360	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.06100	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.16750	-0.18850

ENGINEER DCO
DATE 9/14/79

FIGURE 4.1.1.3-29
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



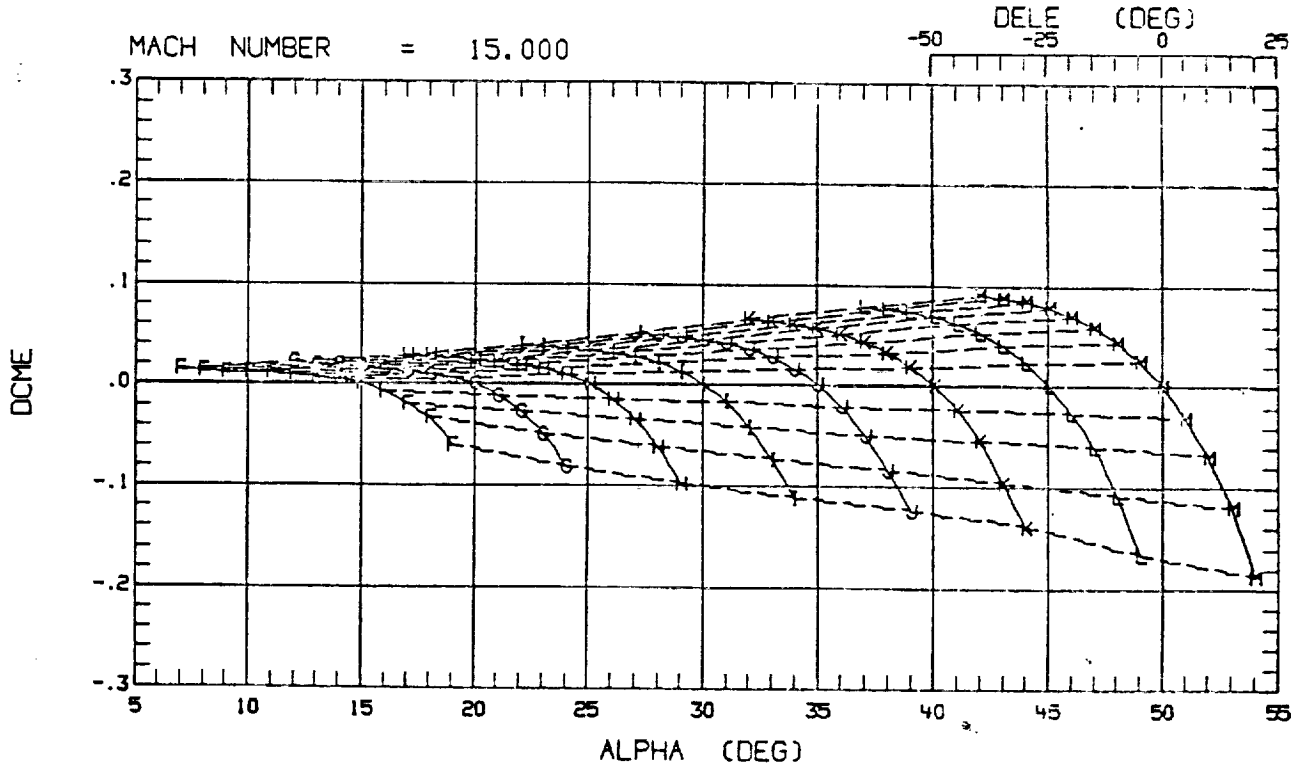
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05170	0.03720	0.02440	0.01650	0.01400	0.01390	0.02090	0.02800
-35.000	0.04680	0.03290	0.02180	0.01420	0.01220	0.01220	0.01900	0.02670
-30.000	0.04170	0.02850	0.01900	0.01330	0.01100	0.01100	0.01770	0.02540
-25.000	0.03460	0.02260	0.01620	0.01150	0.00910	0.01010	0.01620	0.02270
-20.000	0.02750	0.01710	0.01260	0.00990	0.00790	0.00990	0.01440	0.02170
-15.000	0.02090	0.01380	0.01100	0.00880	0.00700	0.00900	0.01230	0.01900
-10.000	0.01190	0.00760	0.00690	0.00620	0.00430	0.00620	0.00950	0.01510
-5.000	0.00730	0.00490	0.00450	0.00410	0.00320	0.00420	0.00580	0.00930
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00080	-0.00080	-0.00200	-0.00350	-0.00640	-0.00800	-0.01150	-0.01470
10.000	-0.00250	-0.00260	-0.00510	-0.00800	-0.01380	-0.02040	-0.02750	-0.03500
15.000	-0.00320	-0.00310	-0.00650	-0.01180	-0.02210	-0.03360	-0.04950	-0.06250
20.000	-0.01420	-0.01400	-0.01840	-0.02800	-0.04230	-0.06100	-0.08200	-0.09900

ENGINEER ECO
DATE 9/14/78

FIGURE 4.1.1.3-30
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



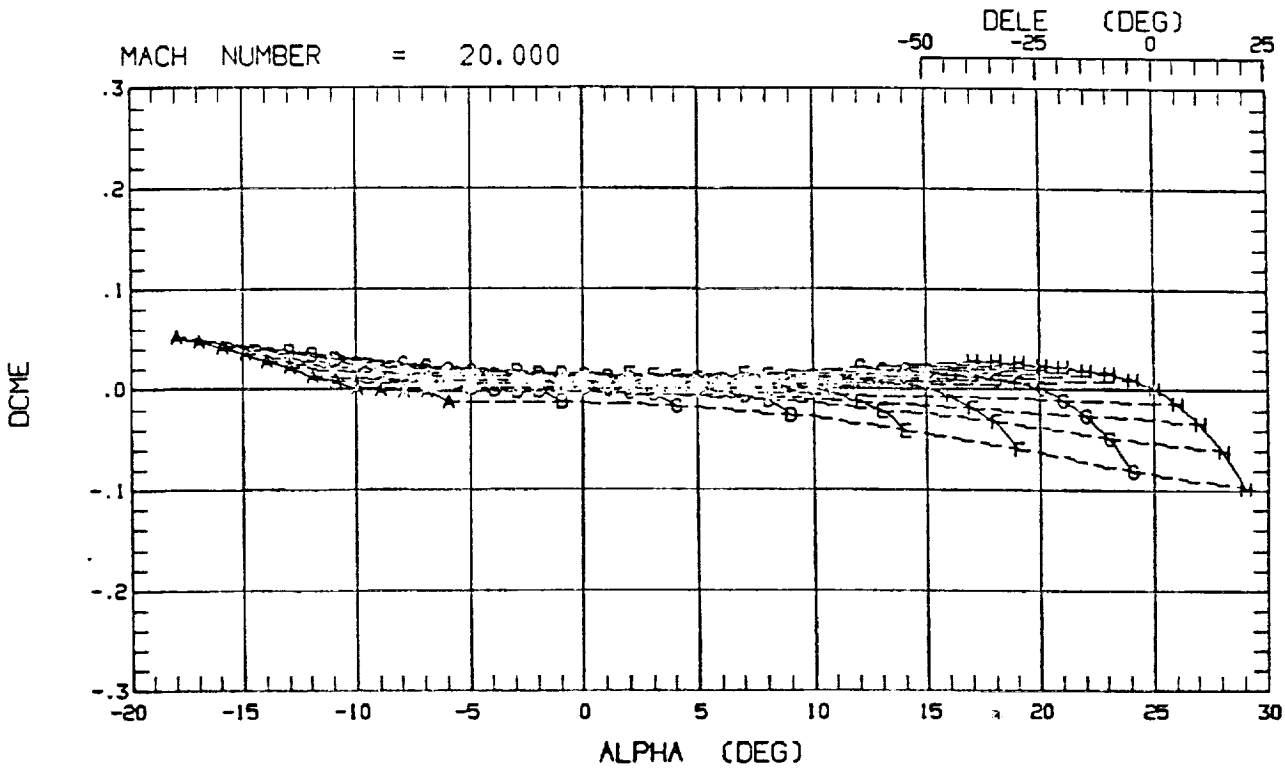
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.01390	0.02090	0.02800	0.03850	0.05070	0.06520	0.07820	0.09020
-35.000	0.01220	0.01900	0.02670	0.03700	0.04900	0.06260	0.07550	0.08750
-30.000	0.01100	0.01770	0.02540	0.03510	0.04675	0.05950	0.07250	0.08340
-25.000	0.01010	0.01620	0.02270	0.03300	0.04400	0.05570	0.06780	0.07730
-20.000	0.00990	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.06900
-15.000	0.00900	0.01230	0.01900	0.02680	0.03485	0.04250	0.05200	0.05780
-10.000	0.00620	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00420	0.00580	0.00930	0.01275	0.01560	0.01800	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00800	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02040	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.03360	-0.04950	-0.06250	-0.07500	-0.08600	-0.09750	-0.10950	-0.12100
20.000	-0.06100	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.16750	-0.18850

ENGINEER GCO
DATE 9/14/78

FIGURE 4.1.1.3-31
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



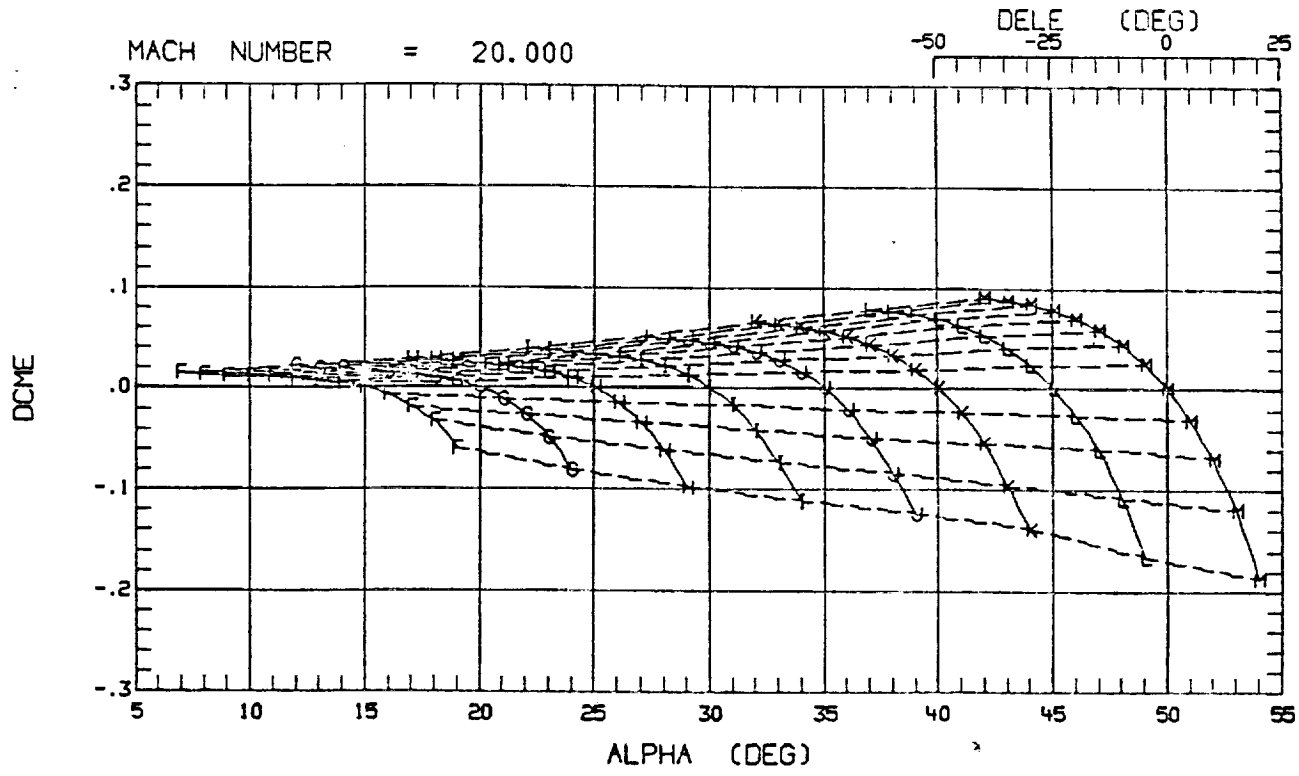
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05170	0.03720	0.02440	0.01650	0.01400	0.01390	0.02090	0.02800
-35.000	0.04680	0.03290	0.02180	0.01420	0.01220	0.01220	0.01900	0.02670
-30.000	0.04170	0.02850	0.01900	0.01330	0.01100	0.01100	0.01770	0.02540
-25.000	0.03460	0.02260	0.01620	0.01150	0.00910	0.01010	0.01620	0.02270
-20.000	0.02750	0.01710	0.01260	0.00990	0.00790	0.00990	0.01440	0.02170
-15.000	0.02090	0.01380	0.01100	0.00880	0.00700	0.00900	0.01230	0.01900
-10.000	0.01190	0.00760	0.00690	0.00620	0.00430	0.00620	0.00950	0.01510
-5.000	0.00730	0.00490	0.00450	0.00410	0.00320	0.00420	0.00580	0.00930
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00080	-0.00080	-0.00200	-0.00350	-0.00640	-0.00800	-0.01150	-0.01470
10.000	-0.00250	-0.00260	-0.00510	-0.00800	-0.01380	-0.02040	-0.02750	-0.03500
15.000	-0.00320	-0.00310	-0.00650	-0.01180	-0.02210	-0.03360	-0.04950	-0.06250
20.000	-0.01420	-0.01400	-0.01840	-0.02800	-0.04230	-0.06100	-0.08200	-0.09900

ENGINEER [illegible]
DATE 9/14/78

FIGURE 4.1.1.3-32
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



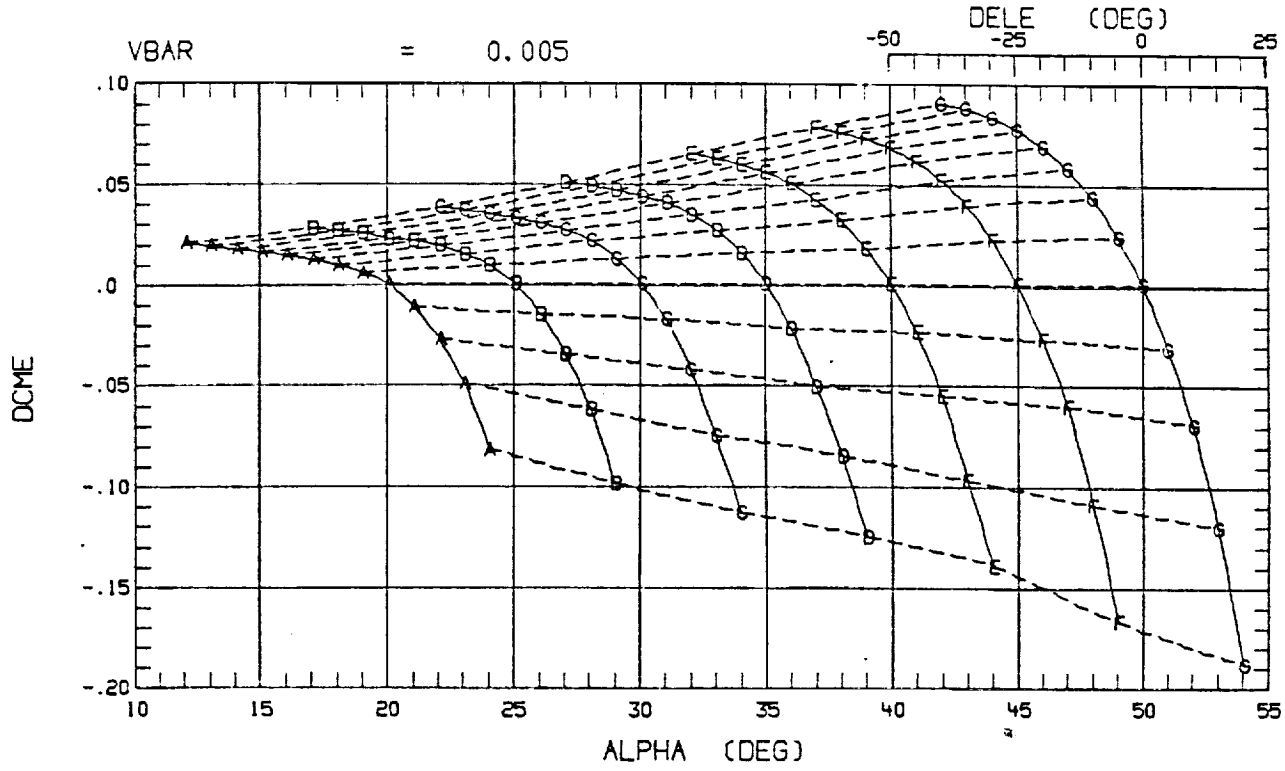
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.01390	0.02090	0.02800	0.03850	0.05070	0.06520	0.07820	0.09020
-35.000	0.01220	0.01900	0.02670	0.03700	0.04900	0.06260	0.07550	0.08750
-30.000	0.01100	0.01770	0.02540	0.03510	0.04675	0.05950	0.07250	0.08340
-25.000	0.01010	0.01620	0.02270	0.03300	0.04400	0.05570	0.06780	0.07730
-20.000	0.00990	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.06900
-15.000	0.00900	0.01230	0.01900	0.02680	0.03485	0.04250	0.05200	0.05780
-10.000	0.00620	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00420	0.00580	0.00930	0.01275	0.01560	0.01800	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00800	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02040	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.03360	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.06100	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.16750	-0.16850

ENGINEER DCO
DATE 4/14/78

FIGURE 4.1.1.3-33
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

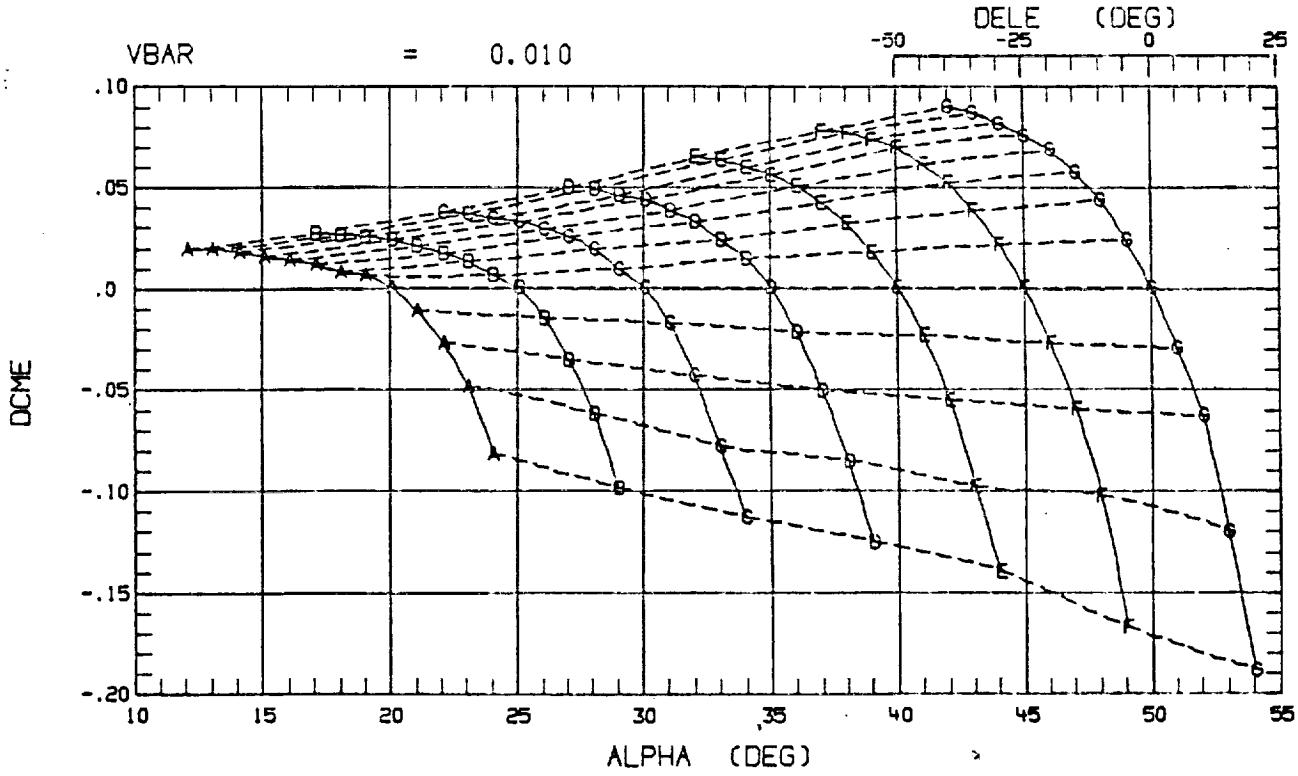
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELE (DEG)	ELEVON PITCHING MOMENT COEFFICIE						
-40.000	0.02090	0.02800	0.03850	0.05070	0.06520	0.07820	0.09020
-35.000	0.01900	0.02670	0.03700	0.04900	0.06260	0.07550	0.08750
-30.000	0.01770	0.02540	0.03510	0.04675	0.05950	0.07250	0.08340
-25.000	0.01620	0.02270	0.03300	0.04400	0.05570	0.06780	0.07730
-20.000	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.06900
-15.000	0.01230	0.01900	0.02680	0.03485	0.04250	0.05200	0.05780
-10.000	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00580	0.00930	0.01275	0.01560	0.01800	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.16750	-0.18850

ENGINEER NASA
DATE

FIGURE 4.1.1.3-34
EFFECT OF ELEVON

ST 70-9[illegible]CCEO IM



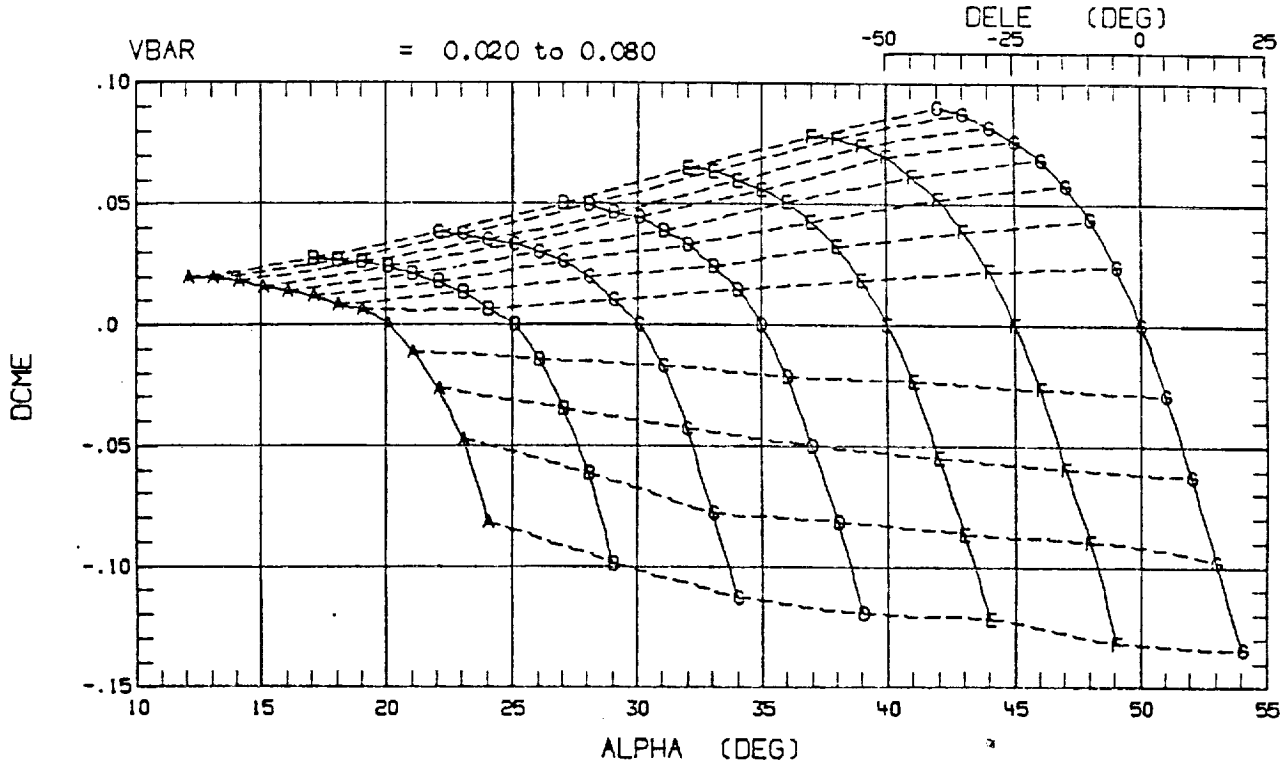
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON PITCHING MOMENT COEFFICIE						
-40.000	0.01920	0.02720	0.03770	0.04980	0.06470	0.07790	0.08980
-35.000	0.01920	0.02630	0.03690	0.04930	0.06350	0.07710	0.08720
-30.000	0.01800	0.02560	0.03480	0.04580	0.05970	0.07370	0.08190
-25.000	0.01560	0.02360	0.03300	0.04400	0.05570	0.06940	0.07600
-20.000	0.01390	0.02070	0.02950	0.03870	0.05040	0.06100	0.06850
-15.000	0.01160	0.01720	0.02570	0.03300	0.04250	0.05180	0.05730
-10.000	0.00790	0.01310	0.01910	0.02400	0.03200	0.03820	0.04330
-5.000	0.00600	0.00630	0.00970	0.01460	0.01800	0.02170	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01150	-0.01470	-0.01750	-0.02200	-0.02370	-0.02720	-0.02950
10.000	-0.02700	-0.03540	-0.04350	-0.05040	-0.05550	-0.06000	-0.06300
15.000	-0.04810	-0.06210	-0.07850	-0.08580	-0.09800	-0.10250	-0.12040
20.000	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.16750	-0.18850

ENGINEER NASA
DATE

FIGURE 4.1.1.3-35
EFFECT OF ELEVON



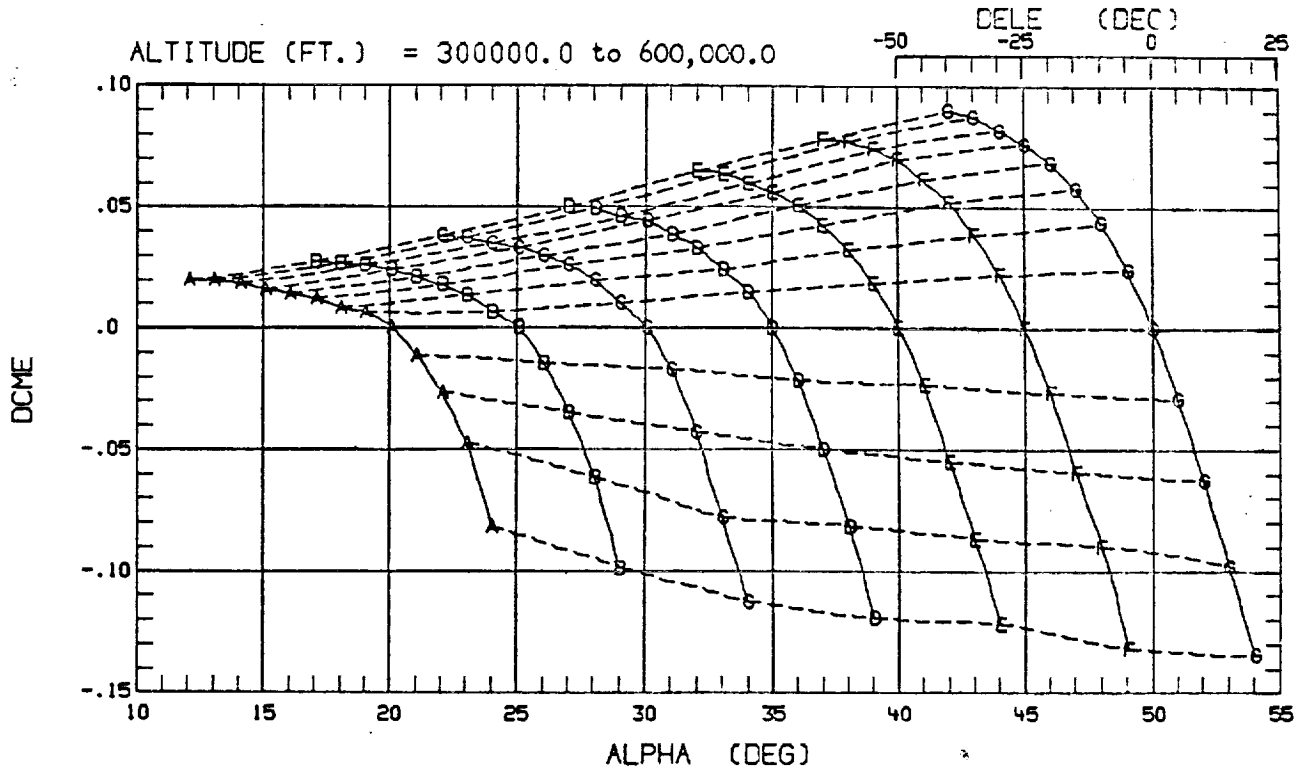
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELE (DEG)	ELEVON PITCHING MOMENT COEFFICIE						
-40.000	0.01920	0.02720	0.03770	0.04980	0.06470	0.07790	0.08960
-35.000	0.01920	0.02630	0.03690	0.04930	0.06350	0.07710	0.08720
-30.000	0.01800	0.02560	0.03480	0.04580	0.05970	0.07370	0.08190
-25.000	0.01560	0.02360	0.03300	0.04400	0.05570	0.06940	0.07600
-20.000	0.01390	0.02070	0.02950	0.03870	0.05040	0.06100	0.06850
-15.000	0.01160	0.01720	0.02570	0.03300	0.04250	0.05180	0.05730
-10.000	0.00790	0.01310	0.01910	0.02400	0.03200	0.03820	0.04330
-5.000	0.00600	0.00630	0.00970	0.01460	0.01800	0.02170	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01150	-0.01470	-0.01750	-0.02200	-0.02370	-0.02720	-0.02950
10.000	-0.02700	-0.03540	-0.04350	-0.05040	-0.05550	-0.06000	-0.06300
15.000	-0.04810	-0.06210	-0.07850	-0.08180	-0.08700	-0.09020	-0.09840
20.000	-0.08200	-0.09900	-0.11300	-0.11970	-0.12200	-0.13200	-0.13500

ENGINEER NASA
DATE

FIGURE 4.1.1.3-36
EFFECT OF ELEVON



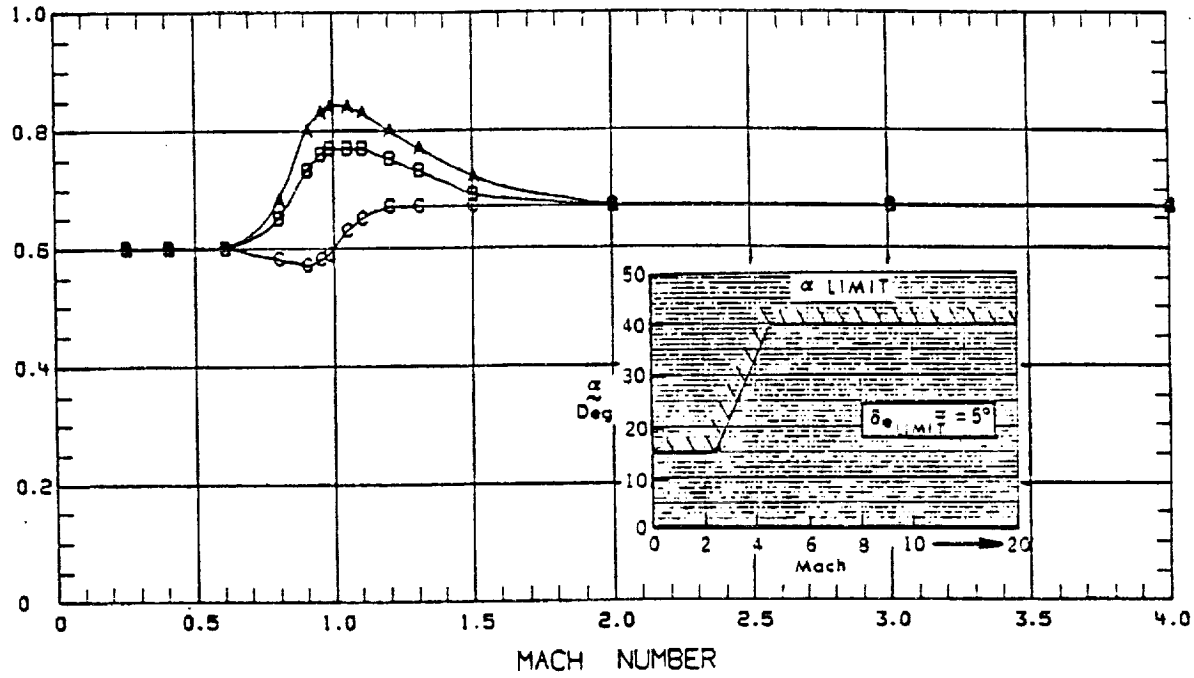
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)						
	20.0	25.0	30.0	35.0	40.0	45.0	50.0
	A	B	C	D	E	F	G
DELE (DEG)	ELEVON PITCHING MOMENT COEFFICIE						
-40.000	0.01920	0.02720	0.03770	0.04980	0.06470	0.07790	0.08980
-35.000	0.01920	0.02630	0.03690	0.04930	0.06350	0.07710	0.08720
-30.000	0.01800	0.02560	0.03480	0.04580	0.05970	0.07370	0.08190
-25.000	0.01560	0.02360	0.03300	0.04400	0.05570	0.06940	0.07600
-20.000	0.01390	0.02070	0.02950	0.03870	0.05040	0.06100	0.06850
-15.000	0.01160	0.01720	0.02570	0.03300	0.04250	0.05180	0.05730
-10.000	0.00790	0.01310	0.01910	0.02400	0.03200	0.03820	0.04330
-5.000	0.00600	0.00630	0.00970	0.01460	0.01800	0.02170	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01150	-0.01470	-0.01750	-0.02200	-0.02370	-0.02720	-0.02950
10.000	-0.02700	-0.03540	-0.04350	-0.05040	-0.05550	-0.06000	-0.06300
15.000	-0.04810	-0.06210	-0.07850	-0.08180	-0.08700	-0.09020	-0.09840
20.000	-0.08200	-0.09900	-0.11300	-0.11970	-0.12200	-0.13200	-0.13500

ENGINEER NASA
DATE

FIGURE 4.1.1.3-37
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

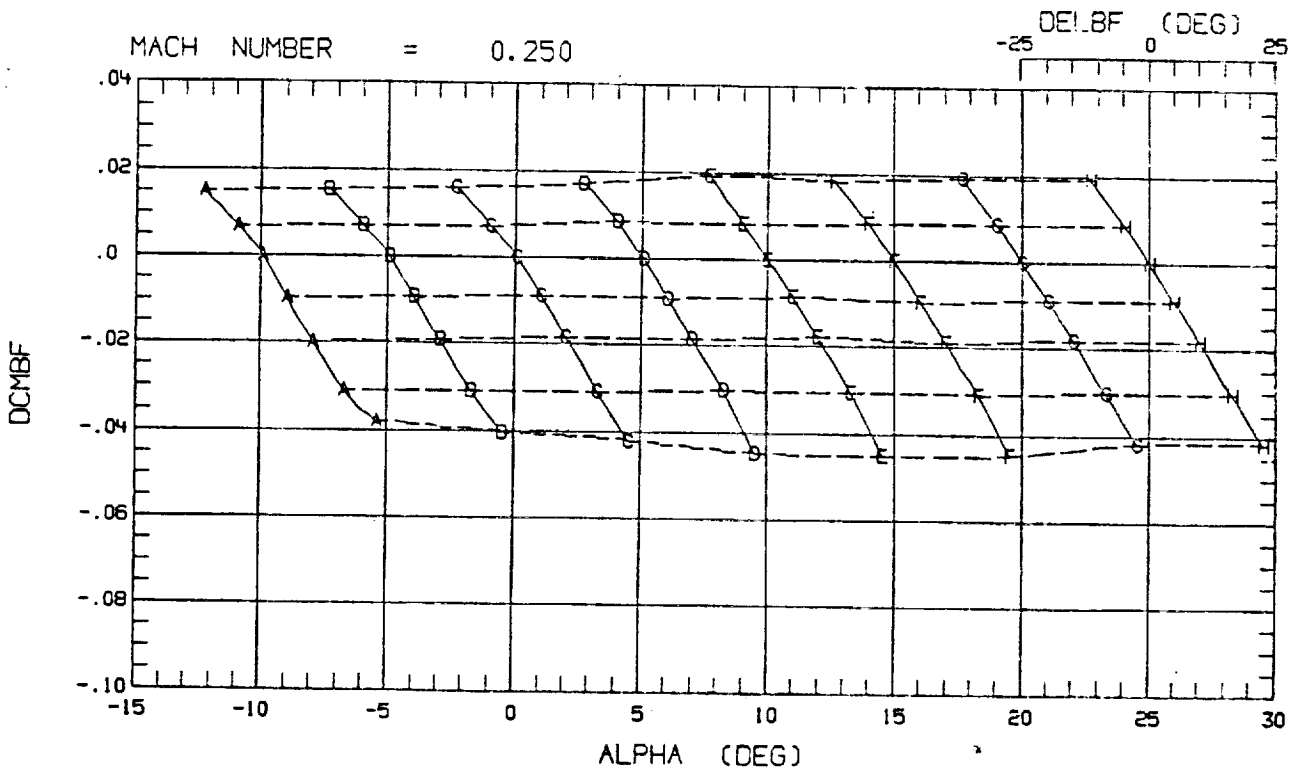
	DELE (DEG)		
	-5.000 A	0.0 B	5.000 C
MACH NUMBER	PITCHING MOM. PARTIAL SPAN FACTOR		
0.250	0.60000	0.60000	0.60000
0.400	0.60000	0.60000	0.60000
0.600	0.60000	0.60000	0.60000
0.800	0.68000	0.65000	0.58000
0.900	0.80000	0.73000	0.57000
0.950	0.83000	0.76000	0.58000
0.980	0.84000	0.77000	0.59000
1.050	0.84000	0.77000	0.63000
1.100	0.83000	0.77000	0.65000
1.200	0.80000	0.75000	0.67000
1.300	0.77000	0.73000	0.67000
1.500	0.72000	0.69000	0.67000
2.000	0.67000	0.67000	0.67000
3.000	0.67000	0.67000	0.67000
4.000	0.67000	0.67000	0.67000
5.000	0.67000	0.67000	0.67000
8.000	0.67000	0.67000	0.67000
10.000	0.67000	0.67000	0.67000
15.000	0.67000	0.67000	0.67000
20.000	0.67000	0.67000	0.67000

NOTE: In the event partial span factors are required which exceed the given limits, the Aero Data Unit at Rockwell International should be contacted before extrapolation of the given data.

ENGINEER GCO WH2
DATE 9/13/78 REV 1-26-79

FIGURE 4.1.1.3-38
ELEVON PARTIAL SPAN FACTOR

41 72-81 OCCO IM



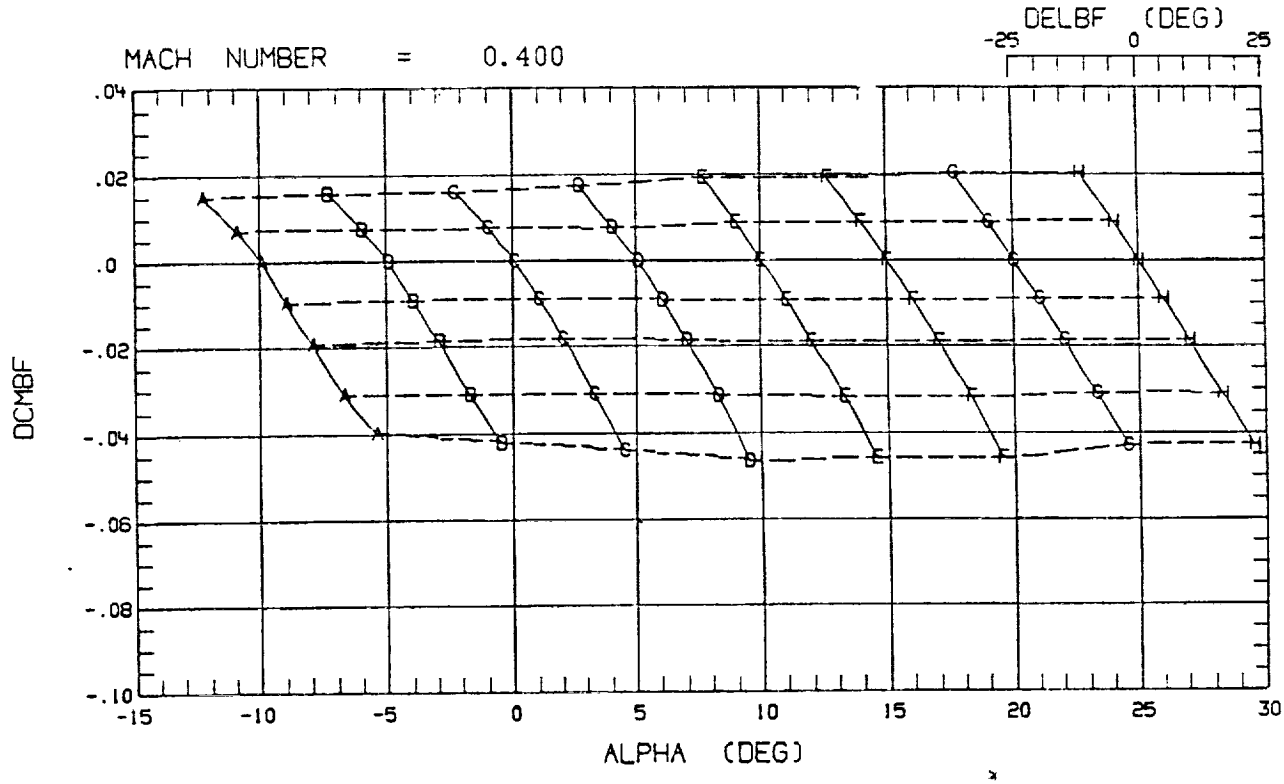
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI							
-11.700	0.01470	0.01530	0.01580	0.01700	0.01900	0.01810	0.01900	0.01900
-5.000	0.00670	0.00690	0.00710	0.00820	0.00800	0.00820	0.00850	0.00850
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00990	-0.00940	-0.00900	-0.00924	-0.00880	-0.00970	-0.00900	-0.00900
10.000	-0.02000	-0.01930	-0.01860	-0.01860	-0.01800	-0.01900	-0.01820	-0.01820
16.300	-0.03110	-0.03100	-0.03100	-0.03050	-0.03070	-0.03090	-0.03040	-0.03040
22.500	-0.03830	-0.04050	-0.04240	-0.04500	-0.04530	-0.04500	-0.04200	-0.04200

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.3-39
EFFECT OF BODY FLAP

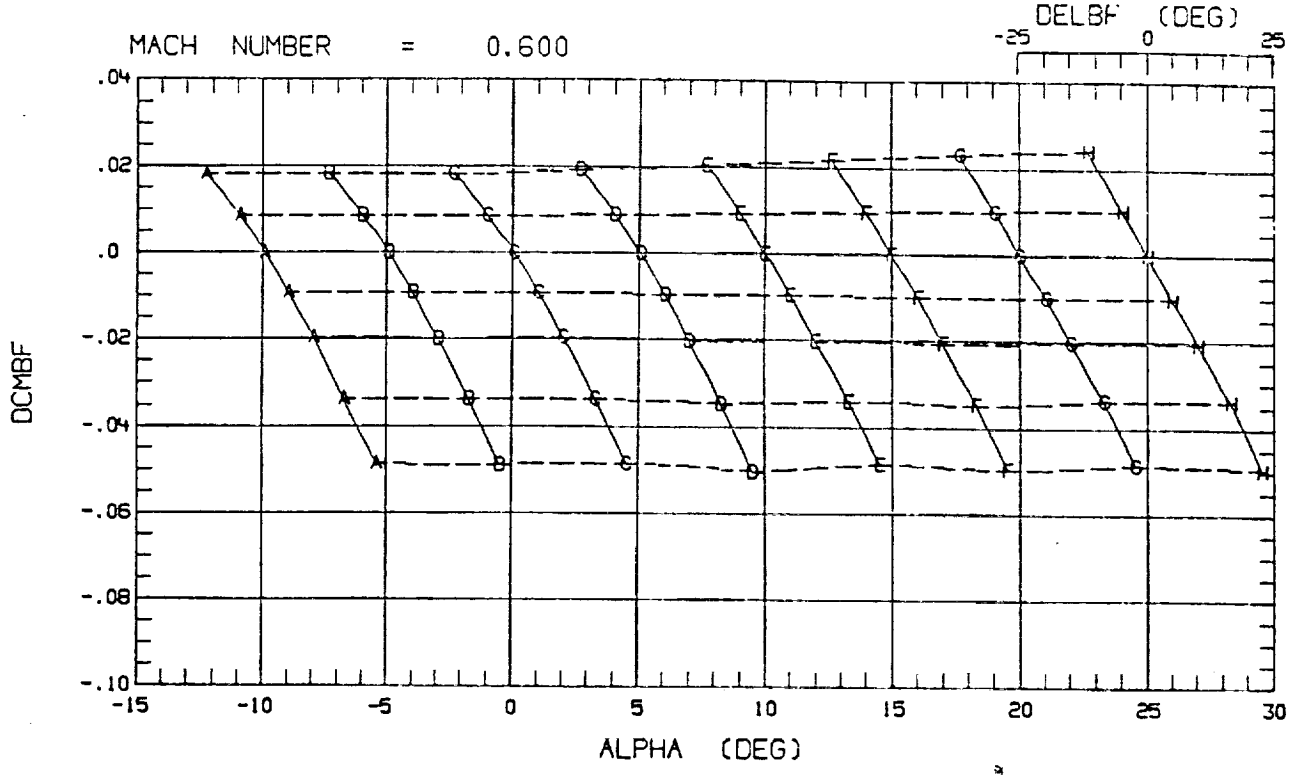


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI							
-11.700	0.01490	0.01550	0.01600	0.01720	0.01900	0.01900	0.02000	0.02000
-5.000	0.00710	0.00730	0.00750	0.00750	0.00867	0.00860	0.00890	0.00890
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00970	-0.00930	-0.00890	-0.00924	-0.00925	-0.00947	-0.00910	-0.00910
10.000	-0.01950	-0.01880	-0.01810	-0.01880	-0.01890	-0.01910	-0.01870	-0.01870
16.300	-0.03100	-0.03110	-0.03110	-0.03130	-0.03170	-0.03190	-0.03100	-0.03100
22.500	-0.04010	-0.04230	-0.04420	-0.04660	-0.04600	-0.04610	-0.04310	-0.04310

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.3-40
EFFECT OF BODY FLAP



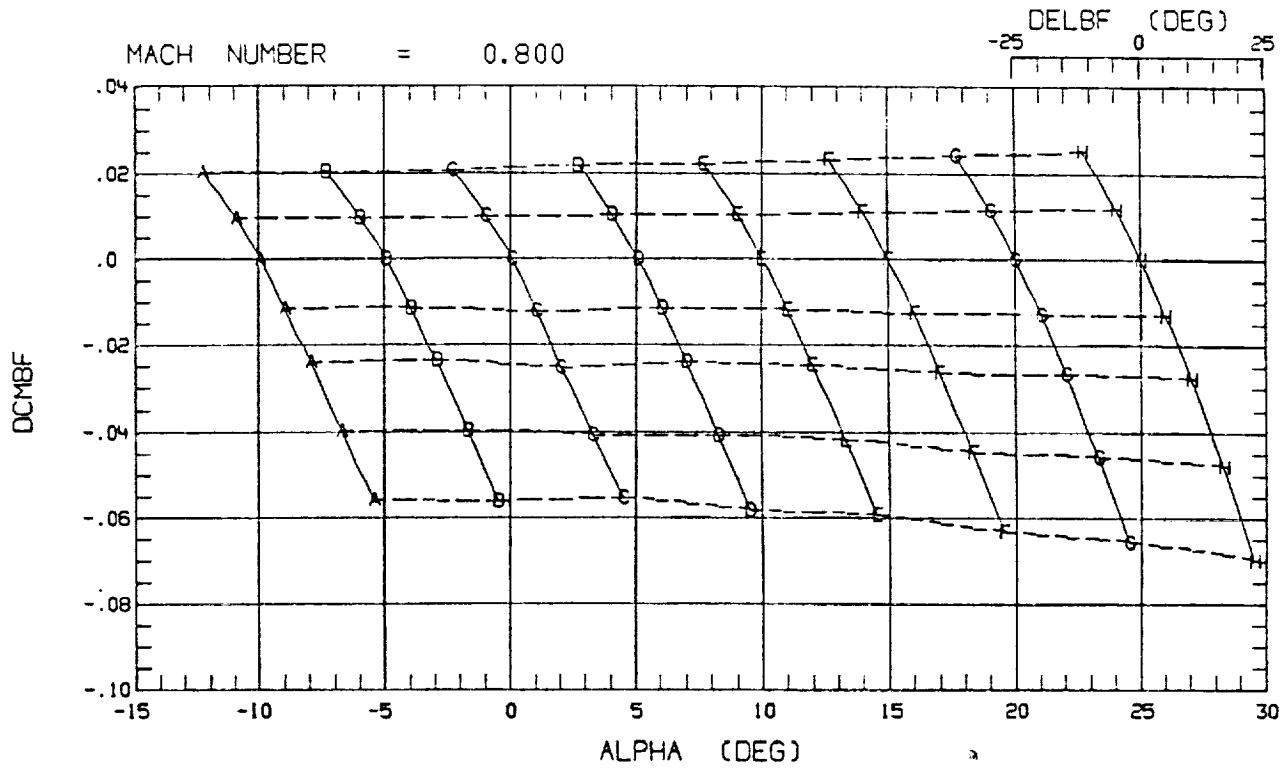
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.01800	0.01814	0.01790	0.01896	0.02012	0.02135	0.02300	0.02400
-5.000	0.00835	0.00840	0.00831	0.00872	0.00906	0.00952	0.00997	0.01030
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00942	-0.00946	-0.00942	-0.00969	-0.00978	-0.01014	-0.01012	-0.01033
10.000	-0.01983	-0.01988	-0.01983	-0.02030	-0.02024	-0.02087	-0.02038	-0.02067
16.300	-0.03400	-0.03406	-0.03394	-0.03487	-0.03428	-0.03512	-0.03400	-0.03400
22.500	-0.04900	-0.04905	-0.04880	-0.05045	-0.04897	-0.04990	-0.04900	-0.05000

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-41
EFFECT OF BODY FLAP



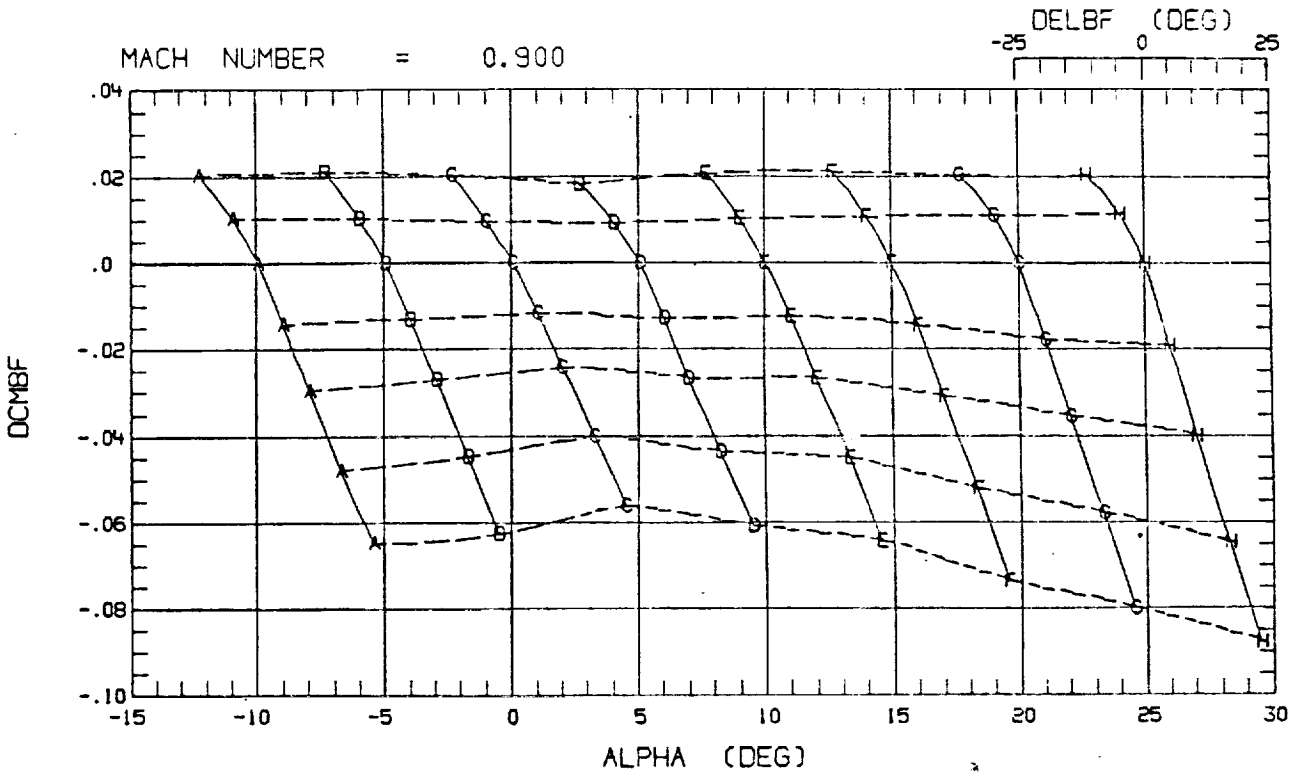
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.02000	0.02017	0.02040	0.02163	0.02182	0.02303	0.02400	0.02500
-5.000	0.00944	0.00948	0.00964	0.01004	0.01017	0.01078	0.01118	0.01165
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01157	-0.01136	-0.01226	-0.01149	-0.01183	-0.01264	-0.01277	-0.01313
10.000	-0.02403	-0.02376	-0.02523	-0.02412	-0.02483	-0.02655	-0.02691	-0.02771
16.300	-0.04000	-0.03986	-0.04092	-0.04092	-0.04196	-0.04482	-0.04600	-0.04800
22.500	-0.05600	-0.05615	-0.05562	-0.05829	-0.05951	-0.06350	-0.06600	-0.07000

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-42
EFFECT OF BODY FLAP



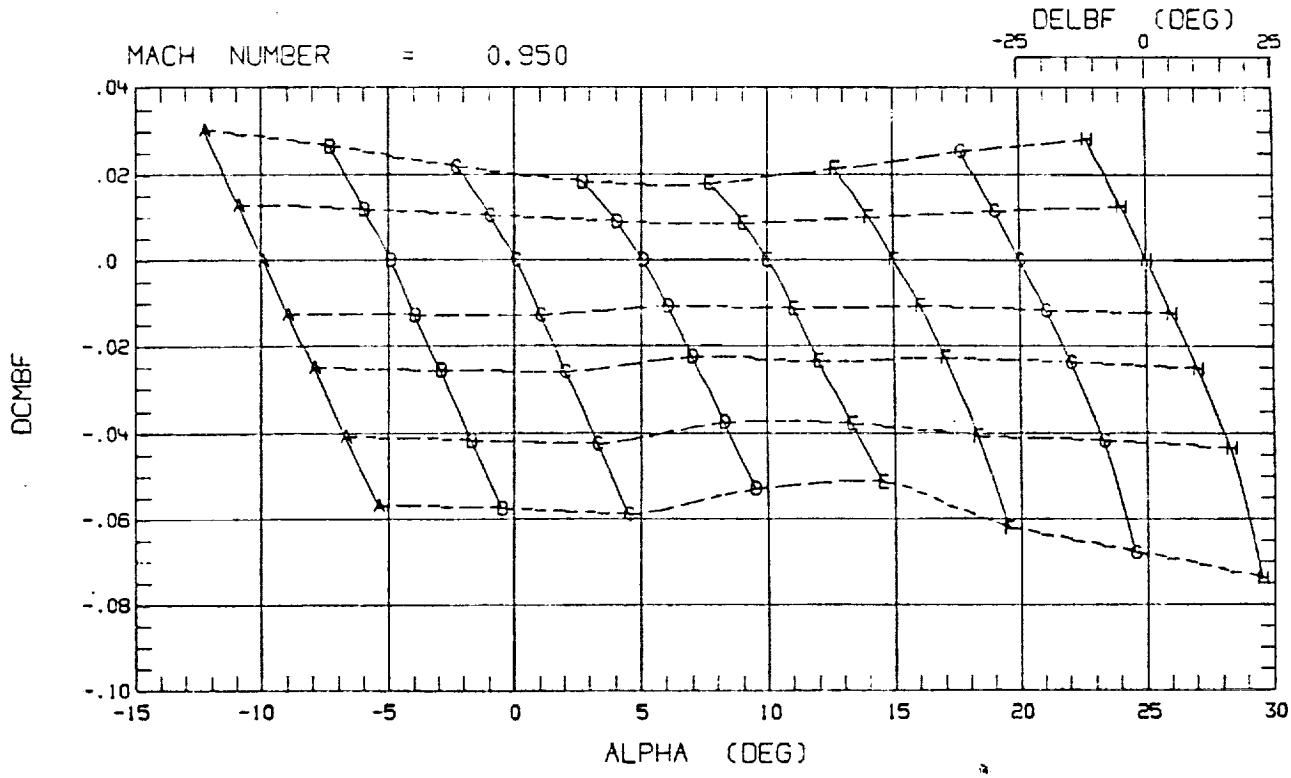
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.02000	0.02077	0.01993	0.01809	0.02061	0.02098	0.02000	0.02000
-5.000	0.01003	0.01005	0.00943	0.00910	0.01003	0.01066	0.01076	0.01127
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01428	-0.01314	-0.01177	-0.01311	-0.01255	-0.01467	-0.01776	-0.01928
10.000	-0.02963	-0.02714	-0.02431	-0.02672	-0.02669	-0.03107	-0.03559	-0.04014
16.300	-0.04800	-0.04493	-0.04027	-0.04389	-0.04537	-0.05229	-0.05800	-0.06500
22.500	-0.06500	-0.06265	-0.05618	-0.06088	-0.06455	-0.07372	-0.08000	-0.08800

ENGINEER WMT
DATE 9-20-78

FIGURE 4.1.1.3-43
EFFECT OF BODY FLAP



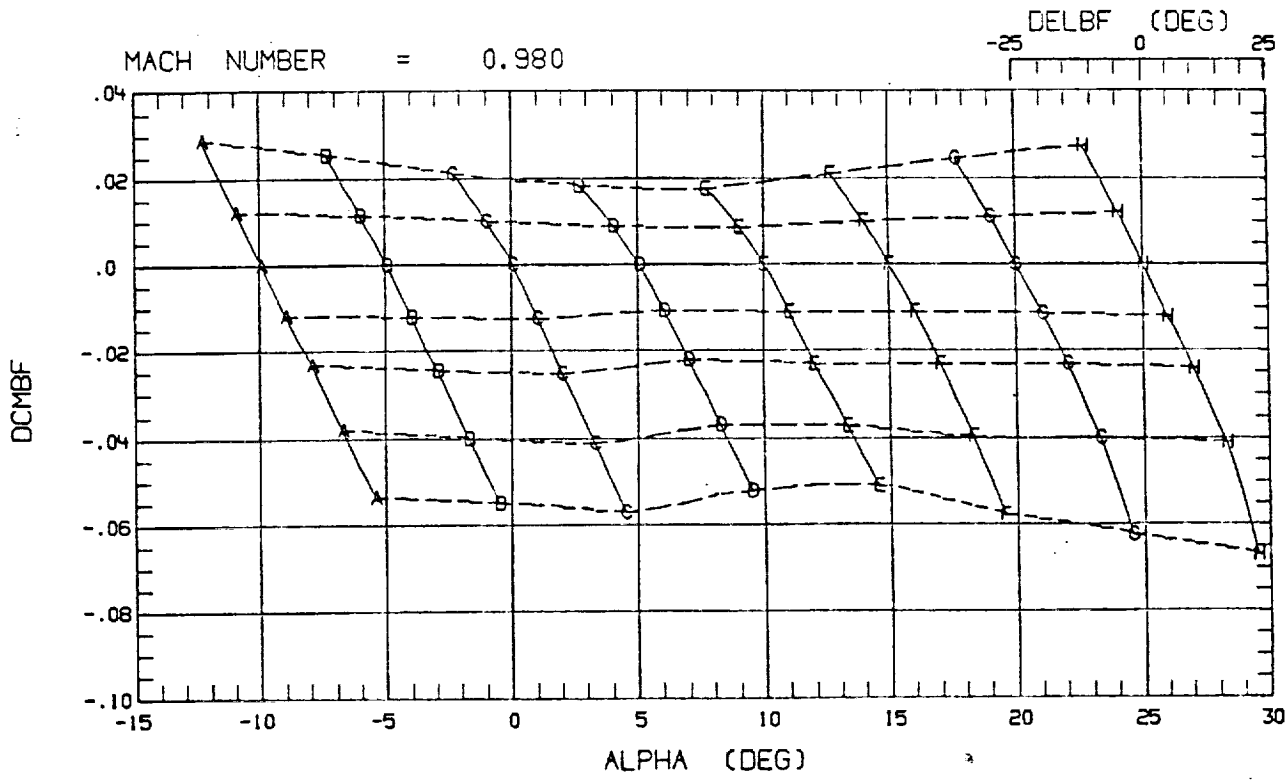
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.03000	0.02617	0.02149	0.01801	0.01762	0.02110	0.02500	0.02800
-5.000	0.01276	0.01159	0.01012	0.00863	0.00853	0.00986	0.01121	0.01233
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01262	-0.01279	-0.01280	-0.01078	-0.01136	-0.01091	-0.01172	-0.01265
10.000	-0.02512	-0.02577	-0.02602	-0.02259	-0.02361	-0.02296	-0.02387	-0.02549
16.300	-0.04100	-0.04196	-0.04271	-0.03783	-0.03822	-0.04085	-0.04200	-0.04400
22.500	-0.05700	-0.05773	-0.05922	-0.05319	-0.05158	-0.06224	-0.06800	-0.07400

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.3-44
EFFECT OF BODY FLAP



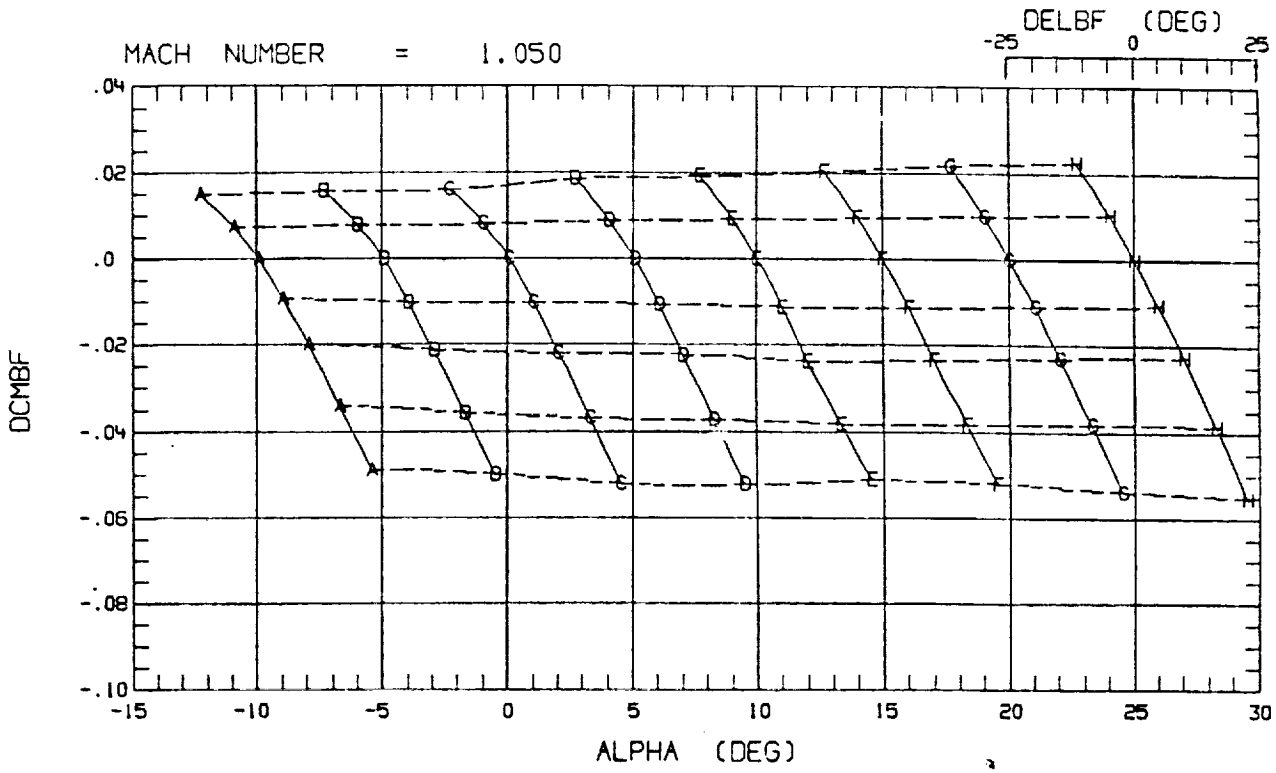
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.02849	0.02495	0.02072	0.01803	0.01741	0.02097	0.02444	0.02736
-5.000	0.01207	0.01106	0.00978	0.00859	0.00842	0.00976	0.01092	0.01193
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01181	-0.01224	-0.01272	-0.01064	-0.01131	-0.01103	-0.01140	-0.01212
10.000	-0.02337	-0.02468	-0.02546	-0.02224	-0.02312	-0.02326	-0.02326	-0.02435
16.300	-0.03822	-0.04017	-0.04149	-0.03718	-0.03755	-0.04005	-0.04047	-0.04130
22.500	-0.05390	-0.05524	-0.05726	-0.05222	-0.05132	-0.05797	-0.06256	-0.06724

ENGINEER WMZ
DATE 9-19-78

FIGURE 4.1.1.3-45
EFFECT OF BODY FLAP



CONFIGURATION

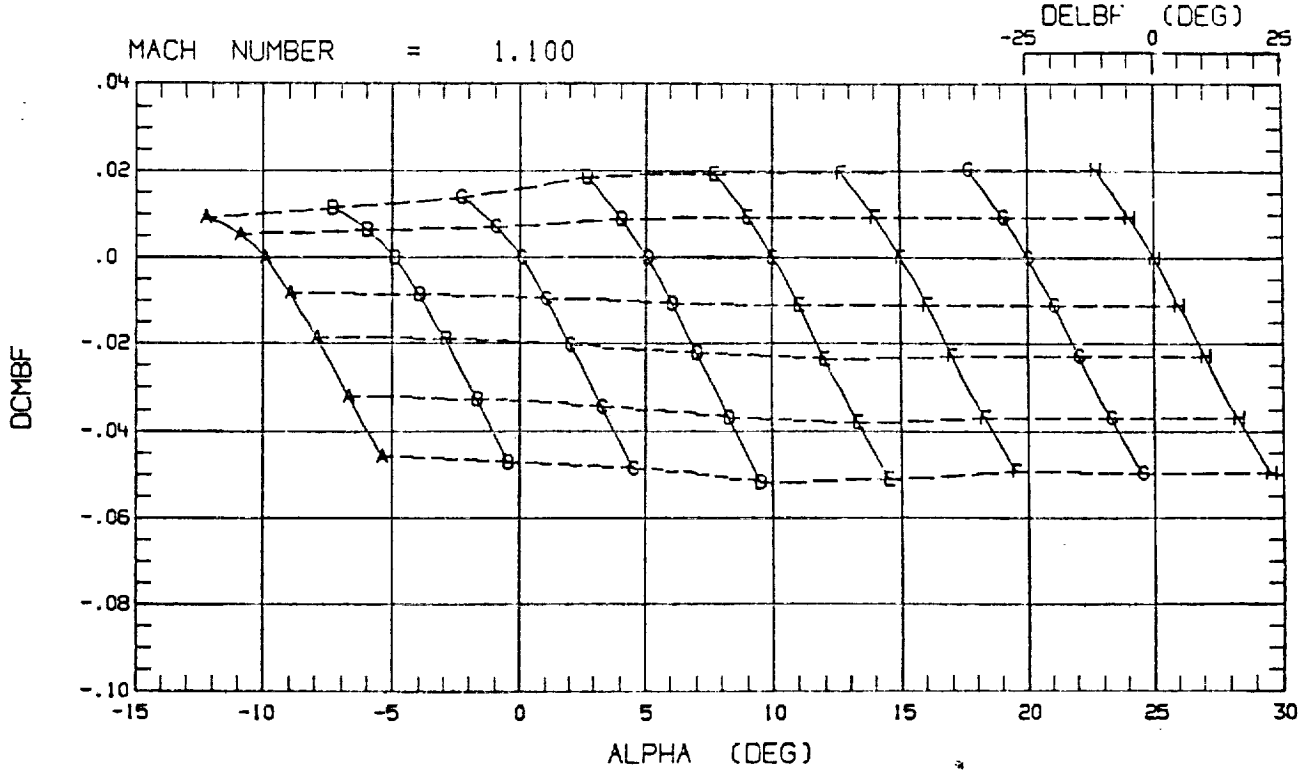
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.01472	0.01531	0.01574	0.01831	0.01889	0.02017	0.02154	0.02235
-5.000	0.00730	0.00762	0.00785	0.00870	0.00897	0.00937	0.00983	0.01012
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00929	-0.01029	-0.01051	-0.01072	-0.01138	-0.01158	-0.01115	-0.01098
10.000	-0.01995	-0.02154	-0.02217	-0.02239	-0.02388	-0.02363	-0.02309	-0.02281
16.300	-0.03422	-0.03596	-0.03722	-0.03742	-0.03854	-0.03839	-0.03854	-0.03882
22.500	-0.04903	-0.05042	-0.05241	-0.05254	-0.05138	-0.05248	-0.05411	-0.05575

ENGINEER WM Z
DATE 9-28-78

FIGURE 4.1.1.3 -46
EFFECT OF BODY FLAP

SI 72-SH-0000 IM

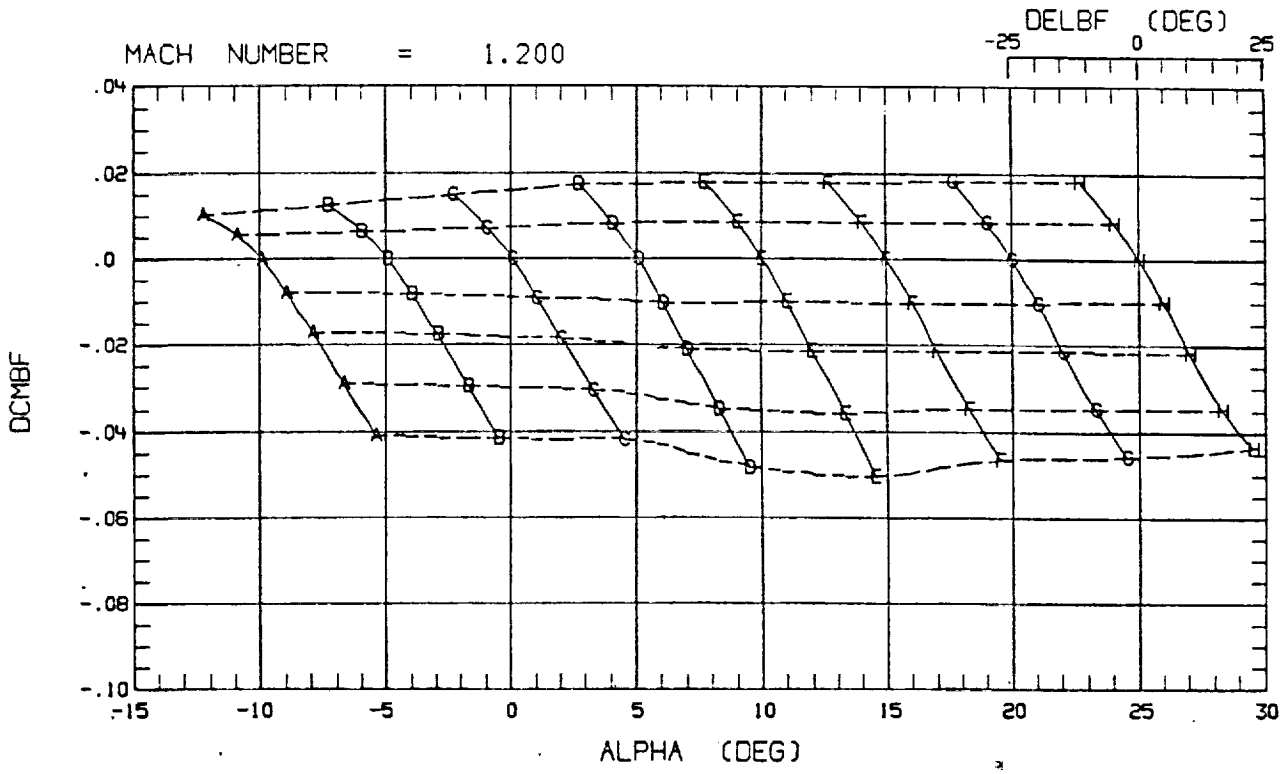


CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00900	0.01124	0.01360	0.01837	0.01918	0.01941	0.02000	0.02000
-5.000	0.00527	0.00607	0.00696	0.00869	0.00905	0.00904	0.00923	0.00923
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00839	-0.00877	-0.00967	-0.01064	-0.01134	-0.01102	-0.01108	-0.01108
10.000	-0.01850	-0.01914	-0.02054	-0.02216	-0.02375	-0.02303	-0.02300	-0.02300
16.300	-0.03200	-0.03298	-0.03465	-0.03698	-0.03835	-0.03720	-0.03720	-0.03720
22.500	-0.04600	-0.04732	-0.04894	-0.05186	-0.05121	-0.04966	-0.05000	-0.05000

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-47
EFFECT OF BODY FLAP



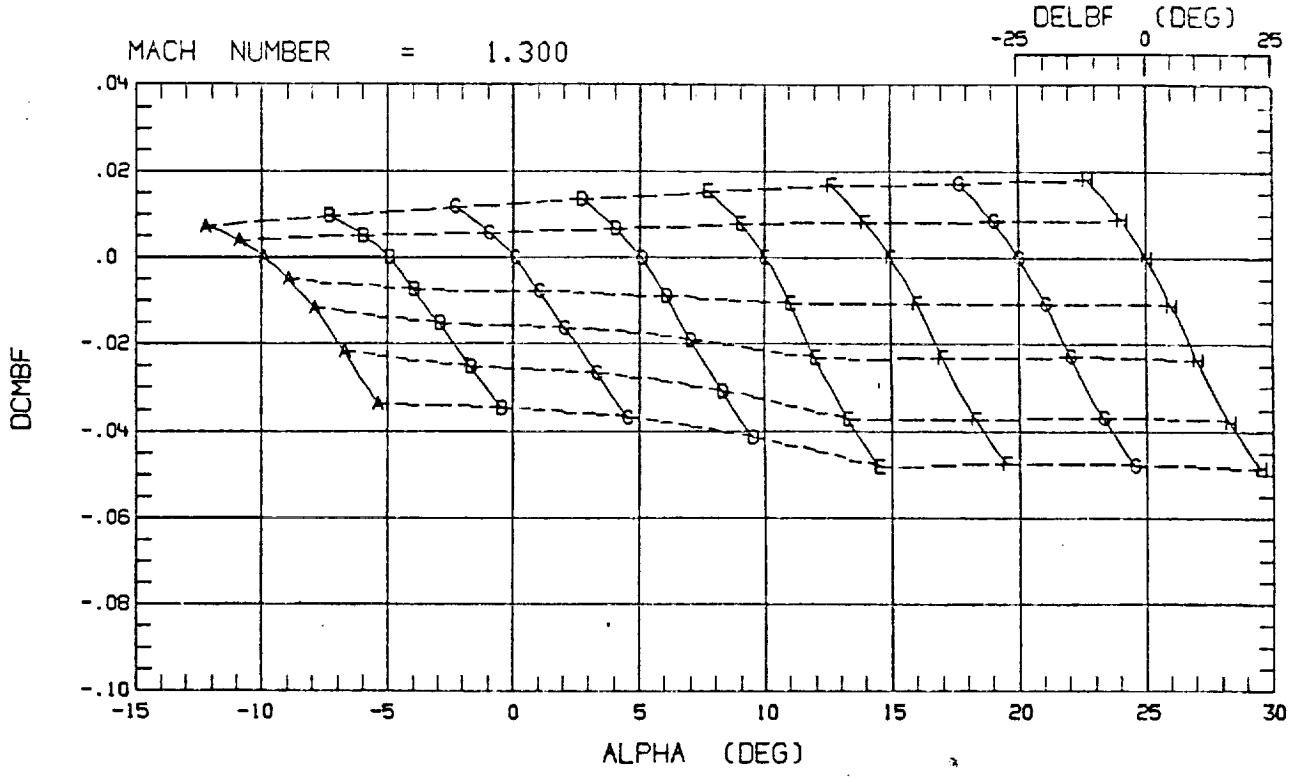
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.01000	0.01229	0.01480	0.01714	0.01753	0.01745	0.01800	0.01800
-5.000	0.00538	0.00618	0.00705	0.00813	0.00834	0.00823	0.00841	0.00841
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00803	-0.00835	-0.00927	-0.01029	-0.01027	-0.01031	-0.01028	-0.01018
10.000	-0.01716	-0.01766	-0.01878	-0.02110	-0.02148	-0.02160	-0.02164	-0.02176
16.300	-0.02900	-0.02971	-0.03055	-0.03481	-0.03594	-0.03487	-0.03487	-0.03487
22.500	-0.04100	-0.04189	-0.04195	-0.04842	-0.05051	-0.04653	-0.04600	-0.04400

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-48
EFFECT OF BODY FLAP



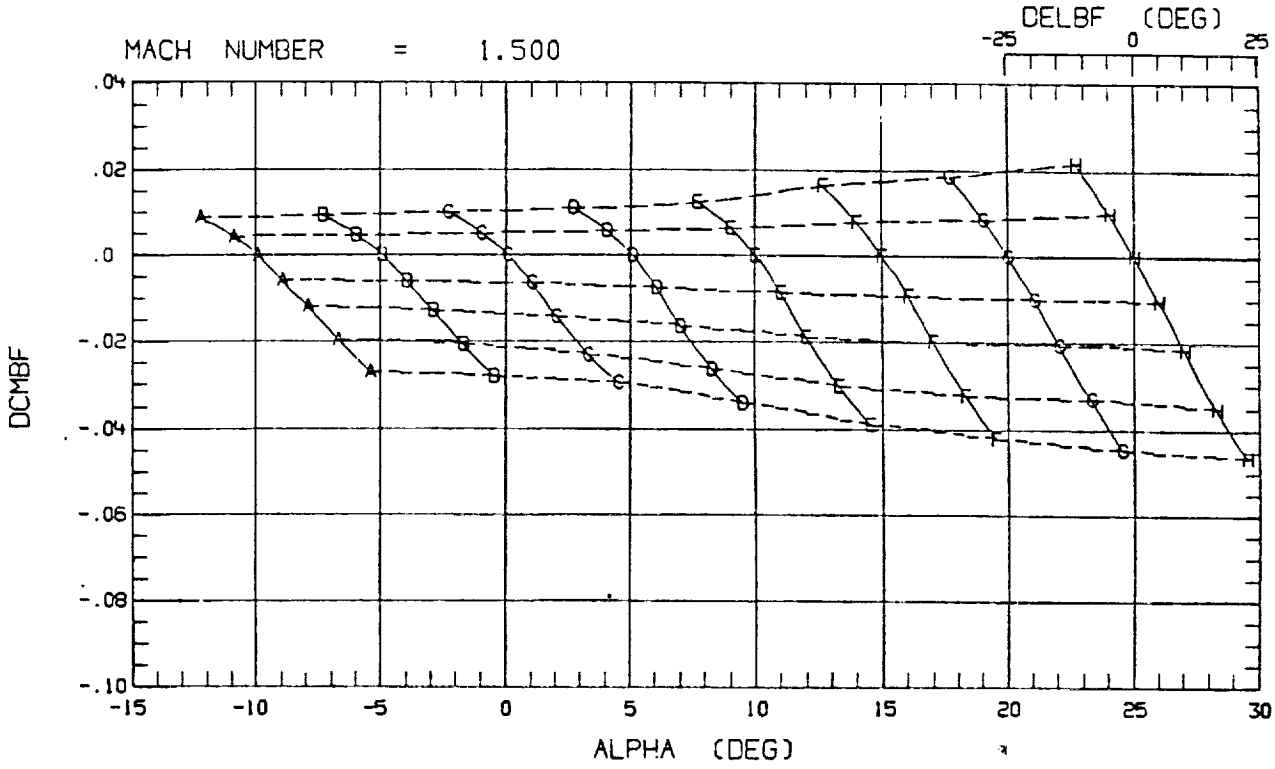
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00700	0.00941	0.01141	0.01327	0.01500	0.01643	0.01700	0.01800
-5.000	0.00389	0.00492	0.00568	0.00660	0.00763	0.00809	0.00824	0.00864
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00525	-0.00764	-0.00807	-0.00920	-0.01081	-0.01081	-0.01077	-0.01106
10.000	-0.01184	-0.01545	-0.01638	-0.01927	-0.02341	-0.02338	-0.02305	-0.02369
16.300	-0.02200	-0.02530	-0.02686	-0.03114	-0.03750	-0.03742	-0.03700	-0.03800
22.500	-0.03400	-0.03502	-0.03722	-0.04183	-0.04837	-0.04774	-0.04800	-0.04900

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-49
EFFECT OF BODY FLAP



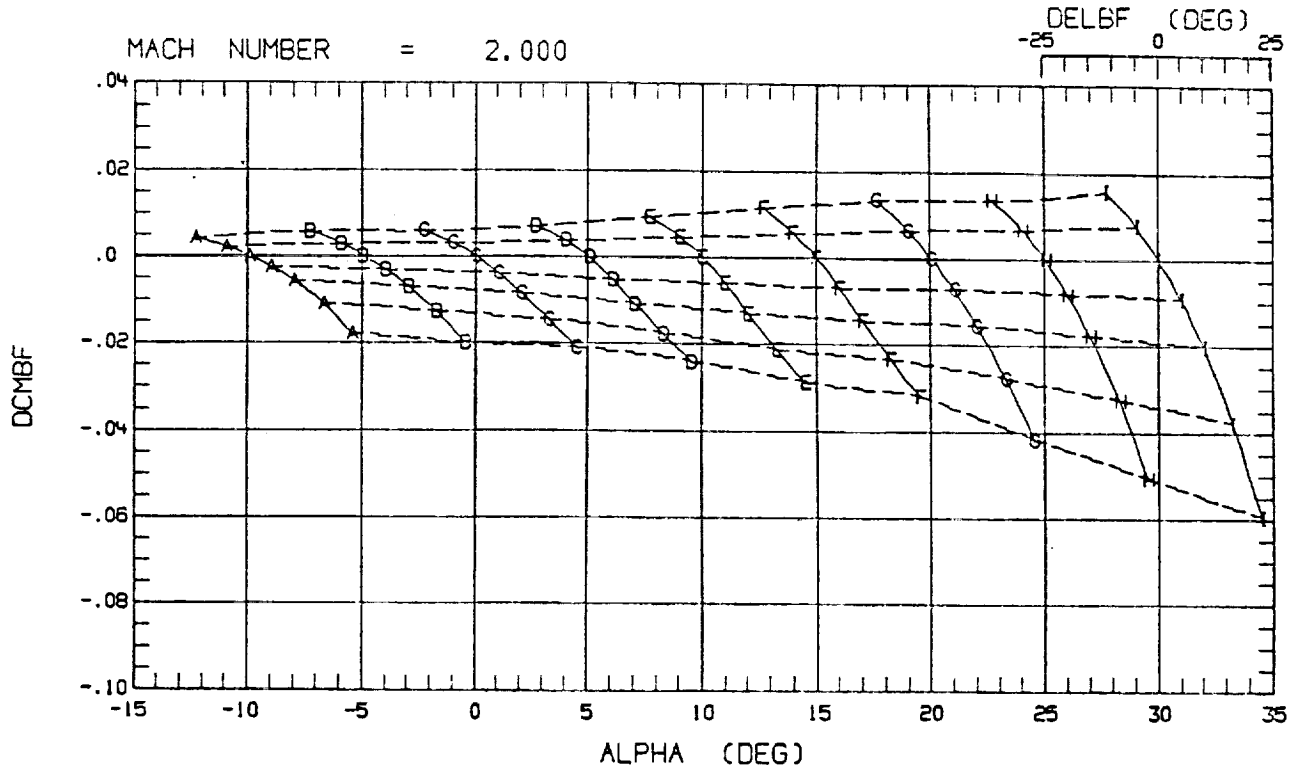
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00858	0.00914	0.00981	0.01073	0.01212	0.01627	0.01849	0.02159
-5.000	0.00423	0.00451	0.00489	0.00543	0.00617	0.00767	0.00846	0.00962
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00598	-0.00620	-0.00670	-0.00764	-0.00877	-0.00951	-0.00998	-0.01060
10.000	-0.01202	-0.01292	-0.01448	-0.01650	-0.01895	-0.02017	-0.02060	-0.02198
16.300	-0.01963	-0.02091	-0.02319	-0.02645	-0.03037	-0.03244	-0.03337	-0.03549
22.500	-0.02713	-0.02821	-0.02979	-0.03424	-0.03929	-0.04229	-0.04509	-0.04674

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.3-50
EFFECT OF BODY FLAP

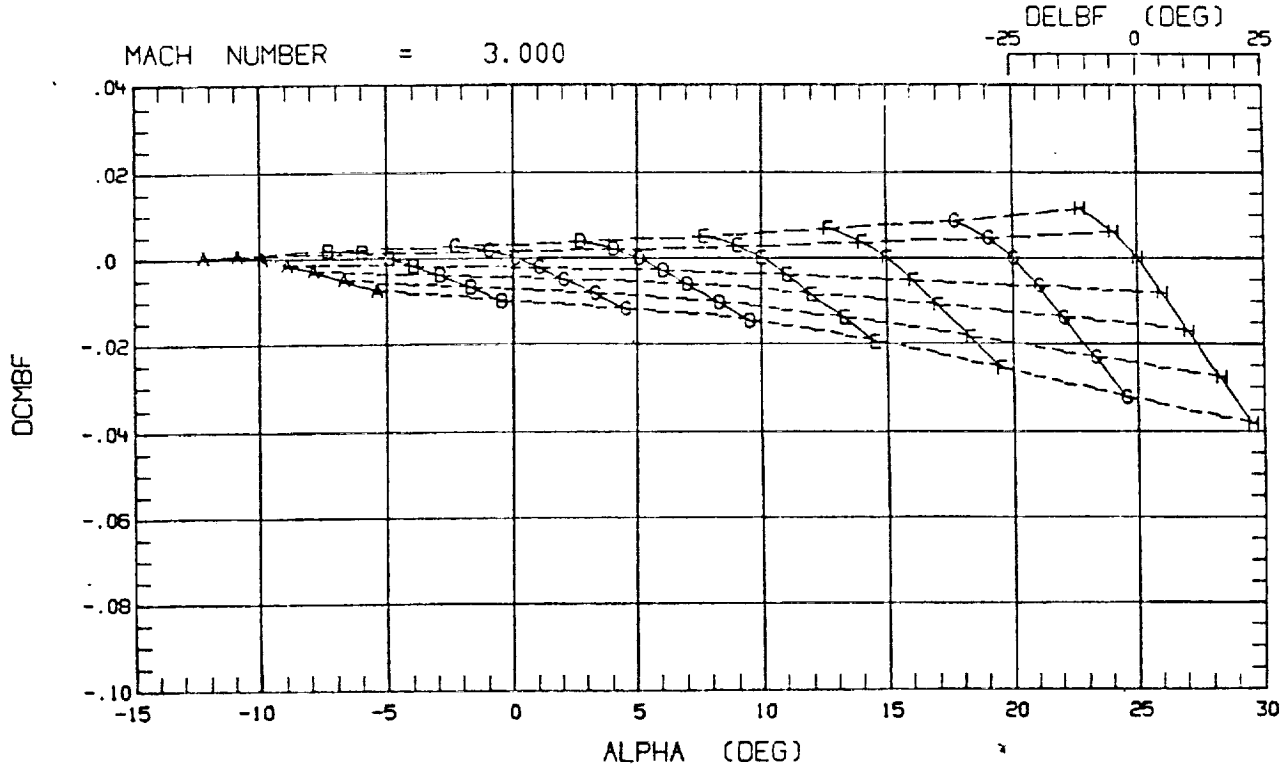


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.								
-11.700	0.00400	0.00570	0.00578	0.00705	0.00909	0.01125	0.01324	0.01334	0.01534
-5.000	0.00211	0.00281	0.00297	0.00360	0.00452	0.00540	0.00636	0.00676	0.00778
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00261	-0.00331	-0.00403	-0.00531	-0.00637	-0.00709	-0.00736	-0.00823	-0.00937
10.000	-0.00575	-0.00715	-0.00867	-0.01101	-0.01320	-0.01467	-0.01575	-0.01799	-0.02044
16.300	-0.01100	-0.01300	-0.01481	-0.01784	-0.02138	-0.02377	-0.02800	-0.03300	-0.03800
22.500	-0.01800	-0.02000	-0.02112	-0.02416	-0.02897	-0.03221	-0.04200	-0.05100	-0.06000

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.3-51
EFFECT OF BODY FLAP

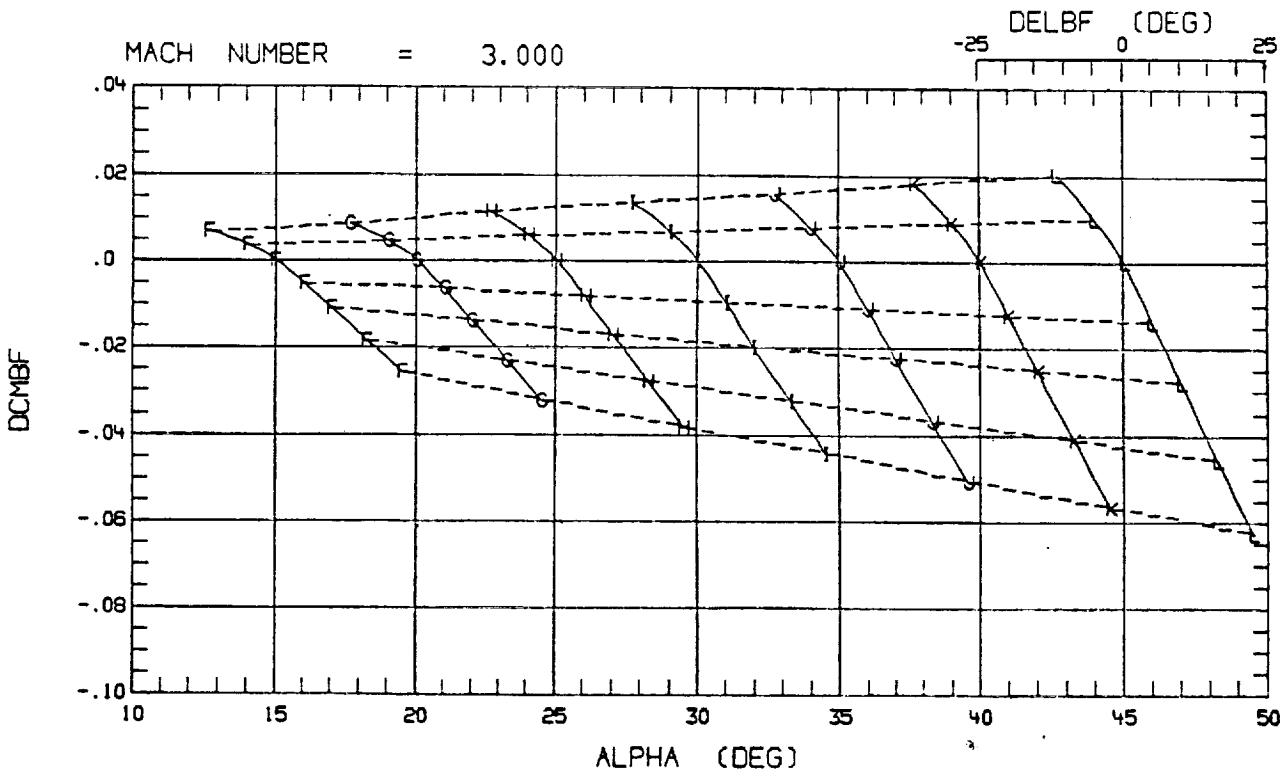


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00006	0.00180	0.00265	0.00375	0.00490	0.00669	0.00850	0.01137
-5.000	0.00041	0.00110	0.00148	0.00198	0.00263	0.00353	0.00447	0.00575
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00143	-0.00186	-0.00233	-0.00292	-0.00416	-0.00542	-0.00671	-0.00849
10.000	-0.00313	-0.00406	-0.00499	-0.00618	-0.00857	-0.01118	-0.01398	-0.01710
16.300	-0.00530	-0.00700	-0.00842	-0.01037	-0.01416	-0.01849	-0.02324	-0.02795
22.500	-0.00750	-0.01000	-0.01189	-0.01459	-0.01971	-0.02575	-0.03248	-0.03865

ENGINEER WMZ
DATE 9-10-78

FIGURE 4.1.1.3-52
EFFECT OF BODY FLAP



CONFIGURATION

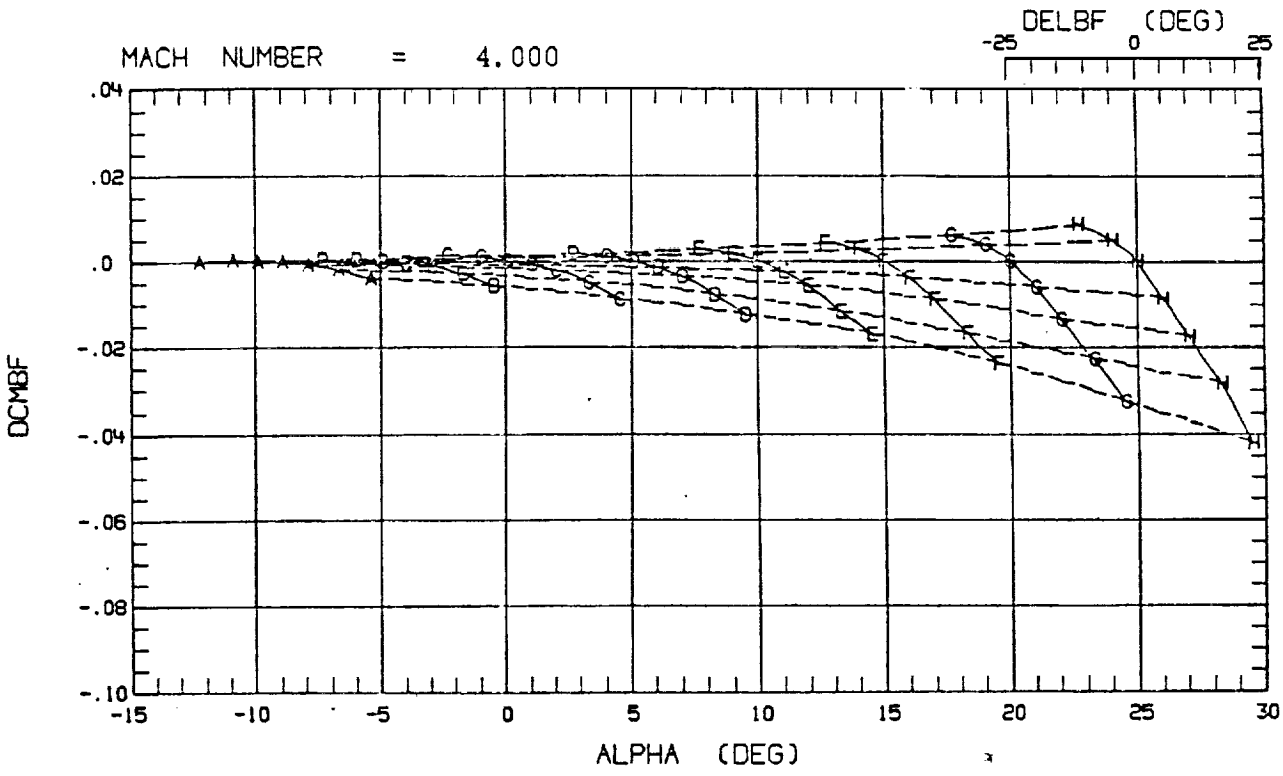
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.						
-11.700	0.00669	0.00850	0.01137	0.01350	0.01550	0.01800	0.02000
-5.000	0.00353	0.00447	0.00575	0.00677	0.00775	0.00890	0.00988
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00542	-0.00671	-0.00849	-0.00981	-0.01131	-0.01260	-0.01390
10.000	-0.01118	-0.01398	-0.01710	-0.02000	-0.02271	-0.02551	-0.02830
16.300	-0.01849	-0.02324	-0.02795	-0.03250	-0.03700	-0.04150	-0.04600
22.500	-0.02575	-0.03248	-0.03865	-0.04450	-0.05100	-0.05700	-0.06300

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.3-53
EFFECT OF BODY FLAP

SD 72-SH-0060 IM



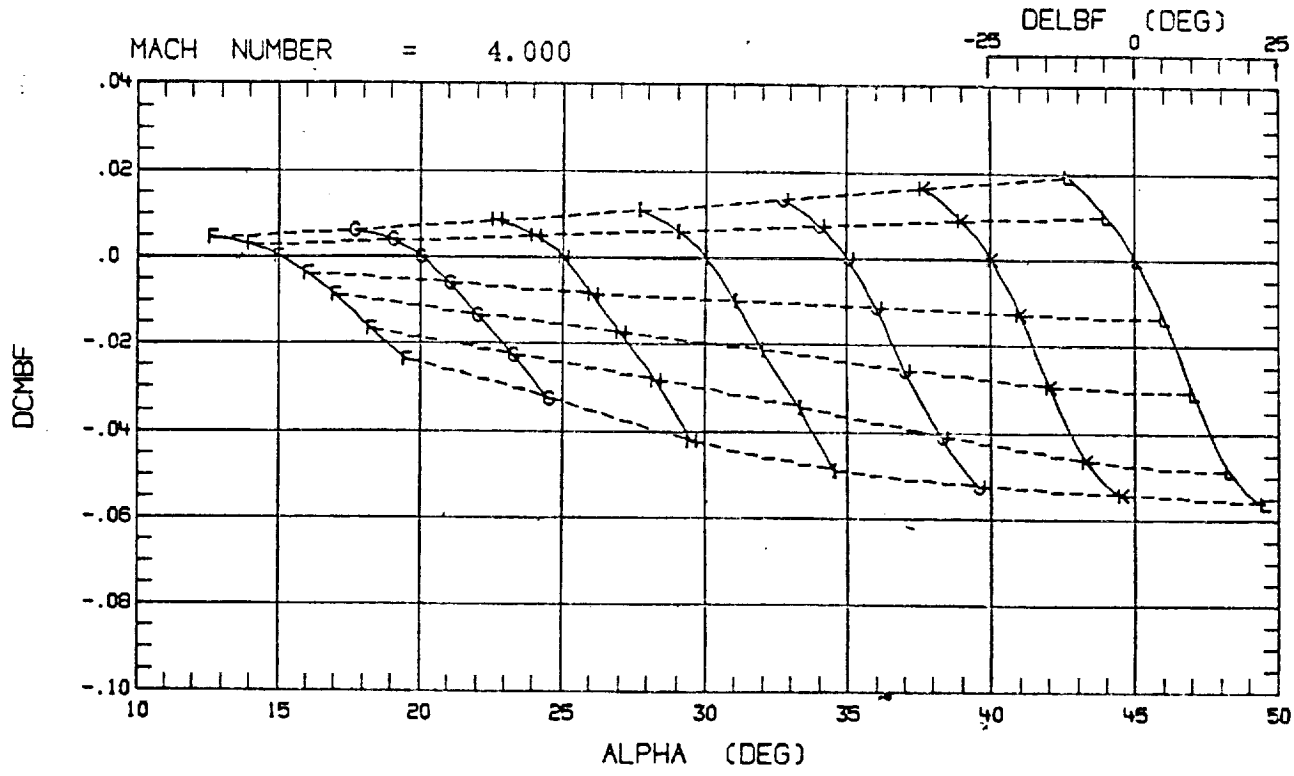
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00030	0.00115	0.00150	0.00255	0.00420	0.00603	0.00830
-5.000	0.00014	0.00032	0.00074	0.00106	0.00169	0.00261	0.00365	0.00480
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00028	-0.00052	-0.00100	-0.00156	-0.00249	-0.00396	-0.00619	-0.00875
10.000	-0.00069	-0.00123	-0.00225	-0.00366	-0.00584	-0.00915	-0.01349	-0.01763
16.300	-0.00195	-0.00305	-0.00495	-0.00781	-0.01175	-0.01702	-0.02304	-0.02870
22.500	-0.00420	-0.00590	-0.00890	-0.01250	-0.01720	-0.02400	-0.03280	-0.04260

ENGINEER DSD
DATE 10-5-73

FIGURE 4.1.1.3- 54
EFFECT OF BODY FLAP



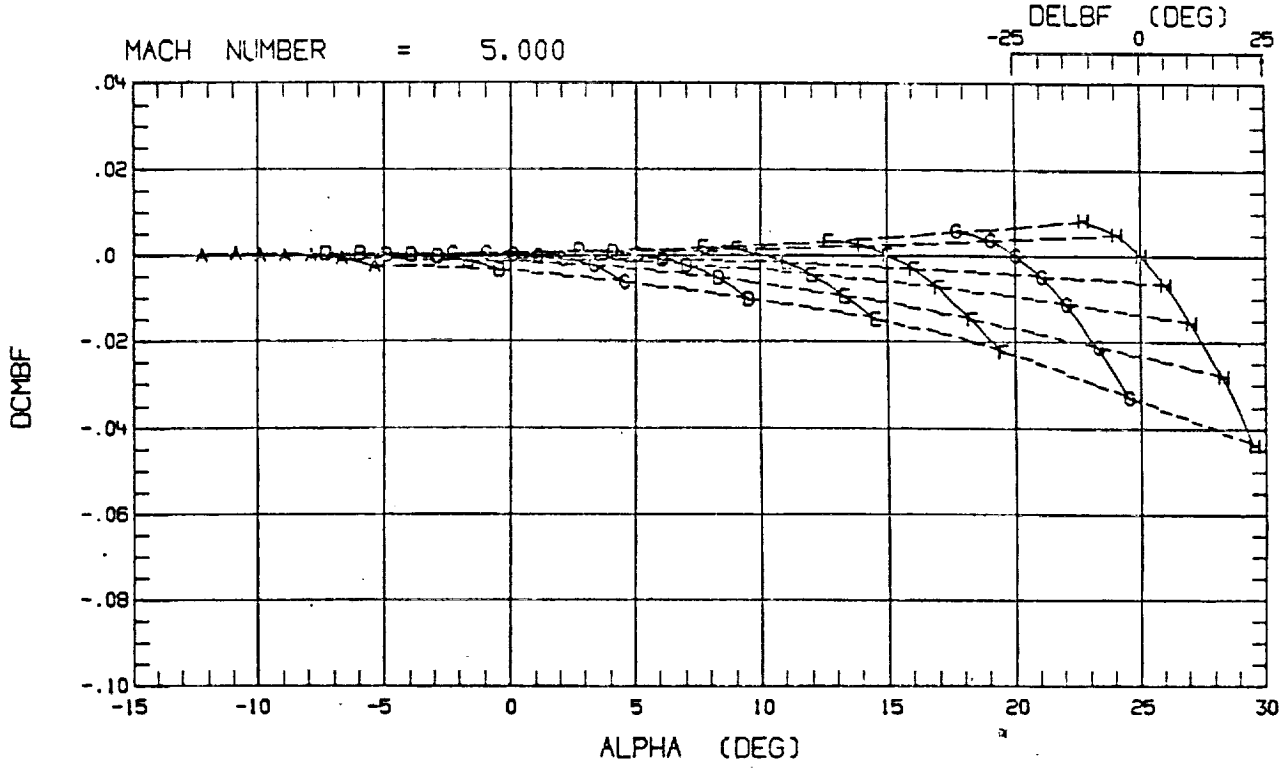
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.						
-11.700	0.00420	0.00603	0.00830	0.01075	0.01335	0.01606	0.01886
-5.000	0.00261	0.00365	0.00480	0.00604	0.00737	0.00866	0.00973
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00396	-0.00619	-0.00875	-0.01000	-0.01163	-0.01309	-0.01380
10.000	-0.00915	-0.01349	-0.01763	-0.02161	-0.02599	-0.02961	-0.03100
16.300	-0.01702	-0.02304	-0.02870	-0.03470	-0.04130	-0.04679	-0.04900
22.500	-0.02400	-0.03280	-0.04260	-0.04930	-0.05260	-0.05460	-0.05625

ENGINEER DD
DATE 10-5-78

FIGURE 4.1.1.3-55
EFFECT OF BODY FLAP



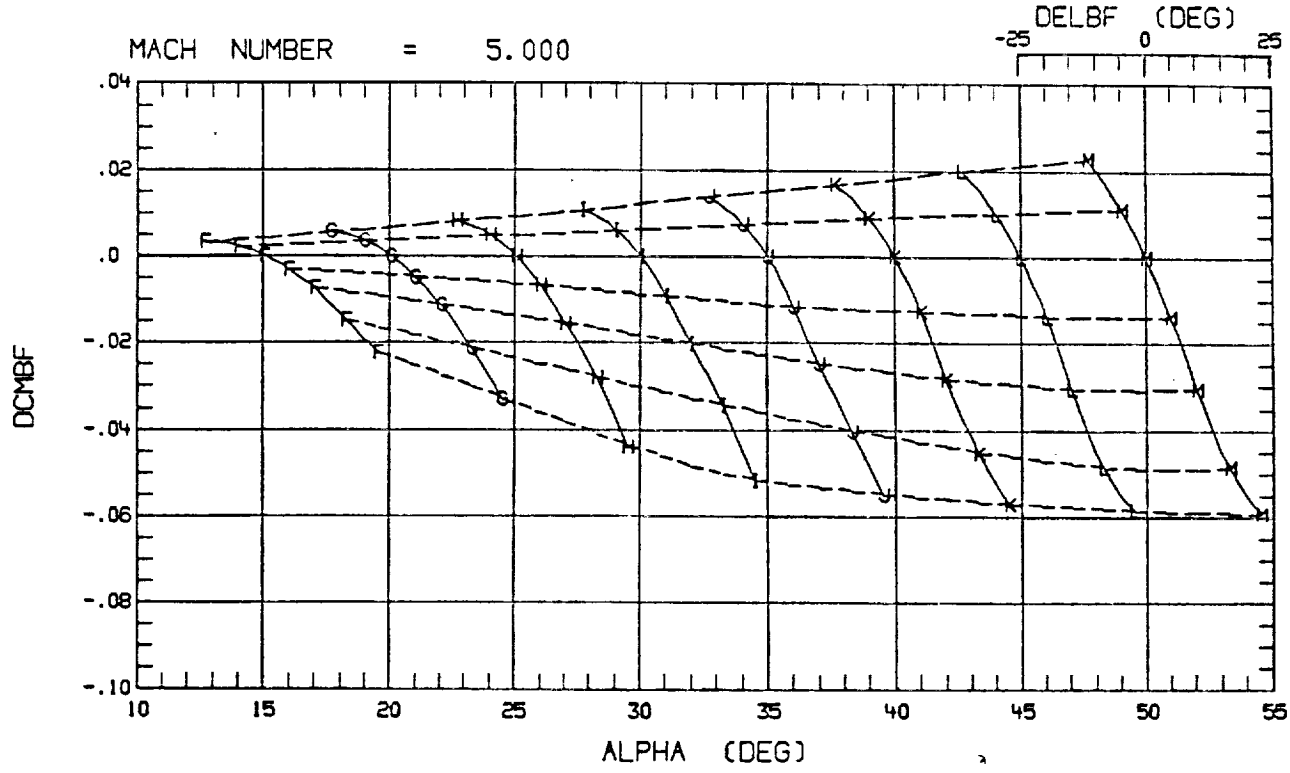
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00010	0.00020	0.00080	0.00160	0.00314	0.00538	0.00791
-5.000	0.00007	0.00014	0.00027	0.00067	0.00123	0.00214	0.00333	0.00465
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00013	-0.00022	-0.00045	-0.00105	-0.00194	-0.00330	-0.00497	-0.00702
10.000	-0.00030	-0.00052	-0.00107	-0.00249	-0.00463	-0.00777	-0.01148	-0.01584
16.300	-0.00090	-0.00140	-0.00275	-0.00560	-0.00967	-0.01520	-0.02150	-0.02830
22.500	-0.00270	-0.00380	-0.00660	-0.01030	-0.01510	-0.02250	-0.03320	-0.04420

ENGINEER DGD
DATE 10-5-78

FIGURE 4.1.1.3-56
EFFECT OF BODY FLAP



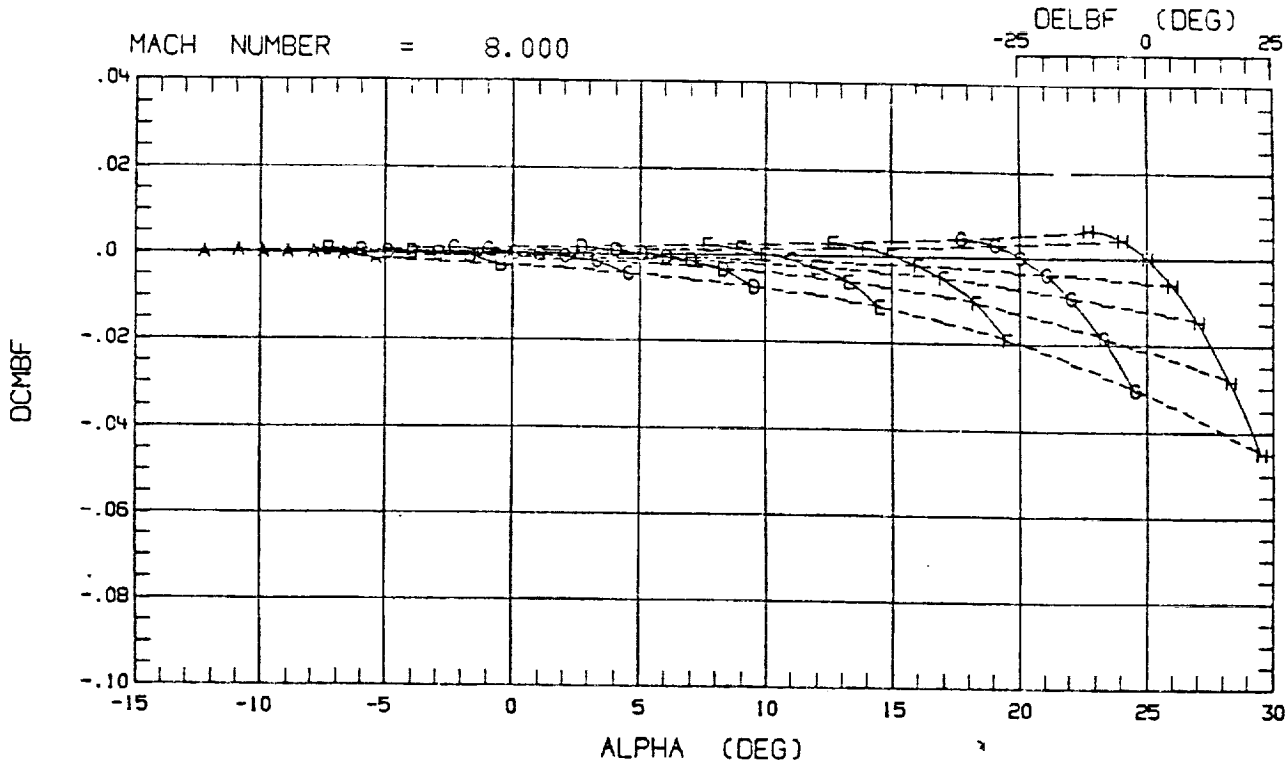
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00314	0.00538	0.00791	0.01062	0.01362	0.01662	0.01962	0.02262
-5.000	0.00214	0.00333	0.00465	0.00600	0.00740	0.00874	0.00996	0.01094
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00330	-0.00497	-0.00702	-0.00955	-0.01192	-0.01296	-0.01385	-0.01405
10.000	-0.00777	-0.01148	-0.01584	-0.02050	-0.02507	-0.02852	-0.03069	-0.03062
16.300	-0.01520	-0.02150	-0.02830	-0.03470	-0.04050	-0.04550	-0.04875	-0.04880
22.500	-0.02250	-0.03320	-0.04420	-0.05220	-0.05520	-0.05730	-0.05880	-0.05950

ENGINEER DGD
DATE 10-5-78

FIGURE 4.1.1.3- 57
EFFECT OF BODY FLAP

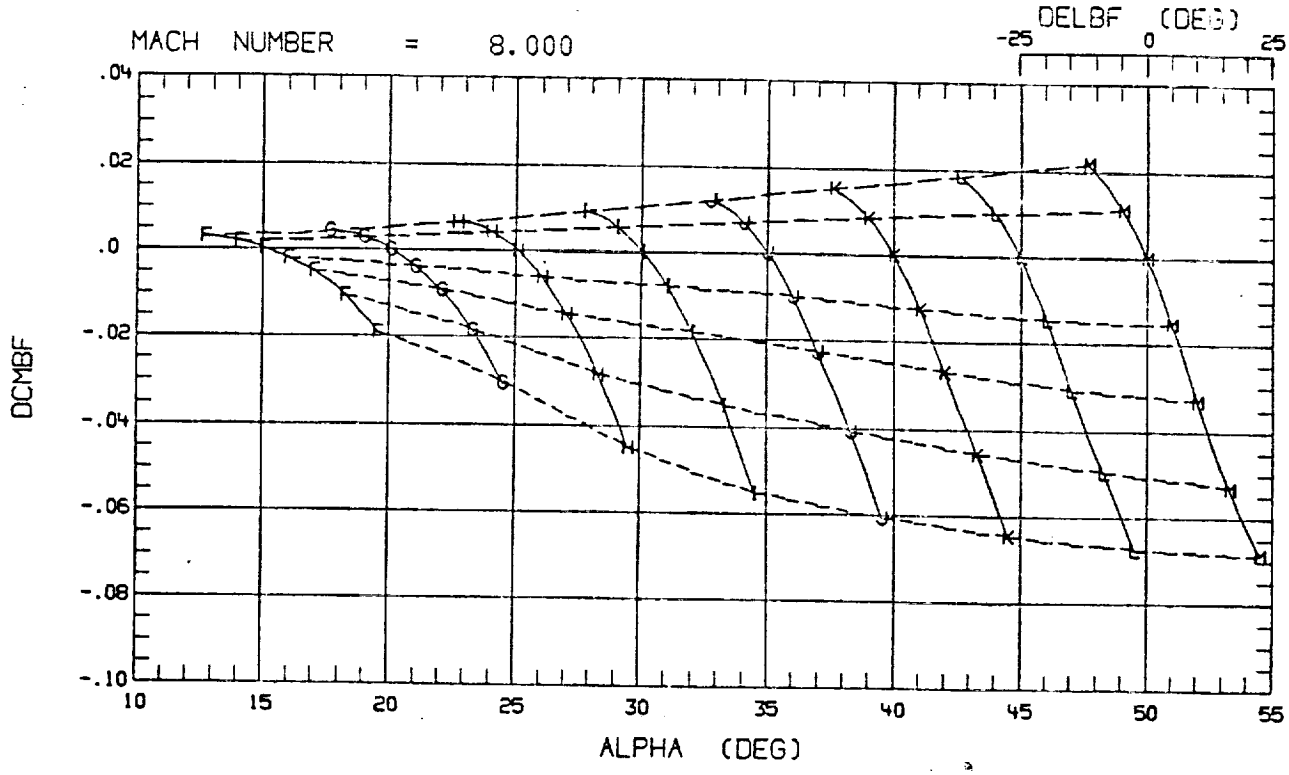


CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00044	0.00088	0.00137	0.00198	0.00280	0.00398	0.00639
-5.000	0.00004	0.00022	0.00043	0.00071	0.00110	0.00170	0.00267	0.00417
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00007	-0.00024	-0.00048	-0.00083	-0.00136	-0.00229	-0.00403	-0.00632
10.000	-0.00016	-0.00049	-0.00099	-0.00175	-0.00298	-0.00520	-0.00948	-0.01479
16.300	-0.00050	-0.00100	-0.00200	-0.00360	-0.00620	-0.01080	-0.01875	-0.02850
22.500	-0.00170	-0.00300	-0.00490	-0.00760	-0.01200	-0.01950	-0.03070	-0.04530

ENGINEER wmz
DATE 9-24-78

FIGURE 4.1.1.3-58
EFFECT OF BODY FLAP



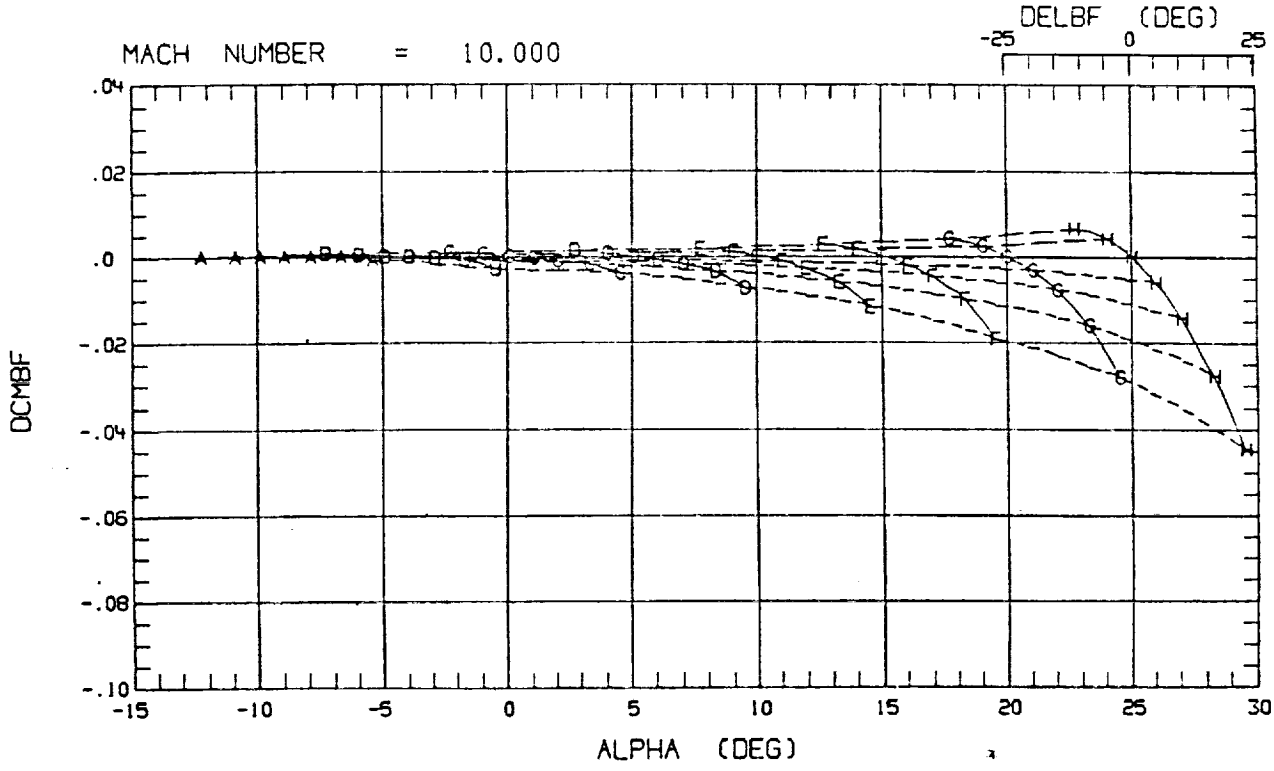
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00280	0.00398	0.00639	0.00910	0.01200	0.01510	0.01830	0.02160
-5.000	0.00170	0.00267	0.00417	0.00556	0.00691	0.00829	0.00962	0.01093
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00229	-0.00403	-0.00632	-0.00813	-0.01009	-0.01274	-0.01483	-0.01538
10.000	-0.00520	-0.00948	-0.01479	-0.01877	-0.02279	-0.02724	-0.03089	-0.03327
16.300	-0.01080	-0.01875	-0.02850	-0.03550	-0.04100	-0.04600	-0.05000	-0.05330
22.500	-0.01950	-0.03070	-0.04530	-0.05550	-0.06100	-0.06500	-0.06760	-0.06870

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-59
EFFECT OF BODY FLAP



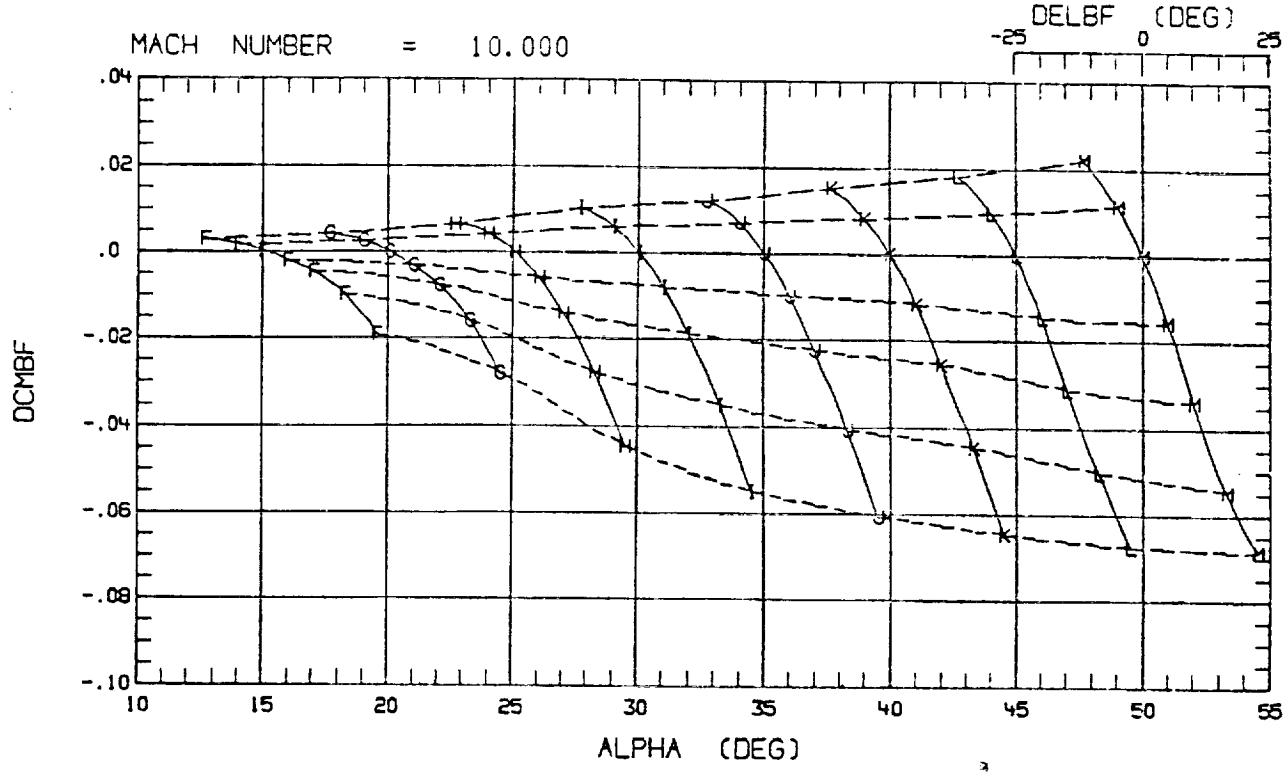
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00054	0.00098	0.00138	0.00178	0.00269	0.00408	0.00641
-5.000	0.00001	0.00024	0.00047	0.00072	0.00103	0.00162	0.00251	0.00414
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00003	-0.00024	-0.00051	-0.00084	-0.00132	-0.00213	-0.00343	-0.00616
10.000	-0.00006	-0.00049	-0.00105	-0.00179	-0.00293	-0.00479	-0.00786	-0.01438
16.300	-0.00020	-0.00086	-0.00200	-0.00366	-0.00617	-0.01015	-0.01610	-0.02800
22.500	-0.00070	-0.00292	-0.00390	-0.00746	-0.01180	-0.01922	-0.02820	-0.04510

ENGINEER WMZ
DATE 9-26-78

FIGURE 4.1.1.3-60
EFFECT OF BODY FLAP



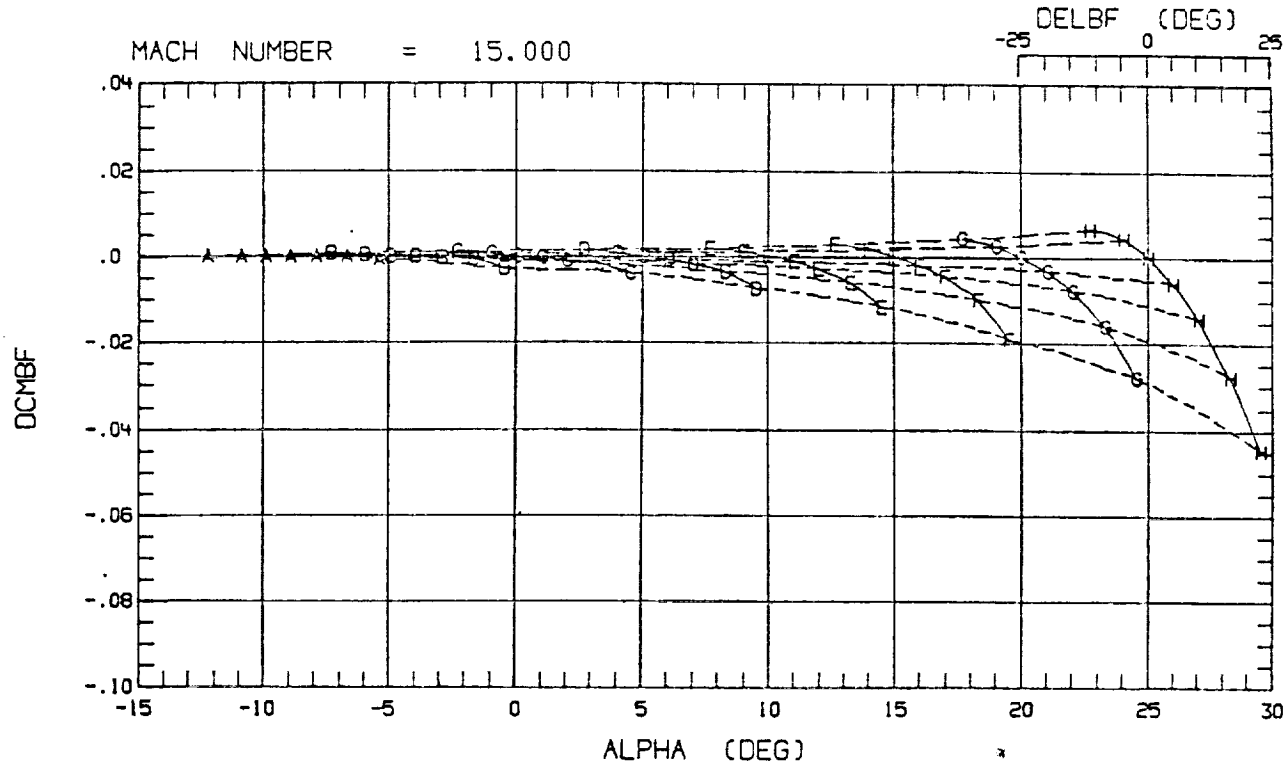
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00269	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00162	0.00251	0.00414	0.00587	0.00692	0.00818	0.00958	0.01111
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00213	-0.00343	-0.00616	-0.00825	-0.01004	-0.01178	-0.01485	-0.01567
10.000	-0.00479	-0.00786	-0.01438	-0.01886	-0.02268	-0.02590	-0.03135	-0.03434
16.300	-0.01015	-0.01610	-0.02800	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.01922	-0.02820	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER WMZ
DATE 9-26-78

FIGURE 4.1.1.3-61
EFFECT OF BODY FLAP

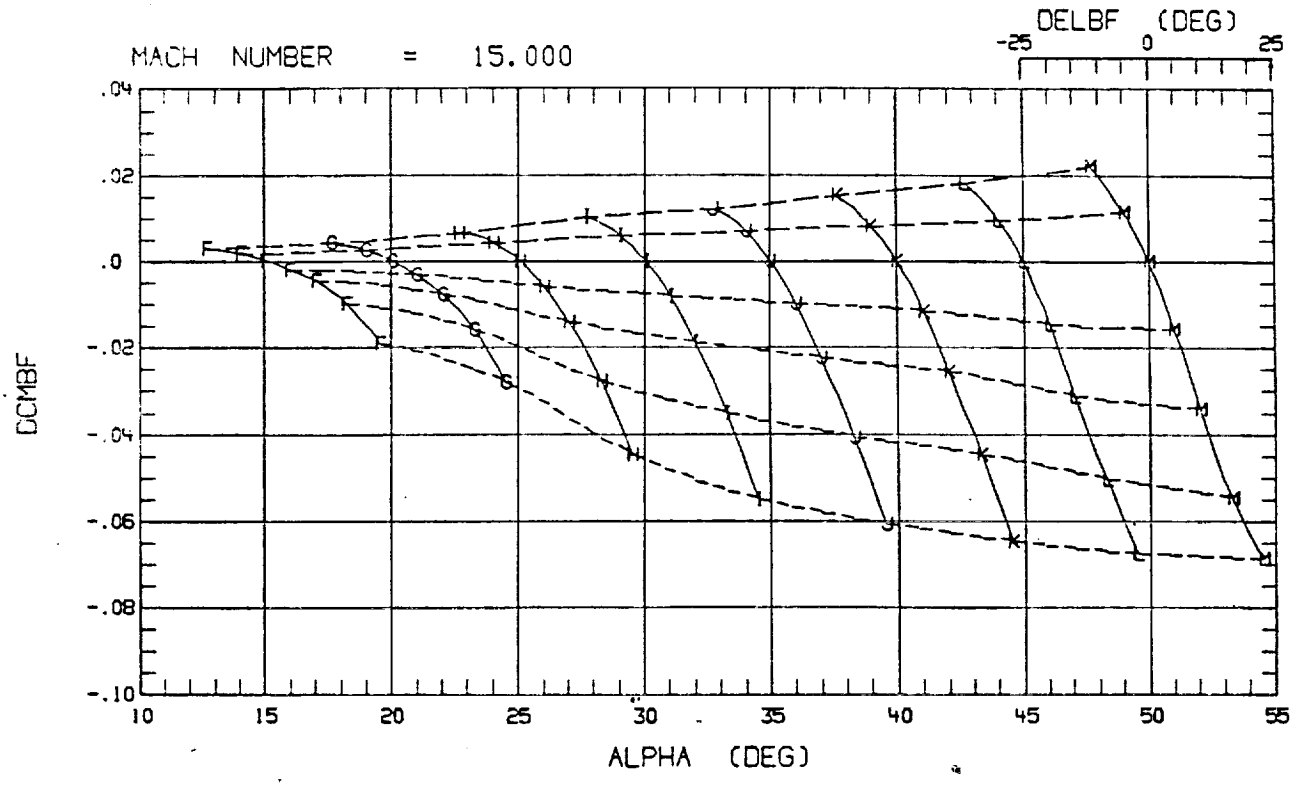


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00054	0.00098	0.00138	0.00178	0.00269	0.00408	0.00641
-5.000	0.00001	0.00024	0.00047	0.00072	0.00103	0.00162	0.00251	0.00414
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00003	-0.00024	-0.00051	-0.00084	-0.00132	-0.00213	-0.00343	-0.00616
10.000	-0.00006	-0.00049	-0.00105	-0.00179	-0.00293	-0.00479	-0.00786	-0.01438
16.300	-0.00020	-0.00086	-0.00200	-0.00366	-0.00617	-0.01015	-0.01610	-0.02800
22.500	-0.00070	-0.00292	-0.00390	-0.00746	-0.01180	-0.01922	-0.02820	-0.04510

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.3-62
EFFECT OF BODY FLAP



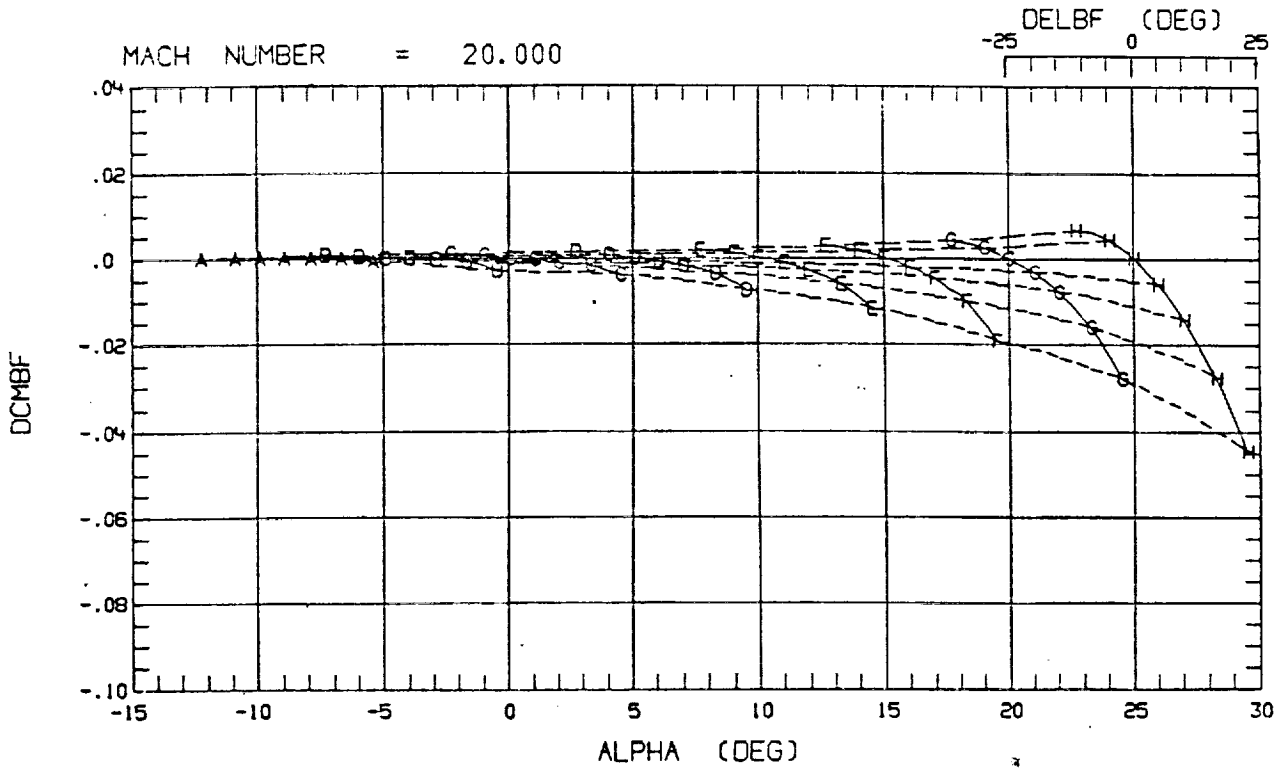
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00269	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00162	0.00251	0.00414	0.00587	0.00692	0.00818	0.00958	0.01111
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00213	-0.00343	-0.00616	-0.00825	-0.01004	-0.01178	-0.01485	-0.01567
10.000	-0.00479	-0.00786	-0.01438	-0.01886	-0.02268	-0.02590	-0.03135	-0.03434
16.300	-0.01015	-0.01610	-0.02800	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.01922	-0.02820	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-63
EFFECT OF BODY FLAP

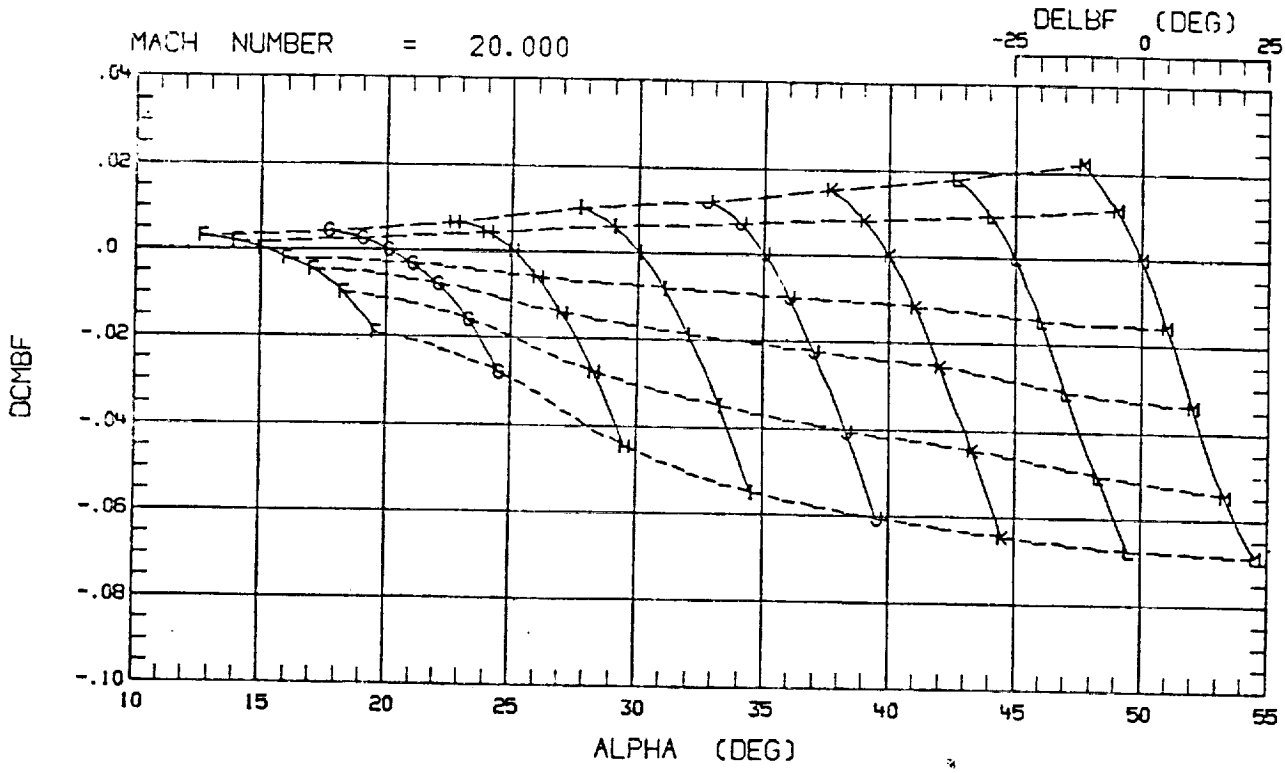


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00054	0.00098	0.00138	0.00178	0.00269	0.00408	0.00641
-5.000	0.00001	0.00024	0.00047	0.00072	0.00103	0.00162	0.00251	0.00414
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00003	-0.00024	-0.00051	-0.00084	-0.00132	-0.00213	-0.00343	-0.00616
10.000	-0.00006	-0.00049	-0.00105	-0.00179	-0.00293	-0.00479	-0.00786	-0.01438
16.300	-0.00020	-0.00086	-0.00200	-0.00366	-0.00617	-0.01015	-0.01610	-0.02800
22.500	-0.00070	-0.00292	-0.00390	-0.00746	-0.01180	-0.01922	-0.02820	-0.04510

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-64
EFFECT OF BODY FLAP



CONFIGURATION

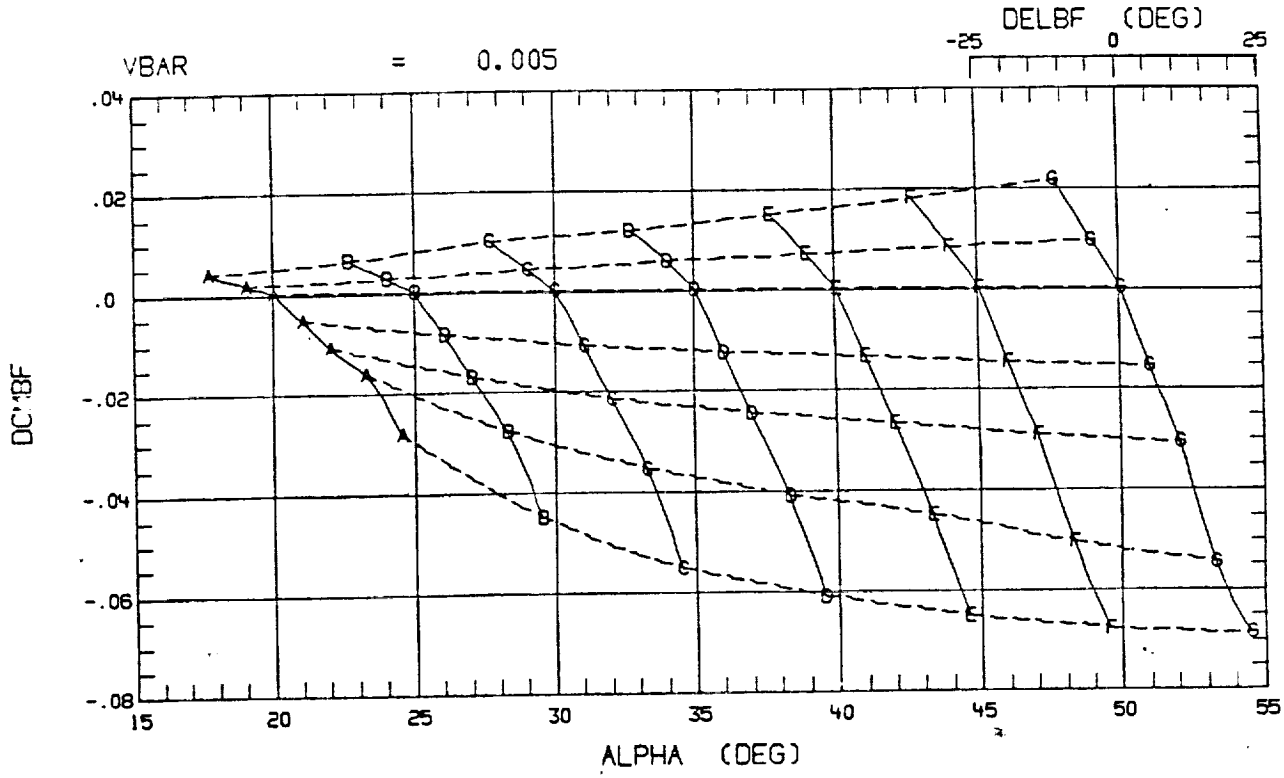
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00269	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00162	0.00251	0.00414	0.00587	0.00692	0.00818	0.00958	0.01111
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00213	-0.00343	-0.00616	-0.00825	-0.01004	-0.01178	-0.01485	-0.01567
10.000	-0.00479	-0.00786	-0.01438	-0.01886	-0.02268	-0.02590	-0.03135	-0.03434
16.300	-0.01015	-0.01610	-0.02800	-0.03550	-0.04090	-0.04500	-0.05060	-0.05460
22.500	-0.01922	-0.02820	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER WMZ
DATE 9-26-78

FIGURE 4.1.1.3-65
EFFECT OF BODY FLAP



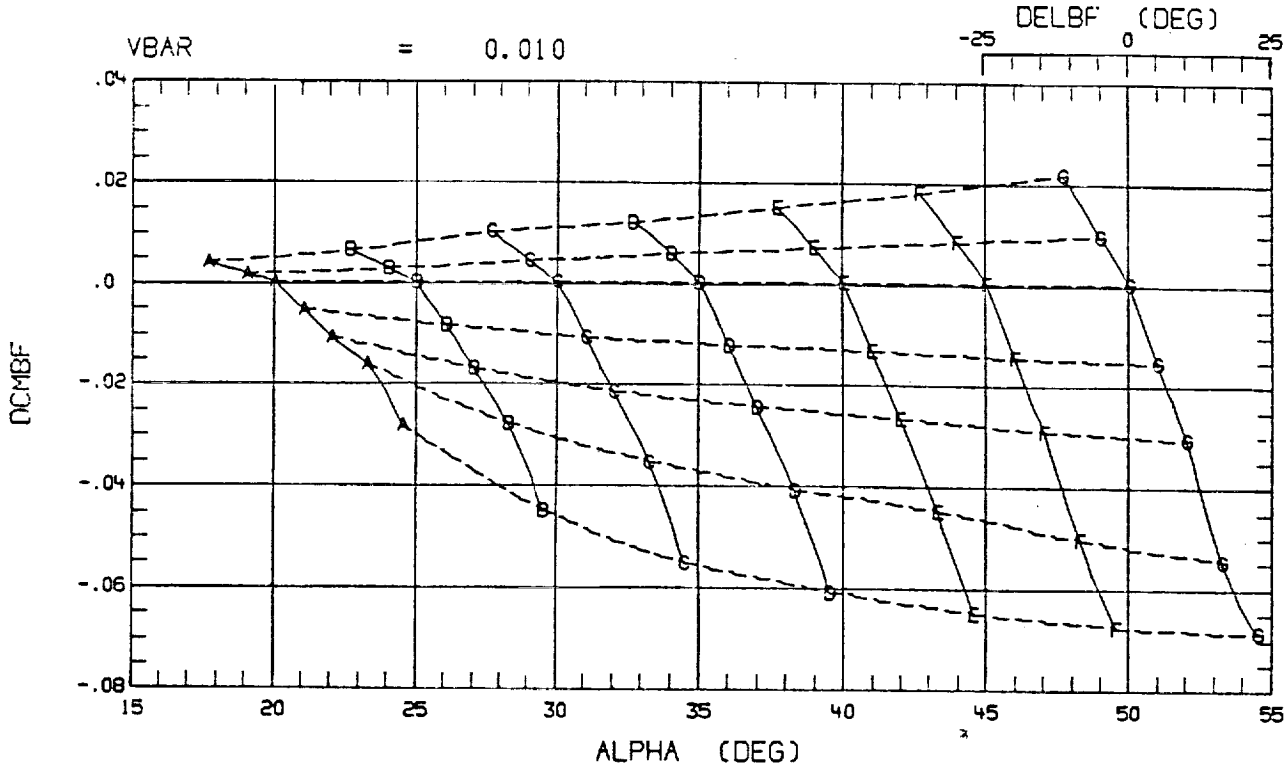
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00174	0.00274	0.00429	0.00583	0.00703	0.00839	0.00968
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00548	-0.00848	-0.01083	-0.01226	-0.01342	-0.01460	-0.01539
10.000	-0.01096	-0.01695	-0.02164	-0.02453	-0.02685	-0.02921	-0.03077
16.300	-0.01610	-0.02800	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.02820	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER NASA
DATE

FIGURE 4.1.1.3-66
EFFECT OF BODY FLAP



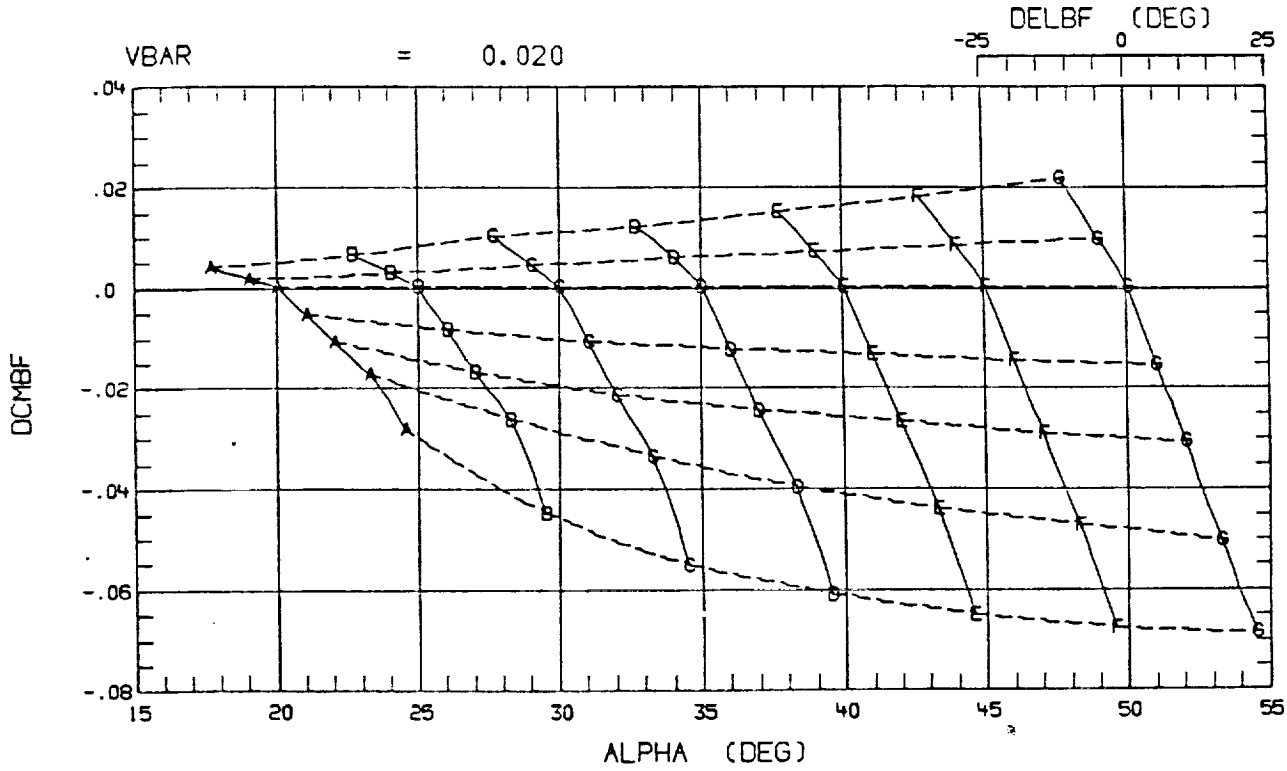
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00174	0.00274	0.00429	0.00583	0.00703	0.00839	0.00968
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00548	-0.00848	-0.01083	-0.01226	-0.01342	-0.01460	-0.01539
10.000	-0.01096	-0.01695	-0.02164	-0.02453	-0.02685	-0.02921	-0.03077
16.300	-0.01610	-0.02800	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.02820	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER NASA
DATE

FIGURE 4.1.1.3-67
EFFECT OF BODY FLAP

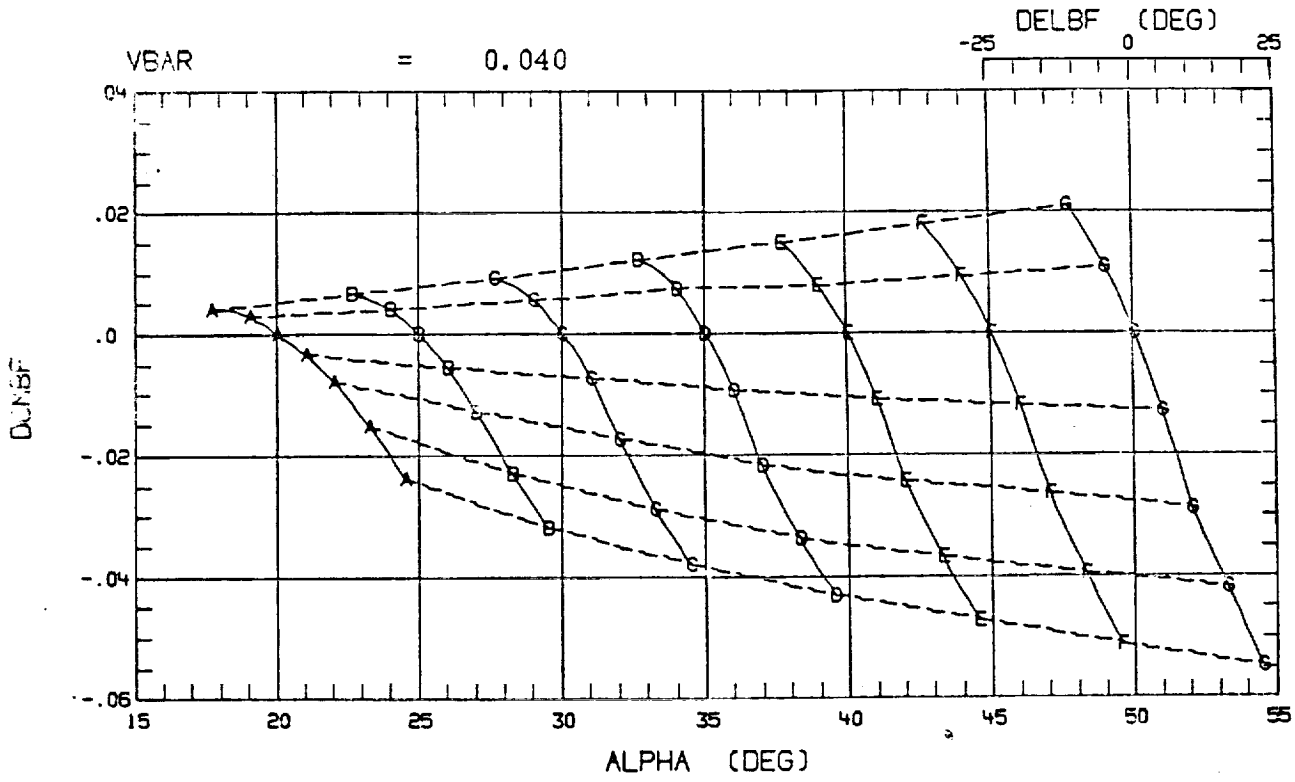


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00174	0.00274	0.00429	0.00583	0.00703	0.00839	0.00968
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00548	-0.00848	-0.01083	-0.01226	-0.01342	-0.01460	-0.01539
10.000	-0.01096	-0.01695	-0.02164	-0.02453	-0.02685	-0.02921	-0.03077
16.300	-0.01740	-0.02640	-0.03370	-0.03980	-0.04400	-0.04740	-0.05050
22.500	-0.02820	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER NASA
DATE

FIGURE 4.1.1.3-68
EFFECT OF BODY FLAP

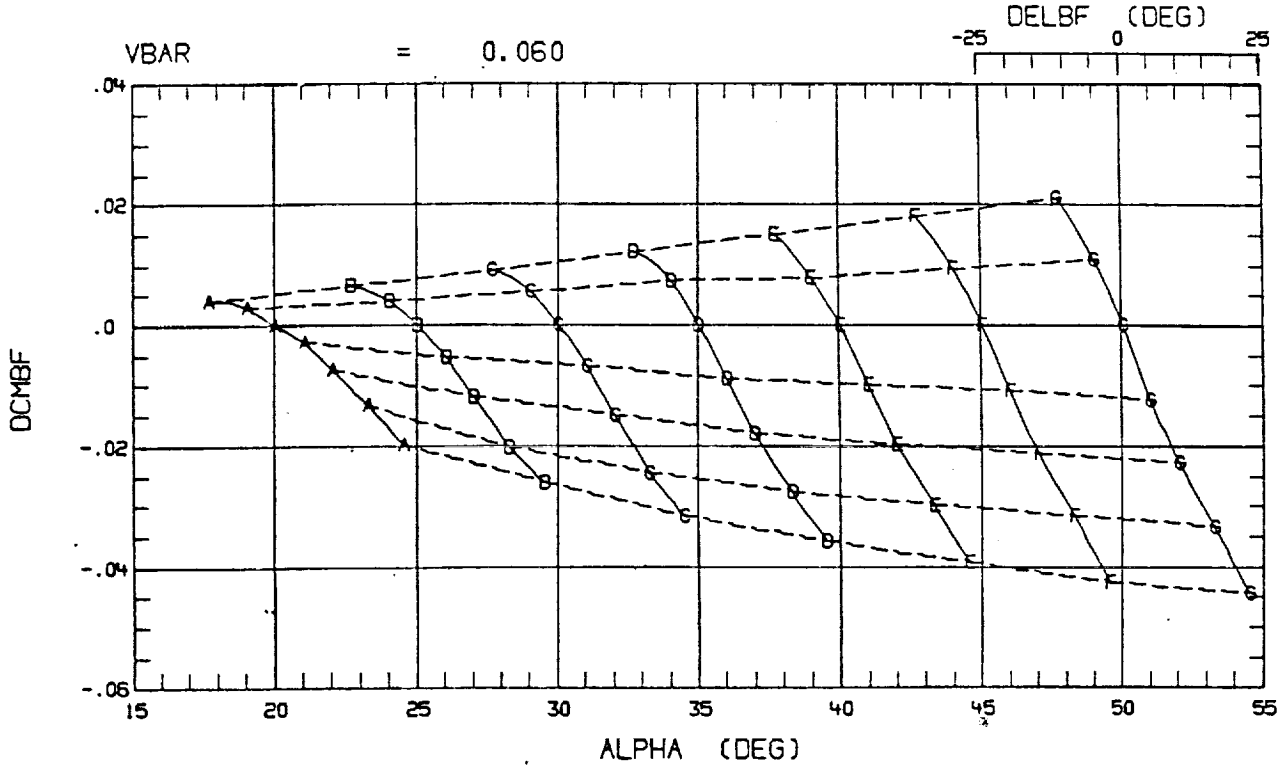


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00400	0.00650	0.00900	0.01200	0.01500	0.01780	0.02100
-5.000	0.00290	0.00390	0.00540	0.00730	0.00780	0.00930	0.01070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00350	-0.00575	-0.00750	-0.00950	-0.01100	-0.01200	-0.01300
10.000	-0.00800	-0.01300	-0.01750	-0.02200	-0.02450	-0.02650	-0.02900
16.300	-0.01530	-0.02320	-0.02910	-0.03390	-0.03700	-0.03960	-0.04200
22.500	-0.02400	-0.03200	-0.03820	-0.04320	-0.04730	-0.05140	-0.05500

ENGINEER NASA
DATE

FIGURE 4.1.1.3-69
EFFECT OF BODY FLAP

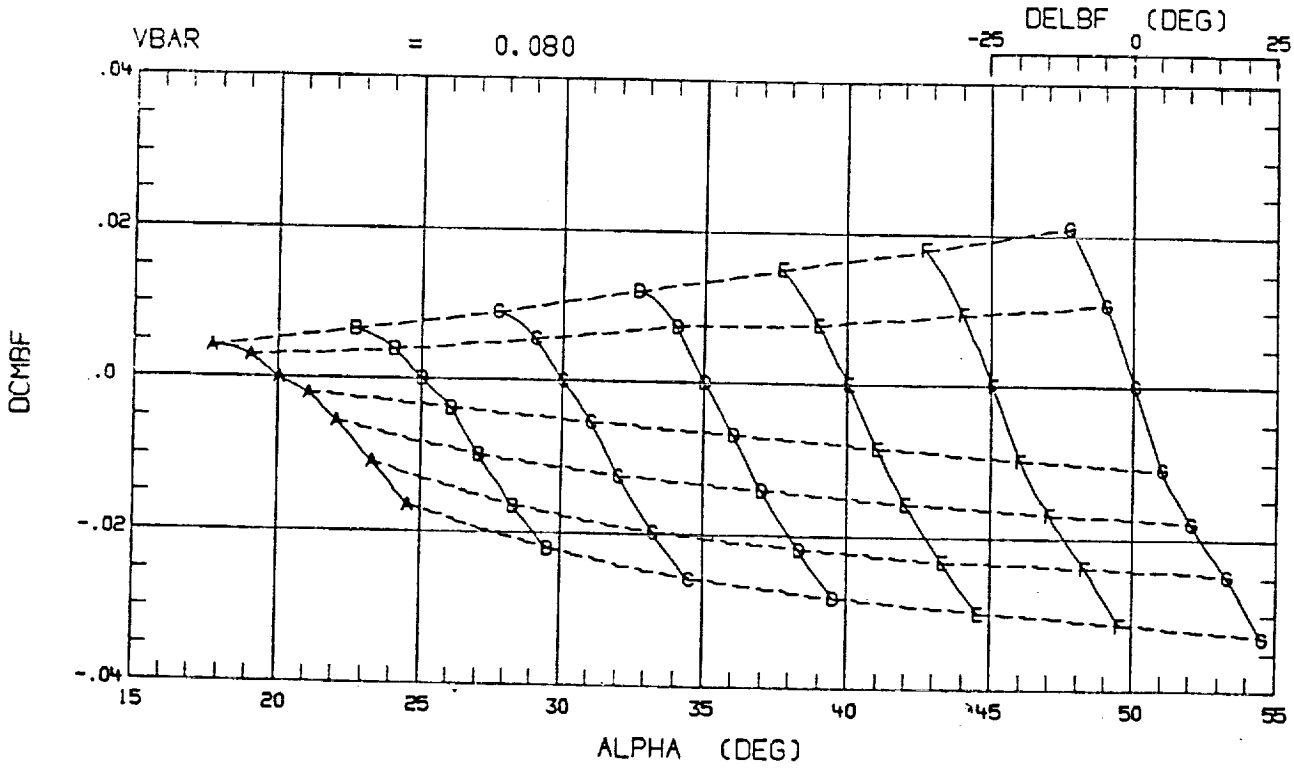


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00400	0.00650	0.00900	0.01200	0.01500	0.01780	0.02100
-5.000	0.00290	0.00390	0.00540	0.00730	0.00780	0.00930	0.01070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00290	-0.00550	-0.00700	-0.00900	-0.01000	-0.01100	-0.01250
10.000	-0.00750	-0.01200	-0.01500	-0.01800	-0.02000	-0.02150	-0.02300
16.300	-0.01340	-0.02030	-0.02460	-0.02780	-0.03000	-0.03180	-0.03350
22.500	-0.02000	-0.02620	-0.03180	-0.03600	-0.03950	-0.04270	-0.04460

ENGINEER NASA
DATE

FIGURE 4.1.1.3- 70
EFFECT OF BODY FLAP



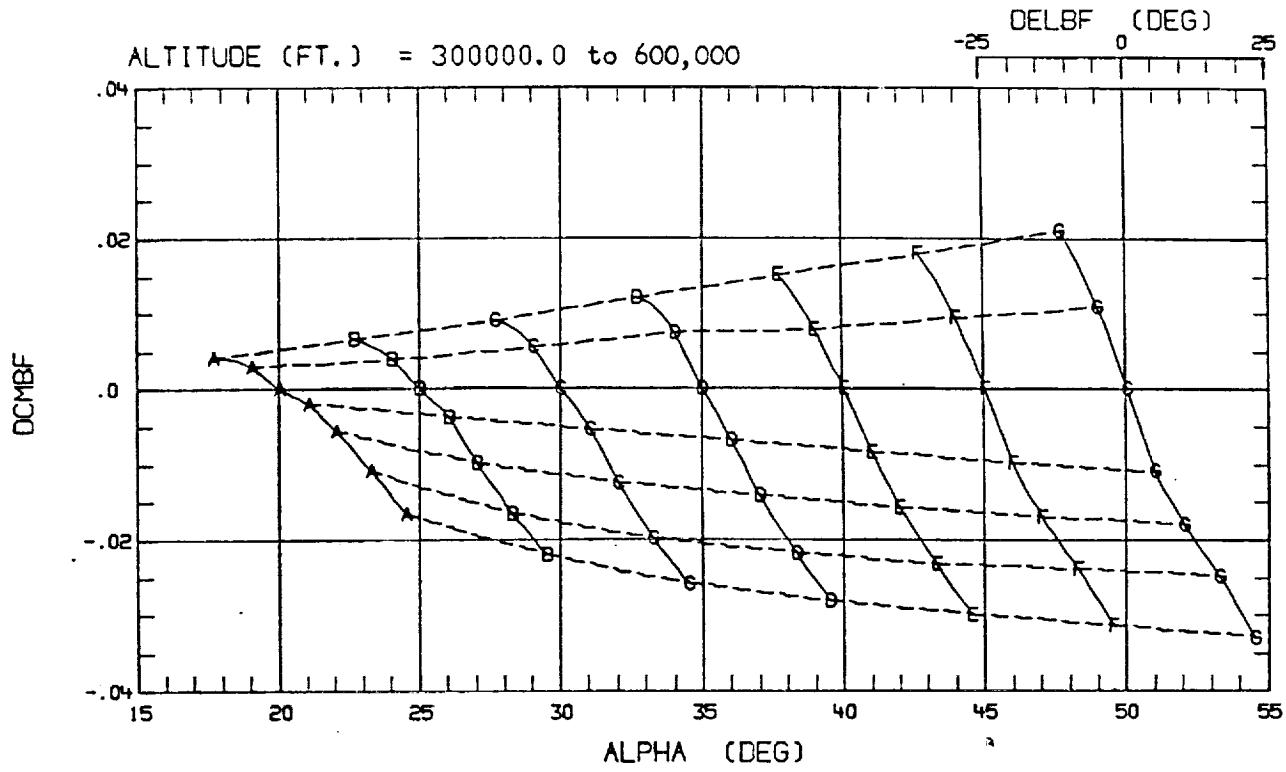
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00400	0.00650	0.00900	0.01200	0.01500	0.01780	0.02100
-5.000	0.00290	0.00390	0.00540	0.00730	0.00780	0.00930	0.01070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00200	-0.00380	-0.00550	-0.00700	-0.00850	-0.01000	-0.01100
10.000	-0.00570	-0.01000	-0.01250	-0.01430	-0.01580	-0.01700	-0.01800
16.300	-0.01100	-0.01660	-0.02000	-0.02190	-0.02330	-0.02400	-0.02500
22.500	-0.01670	-0.02220	-0.02600	-0.02830	-0.03000	-0.03150	-0.03300

ENGINEER NASA
DATE

FIGURE 4.1.1.3-71
EFFECT OF BODY FLAP



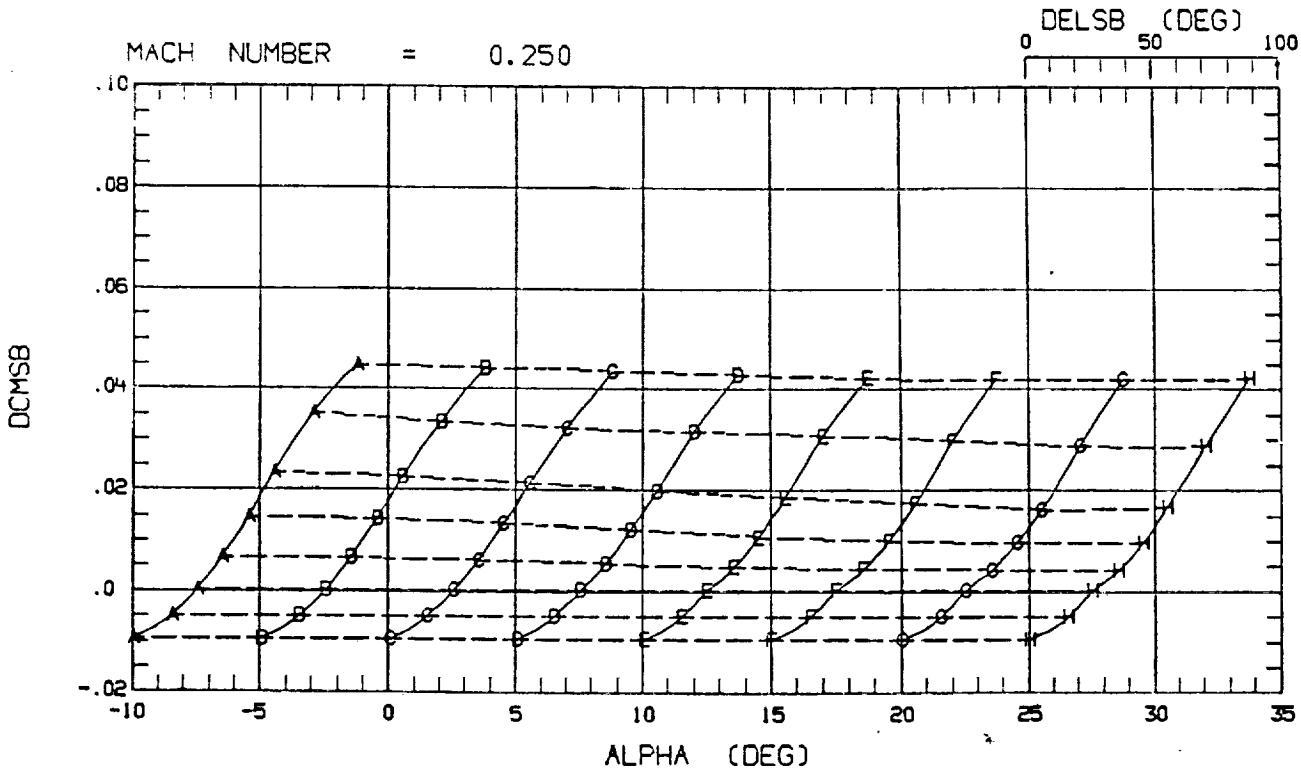
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.0 A	25.0 B	30.0 C	35.0 D	40.0 E	45.0 F	50.0 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00400	0.00650	0.00900	0.01200	0.01500	0.01780	0.02100
-5.000	0.00290	0.00390	0.00540	0.00730	0.00780	0.00930	0.01070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00200	-0.00380	-0.00550	-0.00700	-0.00850	-0.01000	-0.01100
10.000	-0.00570	-0.01000	-0.01250	-0.01430	-0.01580	-0.01700	-0.01800
16.300	-0.01100	-0.01660	-0.02000	-0.02190	-0.02330	-0.02400	-0.02500
22.500	-0.01670	-0.02220	-0.02600	-0.02830	-0.03000	-0.03150	-0.03300

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-72
EFFECT OF BODY FLAP



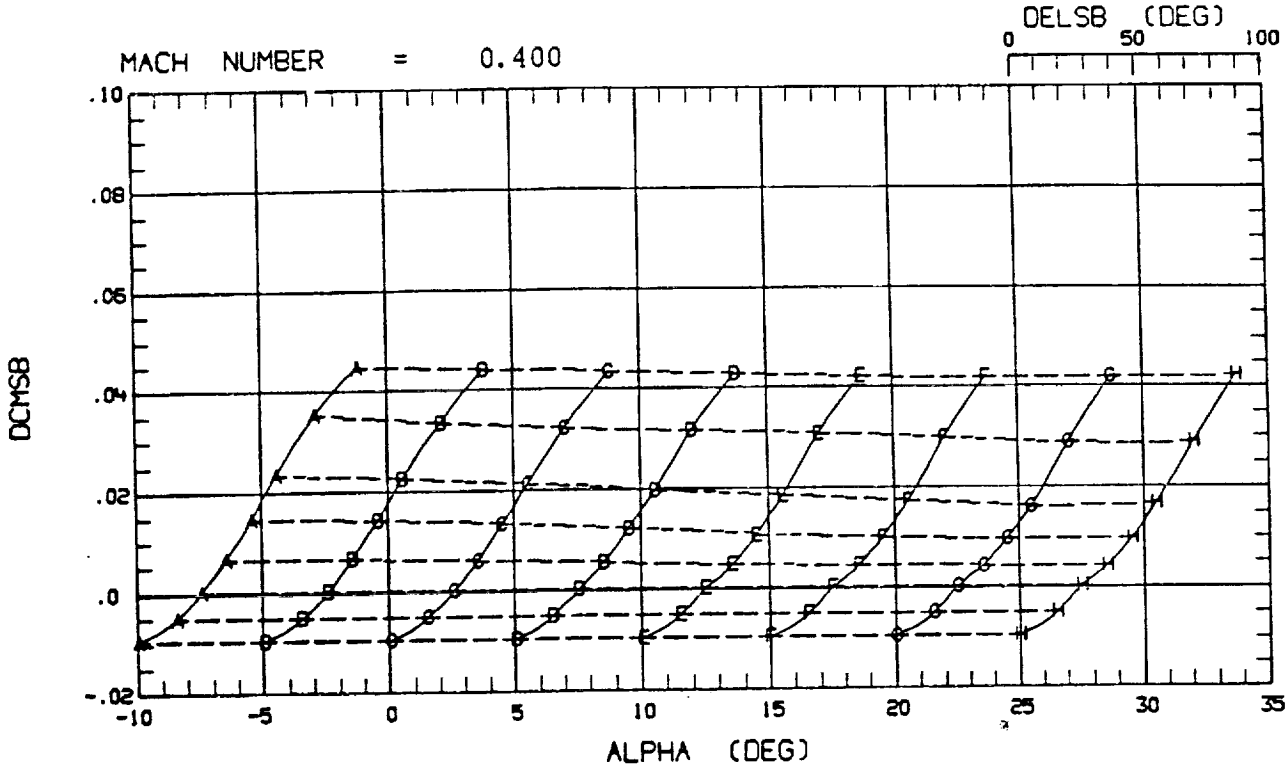
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00970	-0.00970	-0.00970	-0.00970	-0.00970	-0.00970	-0.00970	-0.00970
15.000	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00650	0.00636	0.00600	0.00530	0.00460	0.00440	0.00420	0.00400
45.000	0.01450	0.01409	0.01330	0.01195	0.01060	0.00988	0.00950	0.00940
55.000	0.02330	0.02227	0.02110	0.01970	0.01830	0.01704	0.01600	0.01660
70.000	0.03510	0.03332	0.03200	0.03135	0.03070	0.02965	0.02860	0.02860
87.200	0.04460	0.04410	0.04350	0.04275	0.04200	0.04178	0.04180	0.04200

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-73
EFFECT OF SPEEDBRAKE



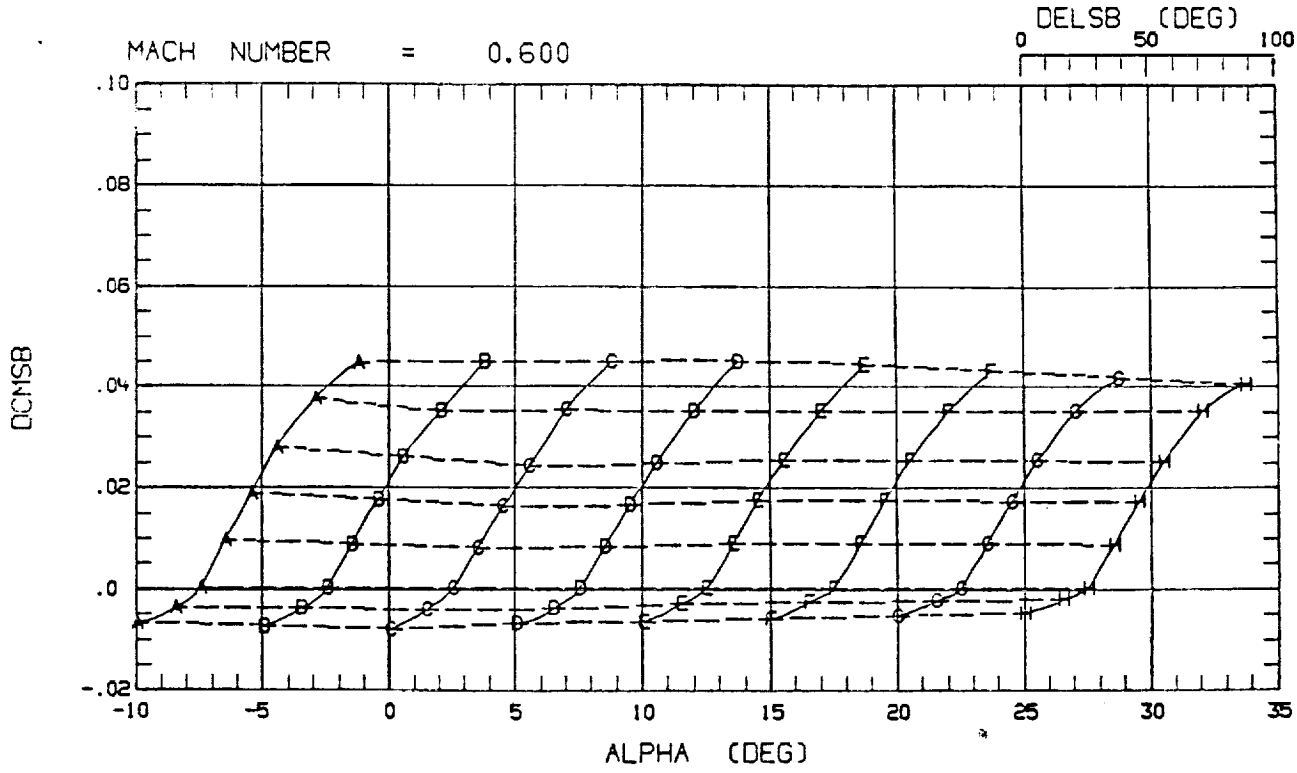
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00970	-0.00970	-0.00970	-0.00970	-0.00970	-0.00970	-0.00970	-0.00970
15.000	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00650	0.00636	0.00600	0.00530	0.00460	0.00440	0.00420	0.00400
45.000	0.01450	0.01409	0.01330	0.01195	0.01060	0.00988	0.00950	0.00940
55.000	0.02330	0.02227	0.02110	0.01970	0.01830	0.01704	0.01600	0.01660
70.000	0.03510	0.03332	0.03200	0.03135	0.03070	0.02965	0.02860	0.02860
87.200	0.04460	0.04410	0.04350	0.04275	0.04200	0.04178	0.04180	0.04200

ENGINEER DSD
DATE 9-13-78

FIGURE 4.1.1.3-74
EFFECT OF SPEEDBRAKE

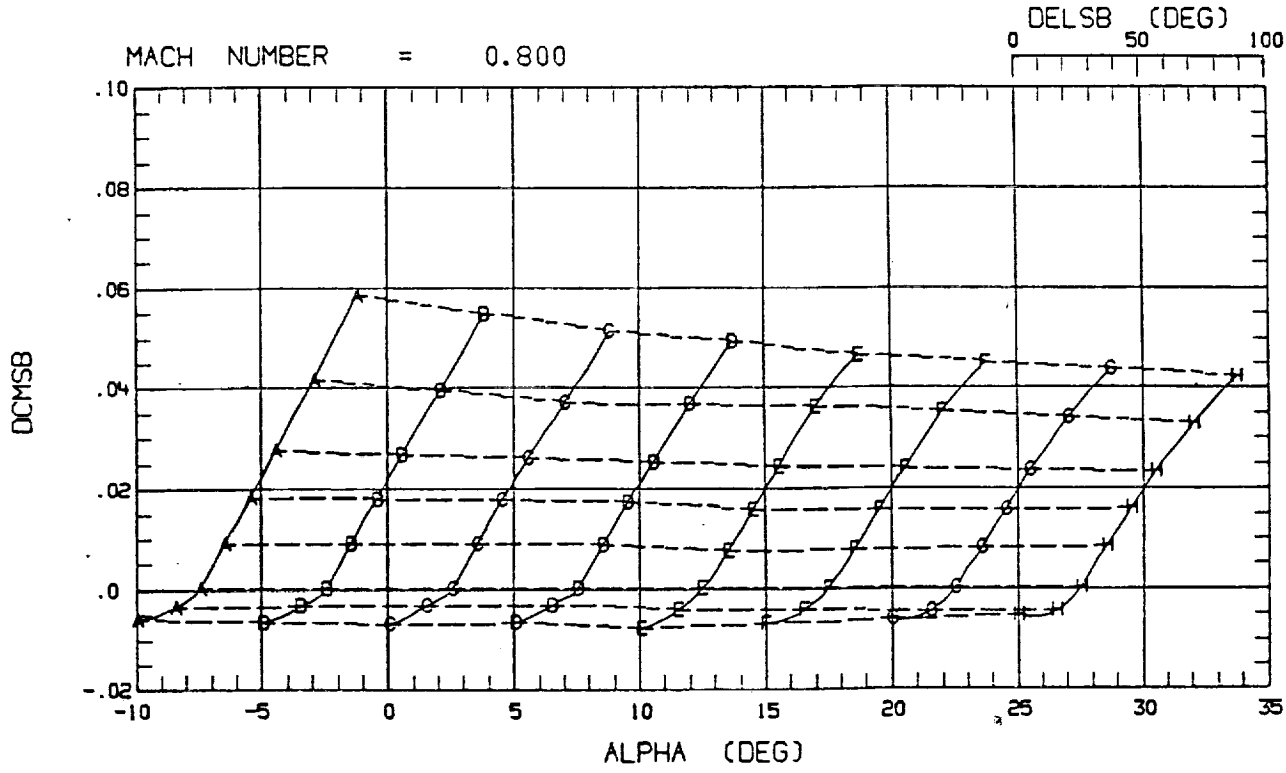


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00686	-0.00746	-0.00806	-0.00686	-0.00657	-0.00597	-0.00537	-0.00477
15.000	-0.00397	-0.00400	-0.00403	-0.00400	-0.00300	-0.00270	-0.00240	-0.00210
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00942	0.00877	0.00811	0.00828	0.00883	0.00881	0.00879	0.00878
45.000	0.01873	0.01743	0.01614	0.01652	0.01740	0.01734	0.01729	0.01723
55.000	0.02776	0.02589	0.02402	0.02465	0.02547	0.02535	0.02523	0.02511
70.000	0.03750	0.03499	0.03529	0.03500	0.03500	0.03500	0.03500	0.03500
87.200	0.04470	0.04485	0.04500	0.04500	0.04433	0.04300	0.04167	0.04034

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-75
EFFECT OF SPEEDBRAKE



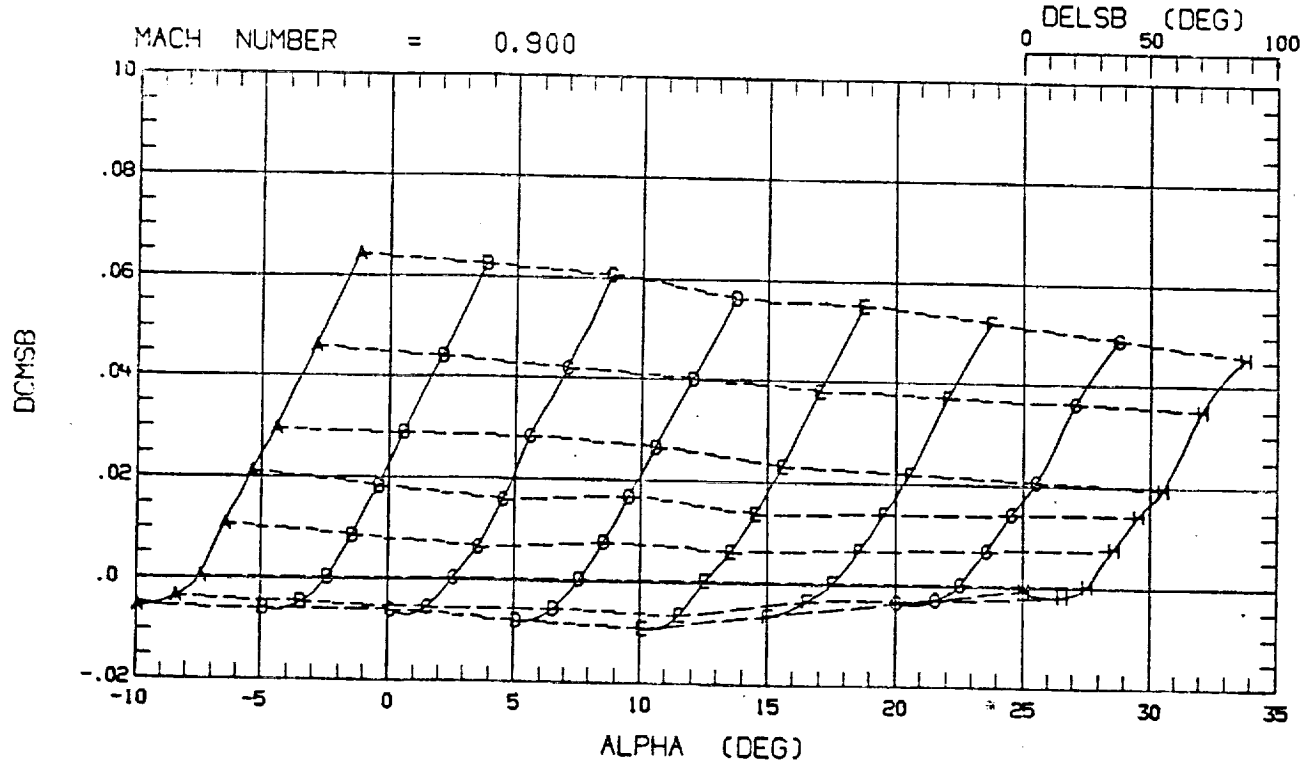
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00612	-0.00653	-0.00694	-0.00675	-0.00770	-0.00688	-0.00606	-0.00524
15.000	-0.00355	-0.00340	-0.00325	-0.00318	-0.00406	-0.00423	-0.00440	-0.00457
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00900	0.00898	0.00896	0.00871	0.00741	0.00768	0.00794	0.00821
45.000	0.01810	0.01789	0.01768	0.01716	0.01568	0.01572	0.01576	0.01579
55.000	0.02739	0.02668	0.02597	0.02521	0.02431	0.02392	0.02353	0.02314
70.000	0.04167	0.03924	0.03681	0.03653	0.03619	0.03500	0.03381	0.03262
87.200	0.05818	0.05473	0.05129	0.04904	0.04639	0.04500	0.04361	0.04222

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-76
EFFECT OF SPEEDBRAKE



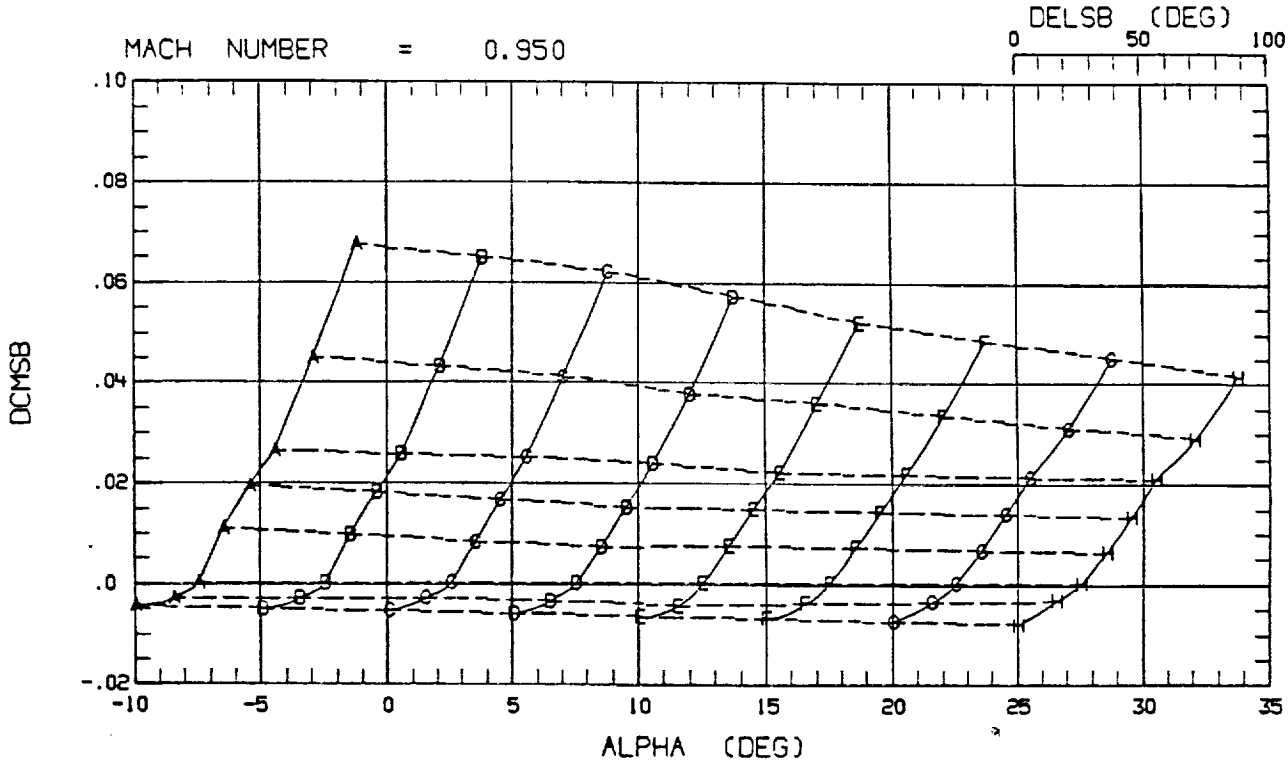
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00576	-0.00597	-0.00618	-0.00811	-0.00930	-0.00649	-0.00368	-0.00087
15.000	-0.00390	-0.00480	-0.00570	-0.00571	-0.00660	-0.00341	-0.00300	-0.00200
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01049	0.00838	0.00626	0.00737	0.00601	0.00646	0.00691	0.00736
45.000	0.02068	0.01822	0.01577	0.01647	0.01349	0.01373	0.01397	0.01422
55.000	0.02919	0.02858	0.02797	0.02641	0.02299	0.02176	0.02053	0.01930
70.000	0.04576	0.04383	0.04190	0.04000	0.03800	0.03699	0.03598	0.03497
87.200	0.06399	0.06219	0.06039	0.05600	0.05500	0.05186	0.04872	0.04558

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-77
EFFECT OF SPEEDBRAKE



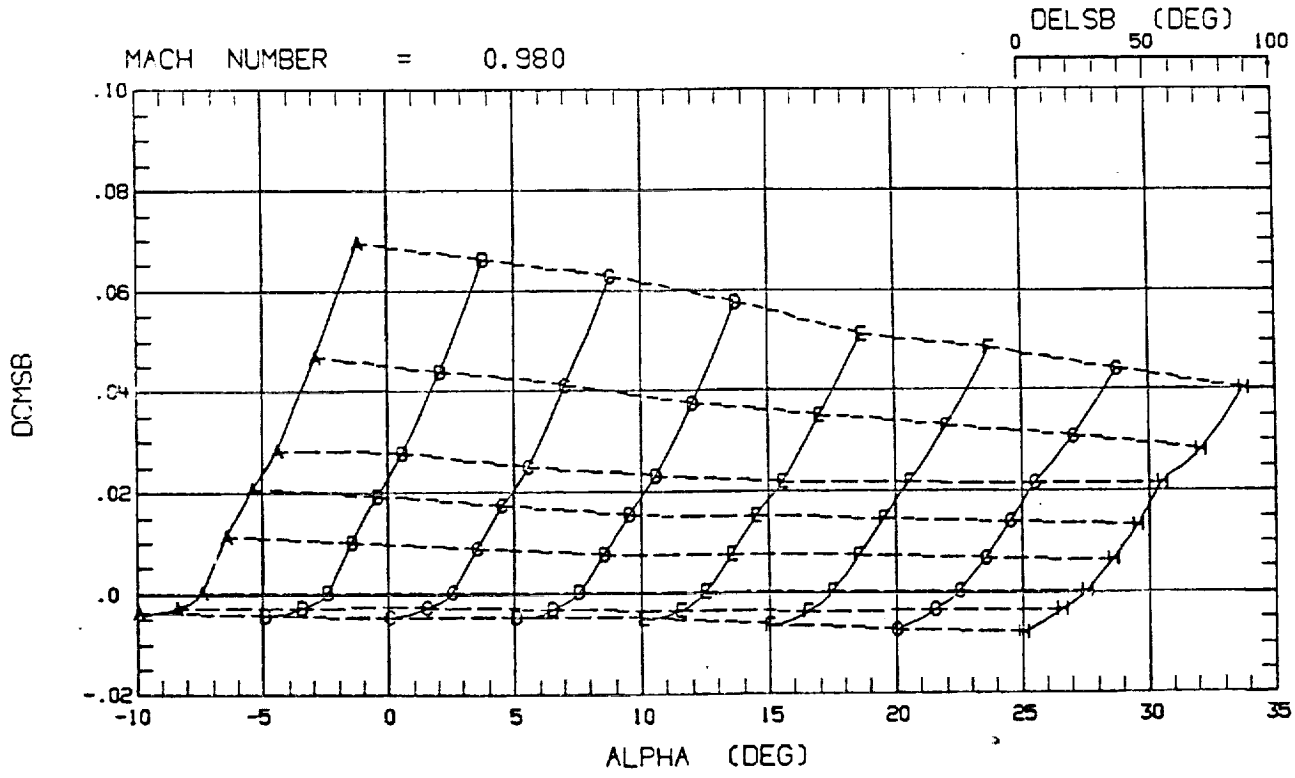
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00450	-0.00500	-0.00550	-0.00600	-0.00650	-0.00700	-0.00750	-0.00800
15.000	-0.00300	-0.00300	-0.00300	-0.00350	-0.00434	-0.00400	-0.00366	-0.00332
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01065	0.00941	0.00816	0.00715	0.00737	0.00698	0.00660	0.00622
45.000	0.01940	0.01795	0.01650	0.01514	0.01469	0.01419	0.01370	0.01320
55.000	0.02632	0.02566	0.02500	0.02375	0.02198	0.02159	0.02120	0.02081
70.000	0.04494	0.04297	0.04100	0.03766	0.03569	0.03335	0.03101	0.02867
87.200	0.06730	0.06465	0.06200	0.05700	0.05197	0.04836	0.04475	0.04114

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-78
EFFECT OF SPEEDBRAKE



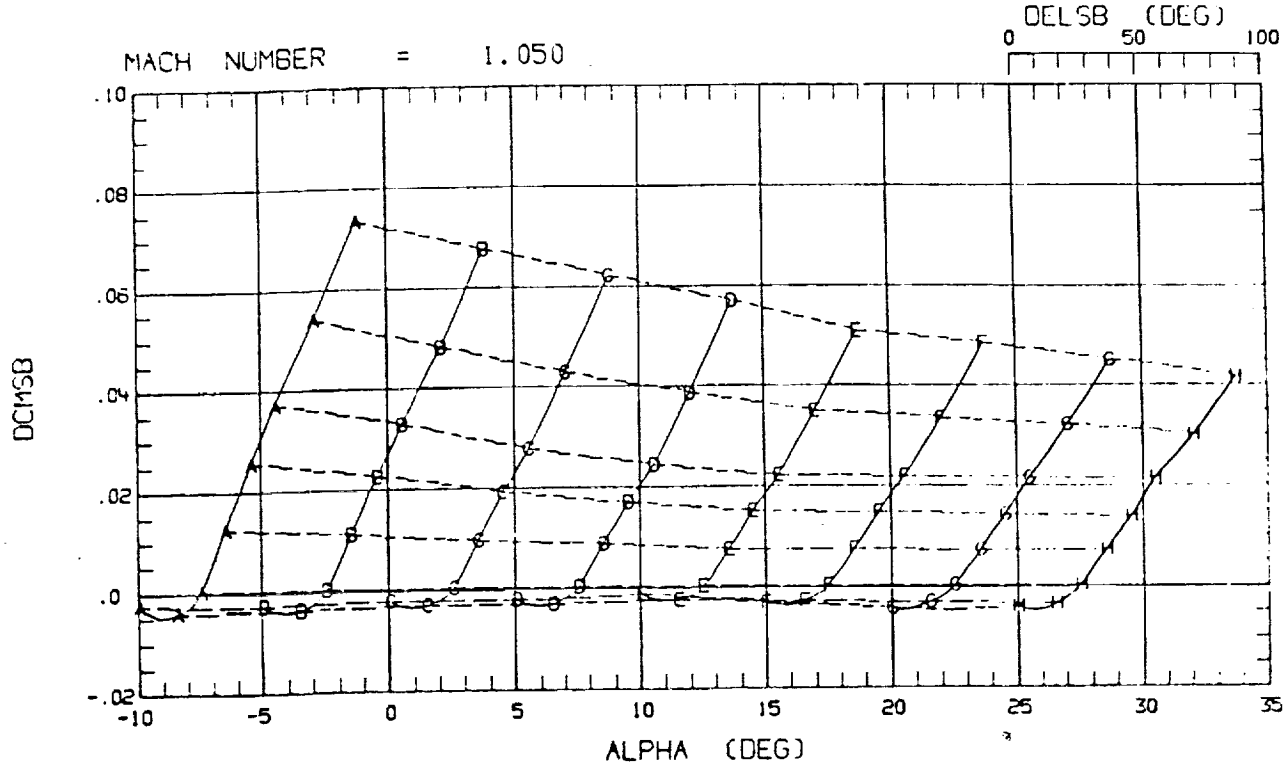
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00386	-0.00439	-0.00481	-0.00485	-0.00494	-0.00646	-0.00741	-0.00803
15.000	-0.00301	-0.00283	-0.00280	-0.00334	-0.00347	-0.00388	-0.00359	-0.00366
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01103	0.00993	0.00866	0.00734	0.00754	0.00719	0.00659	0.00607
45.000	0.02040	0.01904	0.01711	0.01521	0.01503	0.01440	0.01370	0.01303
55.000	0.02807	0.02741	0.02463	0.02309	0.02169	0.02158	0.02141	0.02132
70.000	0.04676	0.04359	0.04103	0.03720	0.03493	0.03271	0.03071	0.02787
87.200	0.06918	0.06582	0.06246	0.05725	0.05094	0.04813	0.04392	0.04009

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-79
EFFECT OF SPEEDBRAKE



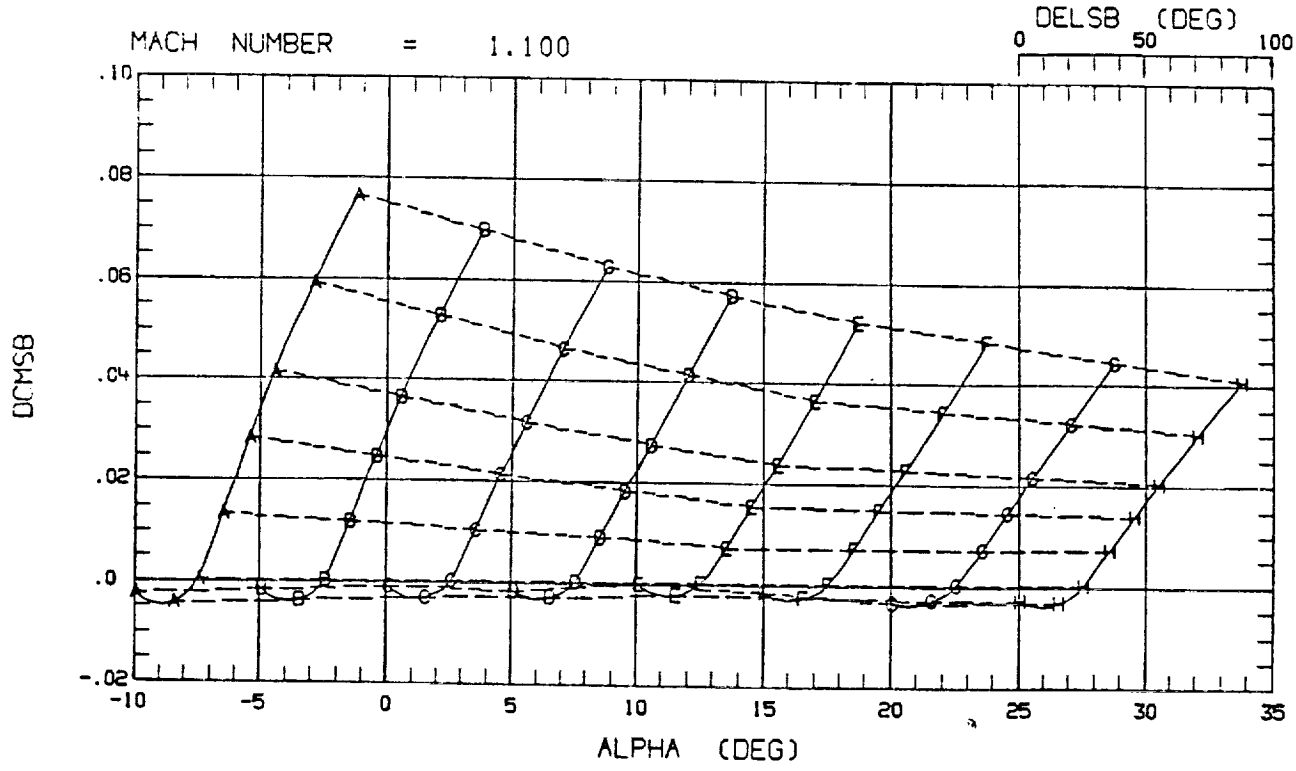
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00271	-0.00265	-0.00225	-0.00247	-0.00154	-0.00319	-0.00458	-0.00428
15.000	-0.00423	-0.00372	-0.00317	-0.00317	-0.00250	-0.00299	-0.00324	-0.00362
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01232	0.01096	0.00952	0.00856	0.00738	0.00740	0.00708	0.00707
45.000	0.02550	0.02241	0.01903	0.01677	0.01500	0.01471	0.01423	0.01386
55.000	0.03691	0.03262	0.02742	0.02427	0.02197	0.02181	0.02151	0.02137
70.000	0.05359	0.04794	0.04278	0.03862	0.03494	0.03339	0.03193	0.03005
87.200	0.07318	0.06753	0.06190	0.05672	0.05068	0.04822	0.04497	0.04158

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-80
EFFECT OF SPEEDBRAKE



CONFIGURATION

BASELINE ORBITER VEHICLE

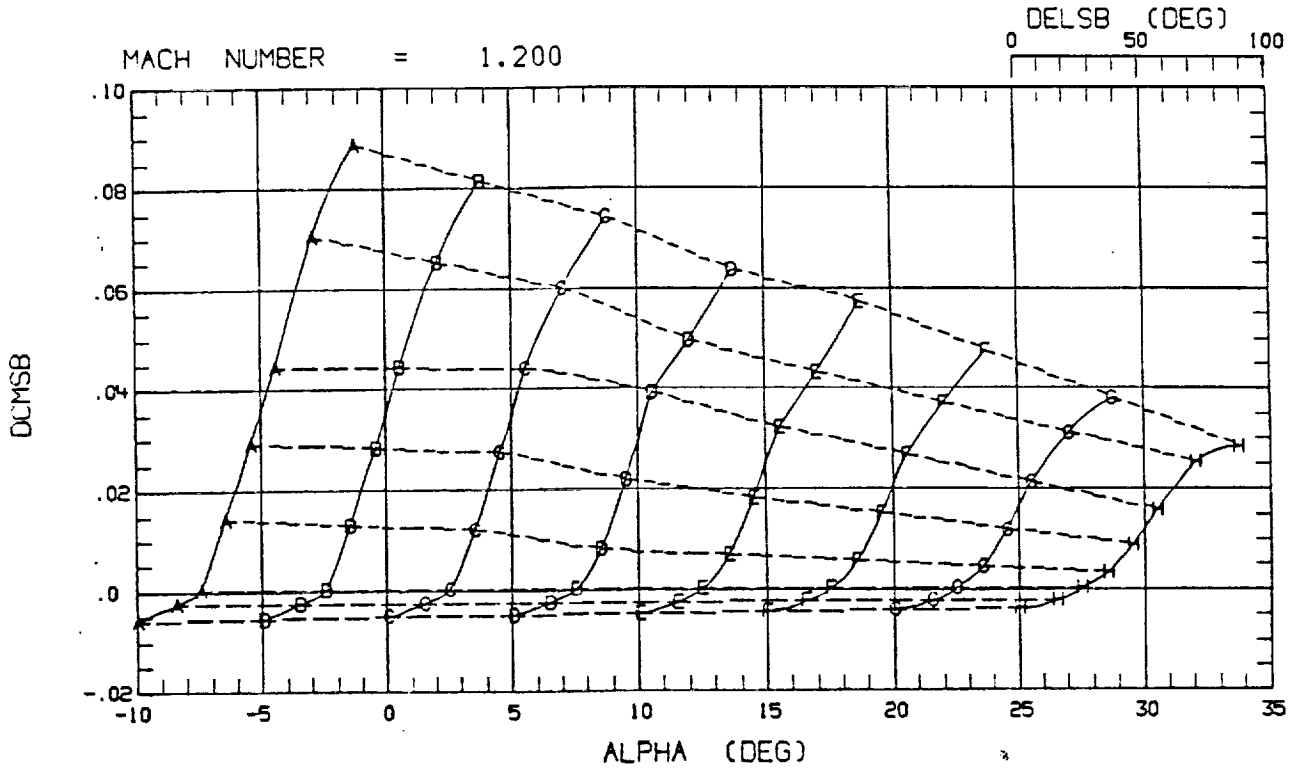
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

REFERENCE DIMENSIONS

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00266	-0.00184	-0.00102	-0.00168	-0.00019	-0.00187	-0.00355	-0.00300
15.000	-0.00453	-0.00384	-0.00315	-0.00298	-0.00221	-0.00259	-0.00298	-0.00337
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01307	0.01166	0.01024	0.00903	0.00720	0.00716	0.00712	0.00708
45.000	0.02798	0.02453	0.02107	0.01819	0.01538	0.01484	0.01430	0.01376
55.000	0.04132	0.03637	0.03142	0.02735	0.02366	0.02255	0.02144	0.02033
70.000	0.05882	0.05253	0.04624	0.04112	0.03642	0.03427	0.03213	0.02999
87.200	0.07630	0.06940	0.06250	0.05700	0.05180	0.04808	0.04436	0.04064

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-81
EFFECT OF SPEEDBRAKE

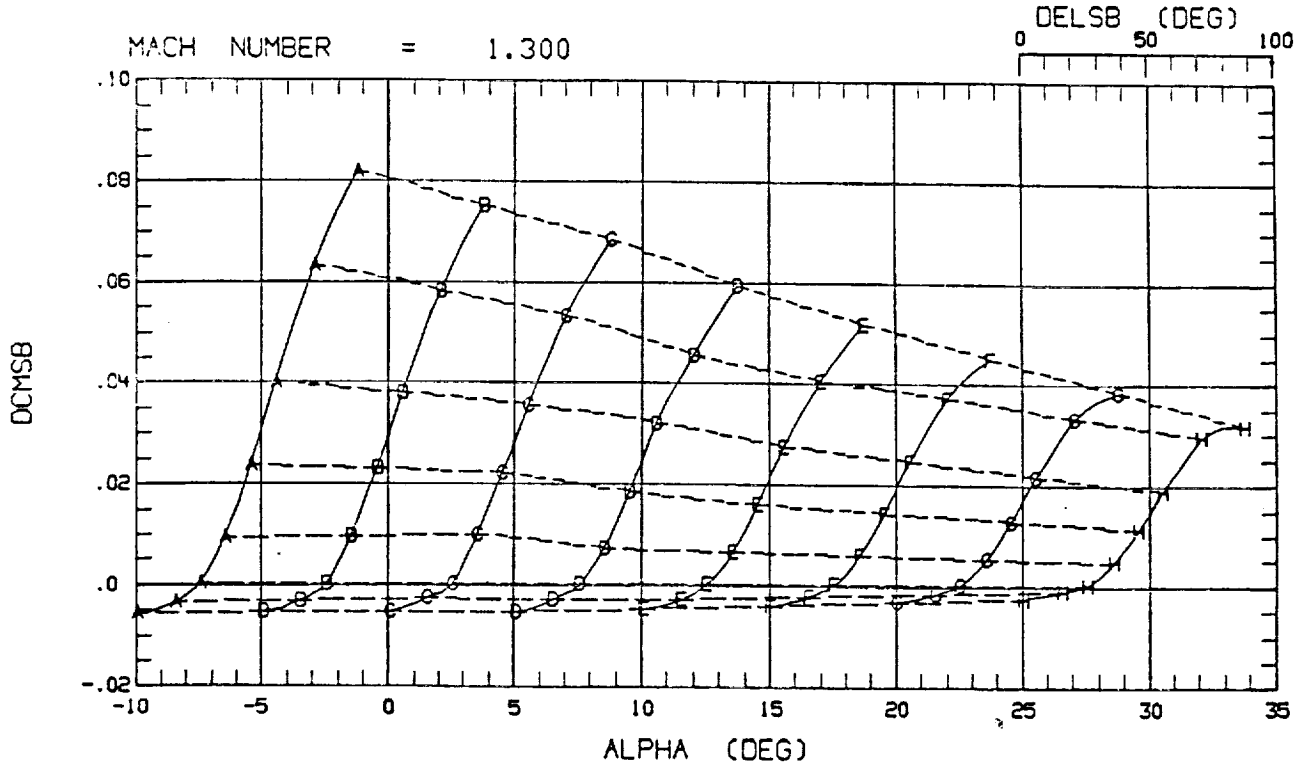


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00600	-0.00560	-0.00520	-0.00501	-0.00480	-0.00450	-0.00420	-0.00390
15.000	-0.00250	-0.00250	-0.00250	-0.00250	-0.00250	-0.00246	-0.00242	-0.00238
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01404	0.01297	0.01191	0.00791	0.00666	0.00552	0.00439	0.00325
45.000	0.02908	0.02811	0.02713	0.02175	0.01799	0.01490	0.01181	0.00872
55.000	0.04435	0.04413	0.04391	0.03904	0.03200	0.02650	0.02100	0.01550
70.000	0.07026	0.06500	0.05974	0.04944	0.04300	0.03700	0.03100	0.02500
87.200	0.08829	0.08113	0.07397	0.06344	0.05700	0.04739	0.03778	0.02817

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-82
EFFECT OF SPEEDBRAKE



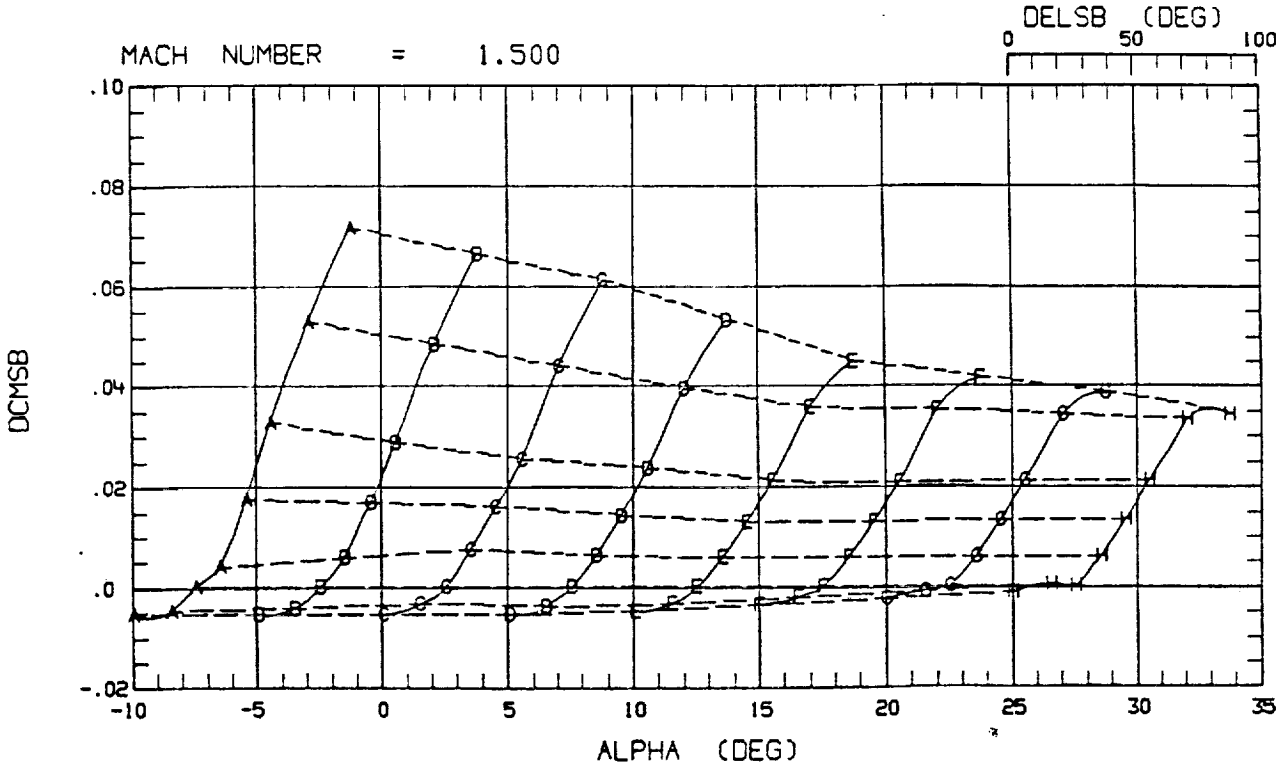
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00575	-0.00549	-0.00525	-0.00532	-0.00477	-0.00404	-0.00332	-0.00260
15.000	-0.00353	-0.00315	-0.00276	-0.00308	-0.00284	-0.00221	-0.00159	-0.00097
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00922	0.00960	0.00998	0.00704	0.00640	0.00579	0.00519	0.00458
45.000	0.02351	0.02281	0.02210	0.01824	0.01585	0.01425	0.01266	0.01106
55.000	0.04002	0.03774	0.03545	0.03186	0.02723	0.02435	0.02147	0.01858
70.000	0.06313	0.05812	0.05312	0.04546	0.04033	0.03694	0.03303	0.02938
87.200	0.08174	0.07499	0.06823	0.05905	0.05163	0.04486	0.03809	0.03132

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-83
EFFECT OF SPEEDBRAKE



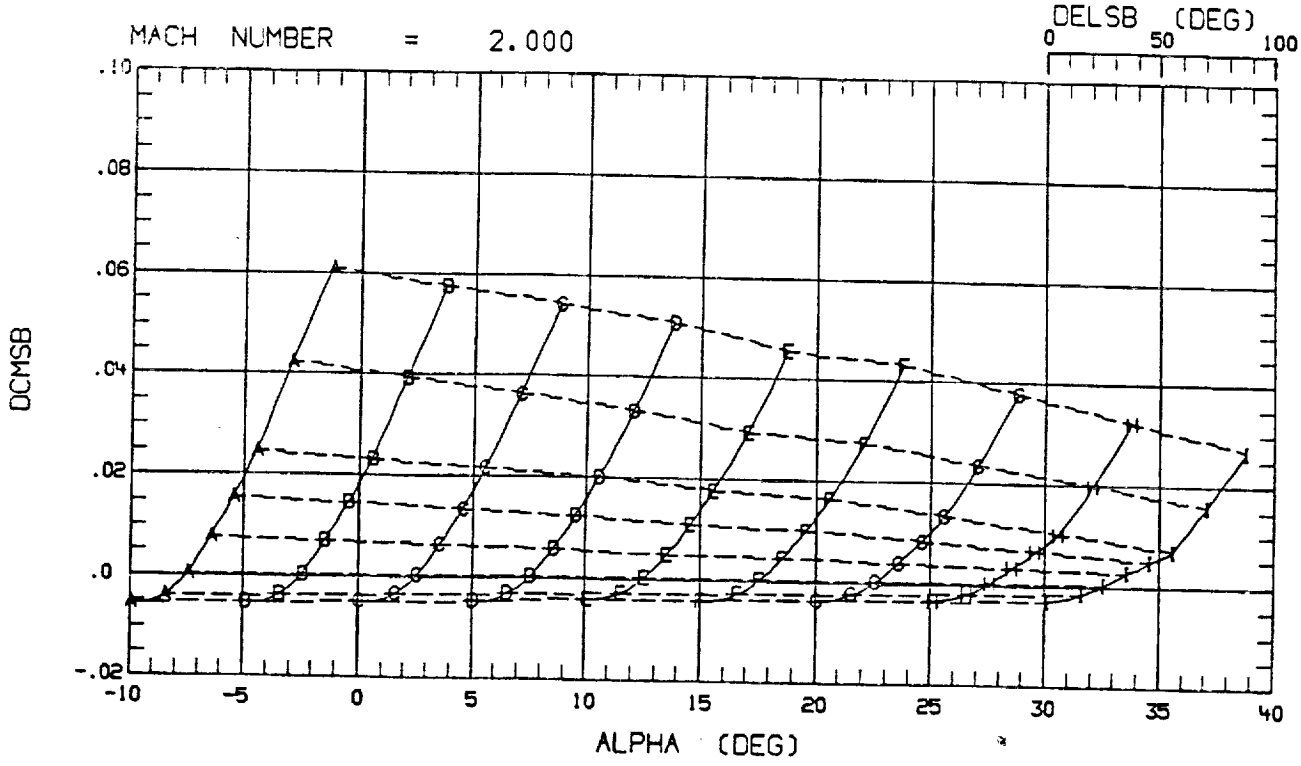
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00544	-0.00534	-0.00529	-0.00552	-0.00466	-0.00348	-0.00232	-0.00118
15.000	-0.00469	-0.00404	-0.00323	-0.00377	-0.00324	-0.00197	-0.00074	0.00047
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00397	0.00587	0.00747	0.00617	0.00590	0.00592	0.00590	0.00585
45.000	0.01739	0.01681	0.01596	0.01425	0.01292	0.01297	0.01314	0.01318
55.000	0.03265	0.02966	0.02545	0.02356	0.02115	0.02072	0.02113	0.02118
70.000	0.05268	0.04828	0.04389	0.03946	0.03566	0.03526	0.03425	0.03324
87.200	0.07139	0.06609	0.06095	0.05318	0.04496	0.04160	0.03855	0.03422

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-84
EFFECT OF SPEEDBRAKE



CONFIGURATION

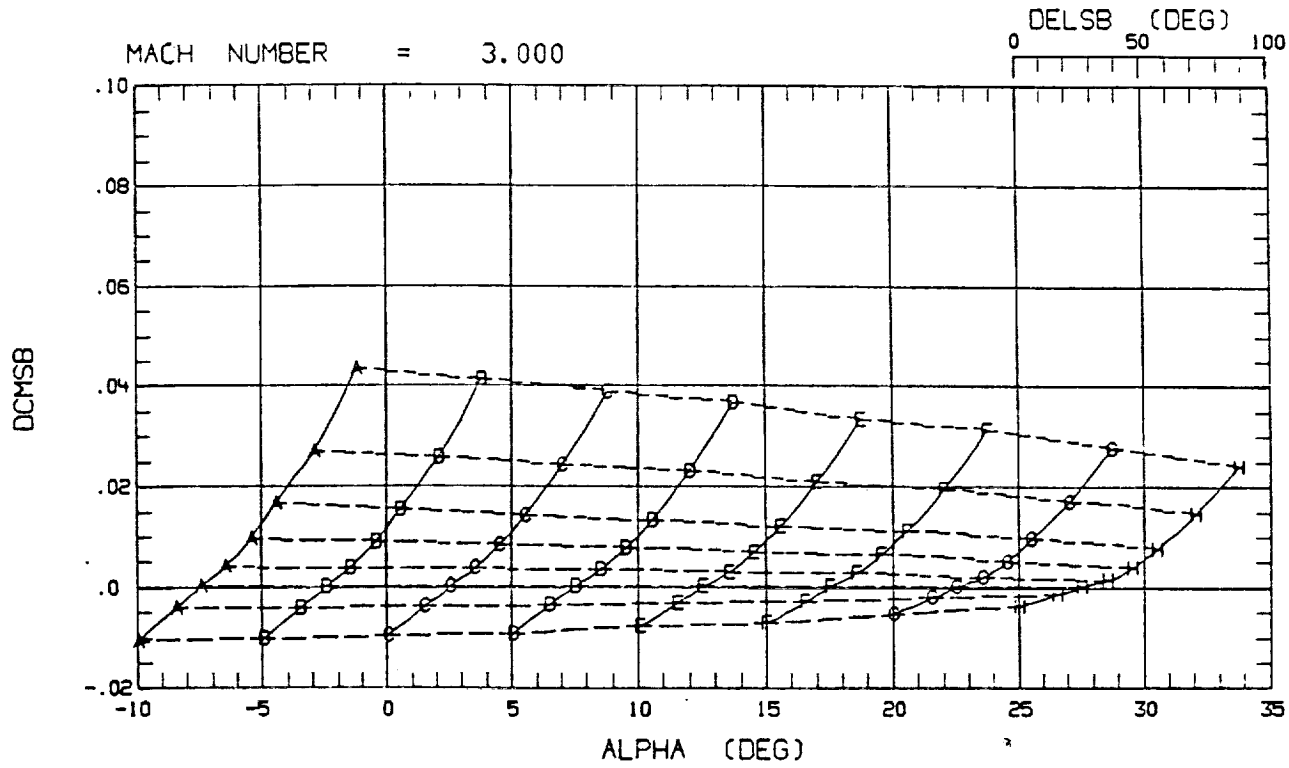
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

DELSB (DEG)	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
	SPEEDBRAKE PITCHING MOMENT INCR								
0.0	-0.00562	-0.00537	-0.00512	-0.00487	-0.00414	-0.00406	-0.00377	-0.00348	-0.00319
15.000	-0.00423	-0.00395	-0.00368	-0.00340	-0.00292	-0.00276	-0.00241	-0.00207	-0.00172
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00727	0.00668	0.00609	0.00551	0.00474	0.00438	0.00375	0.00313	0.00250
45.000	0.01536	0.01429	0.01322	0.01215	0.01063	0.00984	0.00811	0.00637	0.00464
55.000	0.02434	0.02282	0.02130	0.01978	0.01747	0.01622	0.01307	0.00992	0.00677
70.000	0.04223	0.03919	0.03615	0.03311	0.02917	0.02718	0.02334	0.01950	0.01566
87.200	0.06057	0.05727	0.05397	0.05067	0.04548	0.04294	0.03750	0.03206	0.02662

ENGINEER DGD
DATE 9-15-78

FIGURE 4.1.1.3-85
EFFECT OF SPEEDBRAKE



CONFIGURATION

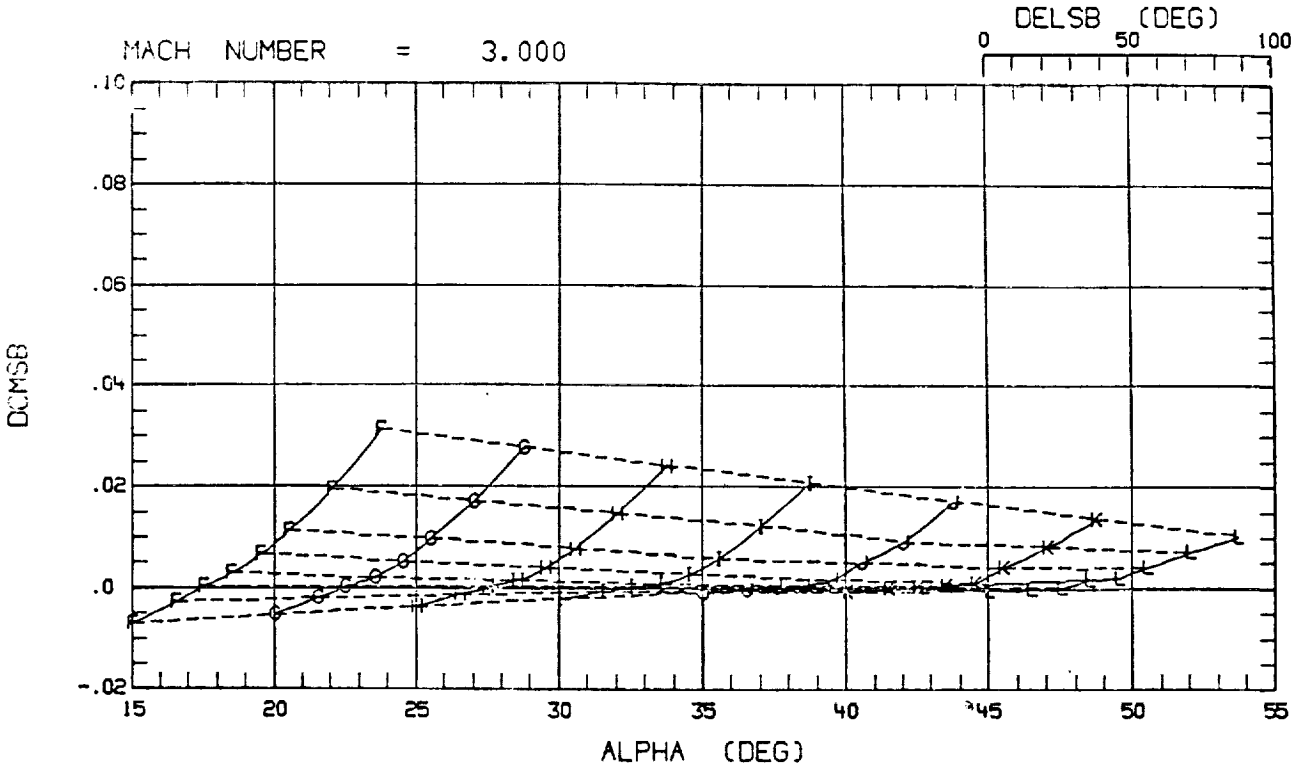
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.01075	-0.01023	-0.00972	-0.00920	-0.00795	-0.00735	-0.00540	-0.00383
15.000	-0.00430	-0.00409	-0.00389	-0.00368	-0.00318	-0.00294	-0.00216	-0.00153
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00391	0.00376	0.00361	0.00346	0.00293	0.00270	0.00182	0.00121
45.000	0.00953	0.00895	0.00837	0.00780	0.00689	0.00637	0.00510	0.00377
55.000	0.01645	0.01532	0.01419	0.01306	0.01183	0.01095	0.00950	0.00750
70.000	0.02683	0.02556	0.02429	0.02302	0.02067	0.01916	0.01700	0.01450
87.200	0.04333	0.04107	0.03881	0.03655	0.03325	0.03111	0.02750	0.02400

ENGINEER DSD
DATE 10-4-78

FIGURE 4.1.1.3-86
EFFECT OF SPEEDBRAKE

SLS-SH-0001 IM

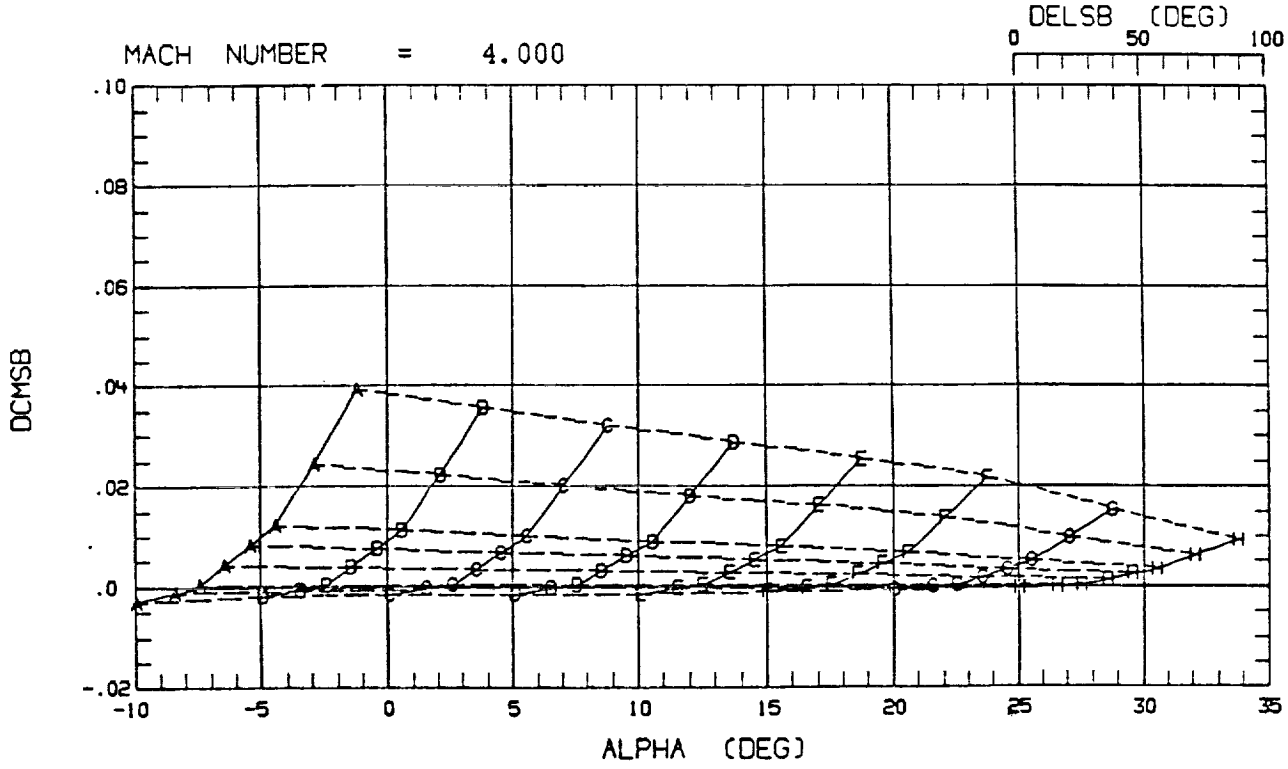


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR						
0.0	-0.00735	-0.00540	-0.00383	-0.00227	-0.00100	-0.00087	-0.00050
15.000	-0.00294	-0.00216	-0.00153	-0.00091	-0.00050	-0.00035	-0.00030
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00270	0.00182	0.00121	0.00060	0.00050	0.00050	0.00154
45.000	0.00637	0.00510	0.00377	0.00243	0.00154	0.00100	0.00200
55.000	0.01095	0.00950	0.00750	0.00550	0.00485	0.00400	0.00400
70.000	0.01916	0.01700	0.01450	0.01200	0.00900	0.00800	0.00700
87.200	0.03111	0.02750	0.02400	0.02050	0.01700	0.01350	0.01000

ENGINEER DGD
DATE 10-4-78

FIGURE 4.1.1.3-87
EFFECT OF SPEEDBRAKE

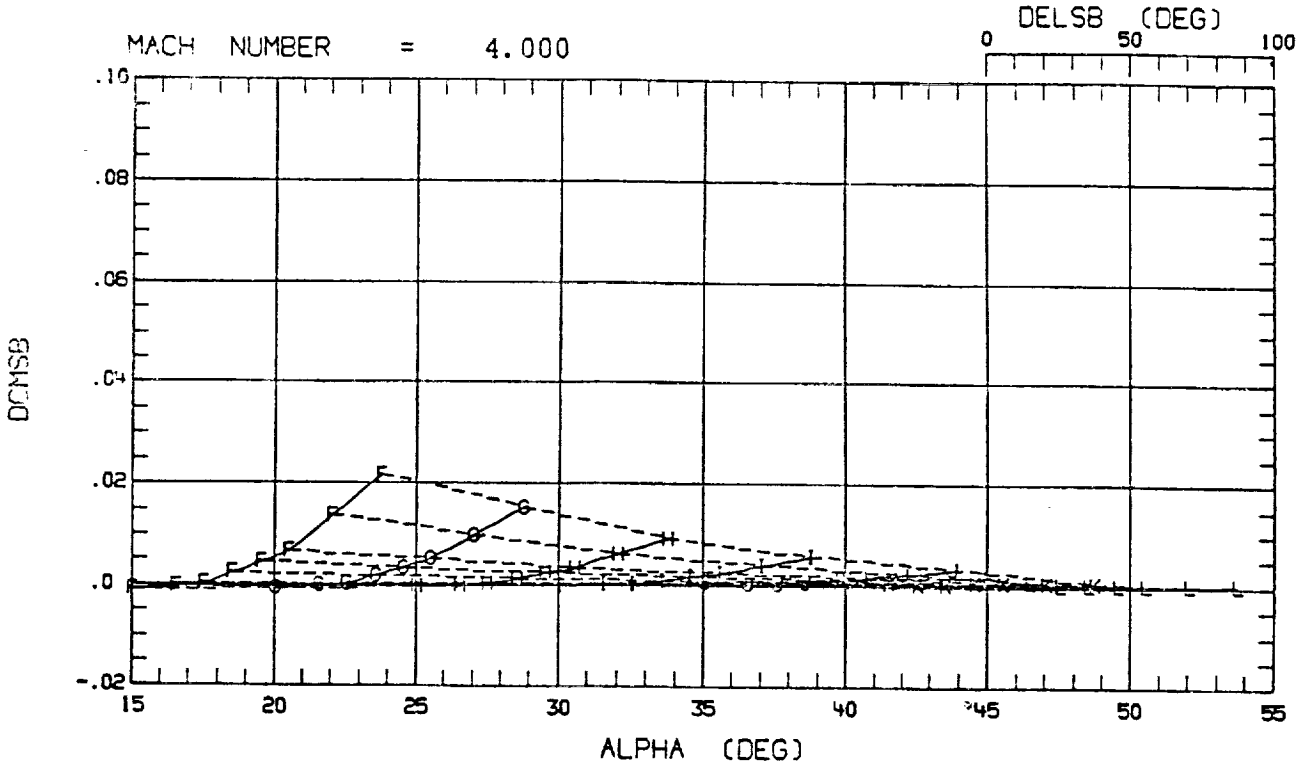


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00318	-0.00218	-0.00158	-0.00158	-0.00158	-0.00124	-0.00079	-0.00058
15.000	-0.00133	-0.00089	-0.00063	-0.00063	-0.00063	-0.00050	-0.00032	-0.00023
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00403	0.00366	0.00329	0.00293	0.00256	0.00214	0.00162	0.00107
45.000	0.00806	0.00732	0.00658	0.00586	0.00512	0.00428	0.00324	0.00214
55.000	0.01208	0.01098	0.00988	0.00878	0.00768	0.00641	0.00486	0.00320
70.000	0.02423	0.02198	0.01983	0.01776	0.01583	0.01345	0.00965	0.00593
87.200	0.03897	0.03537	0.03187	0.02843	0.02517	0.02152	0.01515	0.00906

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-88
EFFECT OF SPEEDBRAKE

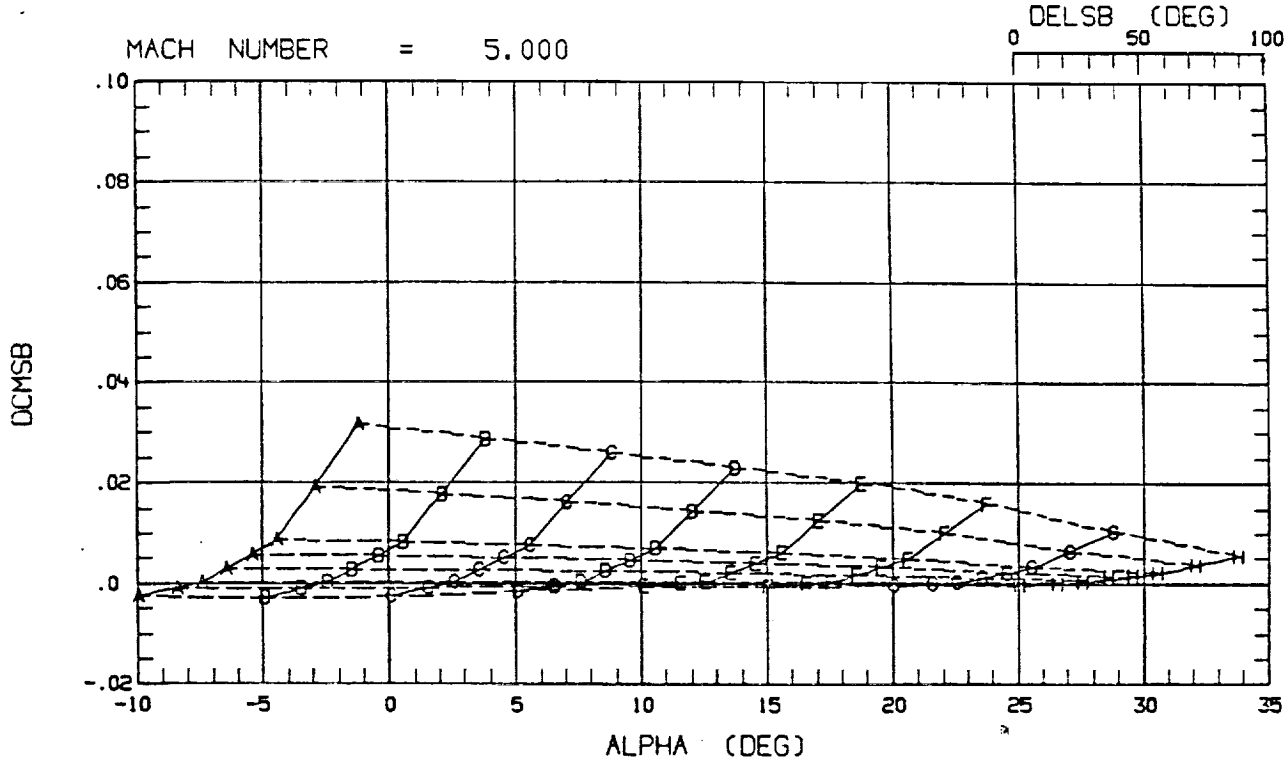


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR						
0.0	-0.00124	-0.00079	-0.00058	-0.00010	0.00037	0.00130	0.00160
15.000	-0.00050	-0.00032	-0.00023	-0.00004	0.00009	0.00036	0.00056
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00214	0.00162	0.00107	0.00074	0.00049	0.00014	0.0
45.000	0.00428	0.00324	0.00214	0.00148	0.00097	0.00028	0.0
55.000	0.00641	0.00486	0.00320	0.00223	0.00146	0.00043	0.0
70.000	0.01345	0.00965	0.00593	0.00373	0.00210	0.00033	0.0
87.200	0.02152	0.01515	0.00906	0.00544	0.00307	0.00054	0.0

ENGINEER D&D
DATE 9-12-88

FIGURE 4.1.1.3-89
EFFECT OF SPEEDBRAKE



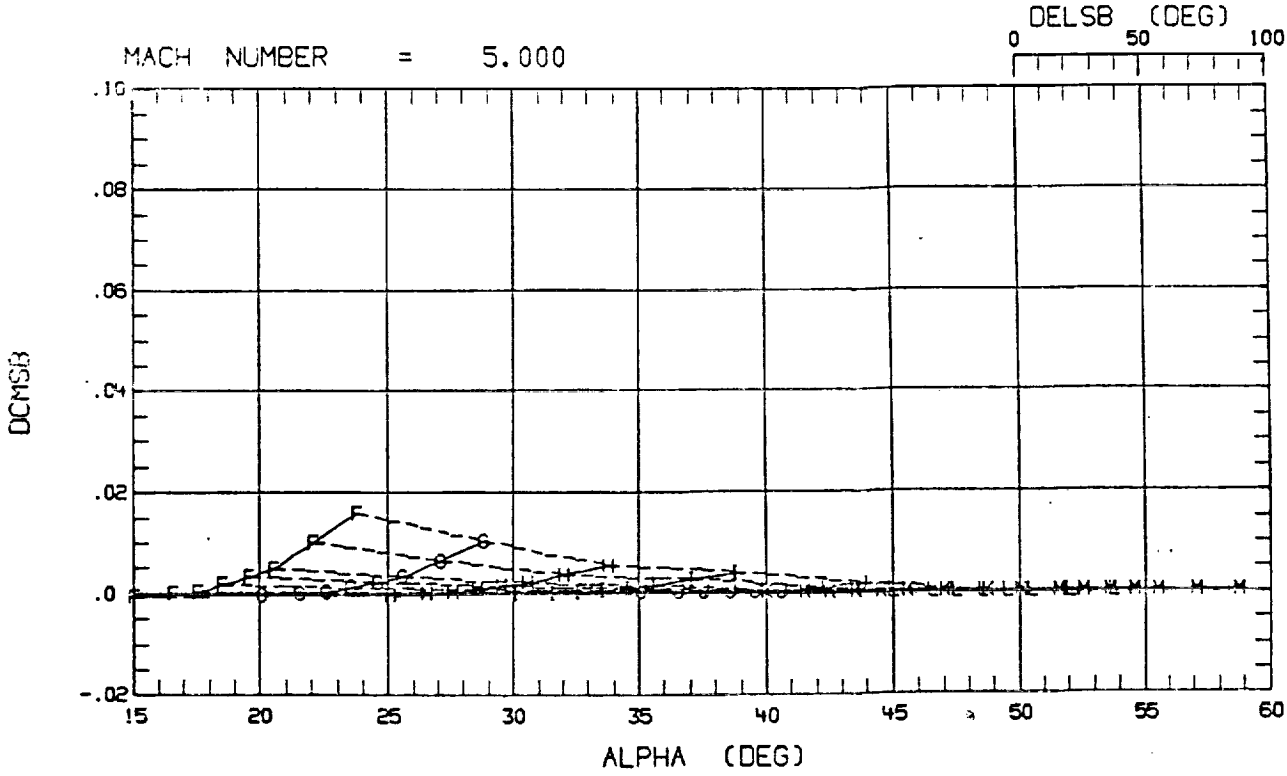
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00275	-0.00299	-0.00275	-0.00180	-0.00085	-0.00068	-0.00056	-0.00049
15.000	-0.00104	-0.00113	-0.00104	-0.00069	-0.00034	-0.00035	-0.00022	-0.00020
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00284	0.00268	0.00248	0.00222	0.00194	0.00158	0.00102	0.00061
45.000	0.00569	0.00536	0.00495	0.00443	0.00388	0.00316	0.00204	0.00122
55.000	0.00853	0.00804	0.00743	0.00665	0.00583	0.00474	0.00307	0.00183
70.000	0.01900	0.01759	0.01600	0.01422	0.01230	0.00988	0.00634	0.00349
87.200	0.03142	0.02853	0.02562	0.02267	0.01972	0.01577	0.01009	0.00539

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-90
EFFECT OF SPEEDBRAKE



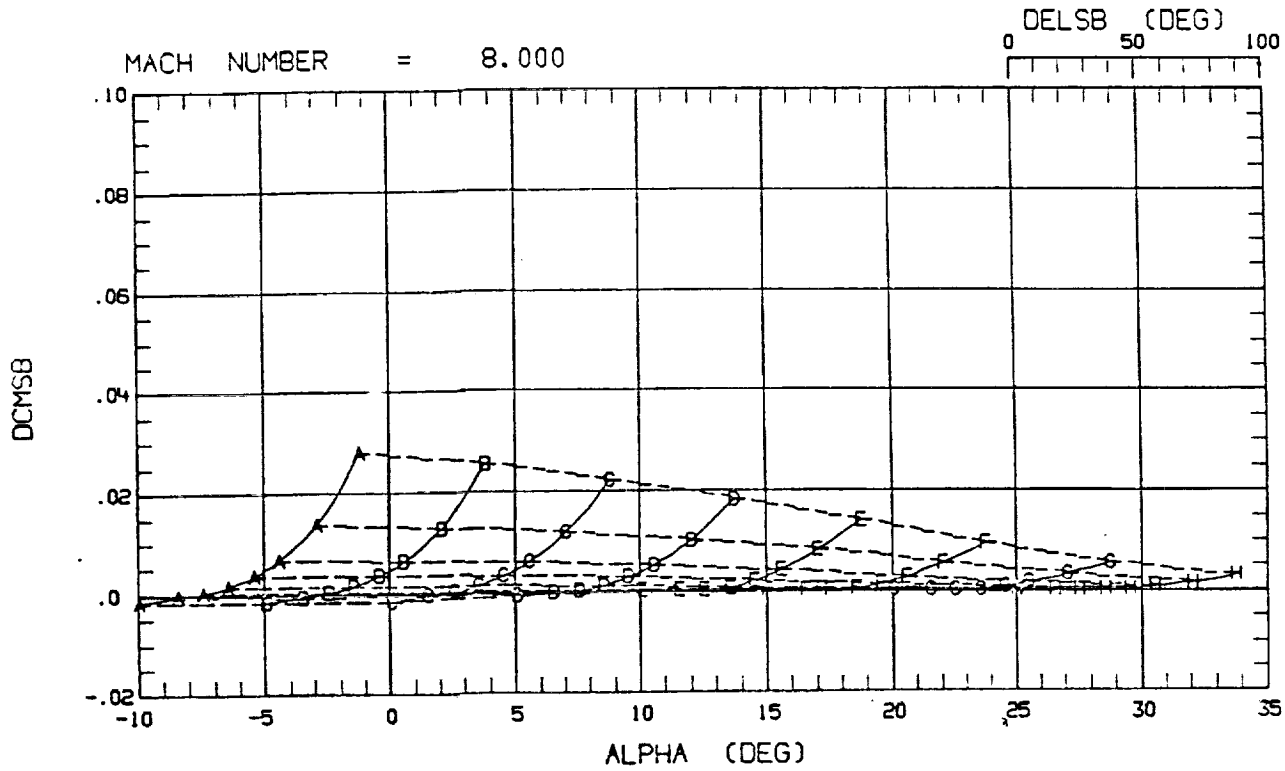
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00088	-0.00056	-0.00049	-0.00017	0.0	0.0	0.0	0.0
15.000	-0.00035	-0.00022	-0.00020	-0.00007	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00158	0.00102	0.00061	0.00043	0.00003	0.0	0.0	0.0
45.000	0.00316	0.00204	0.00122	0.00086	0.00006	0.0	0.0	0.0
55.000	0.00474	0.00307	0.00183	0.00130	0.00010	0.0	0.0	0.0
70.000	0.00988	0.00634	0.00349	0.00247	0.00082	0.0	0.0	0.0
87.200	0.01577	0.01009	0.00539	0.00382	0.00177	0.0	0.0	0.0

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-91
EFFECT OF SPEEDBRAKE

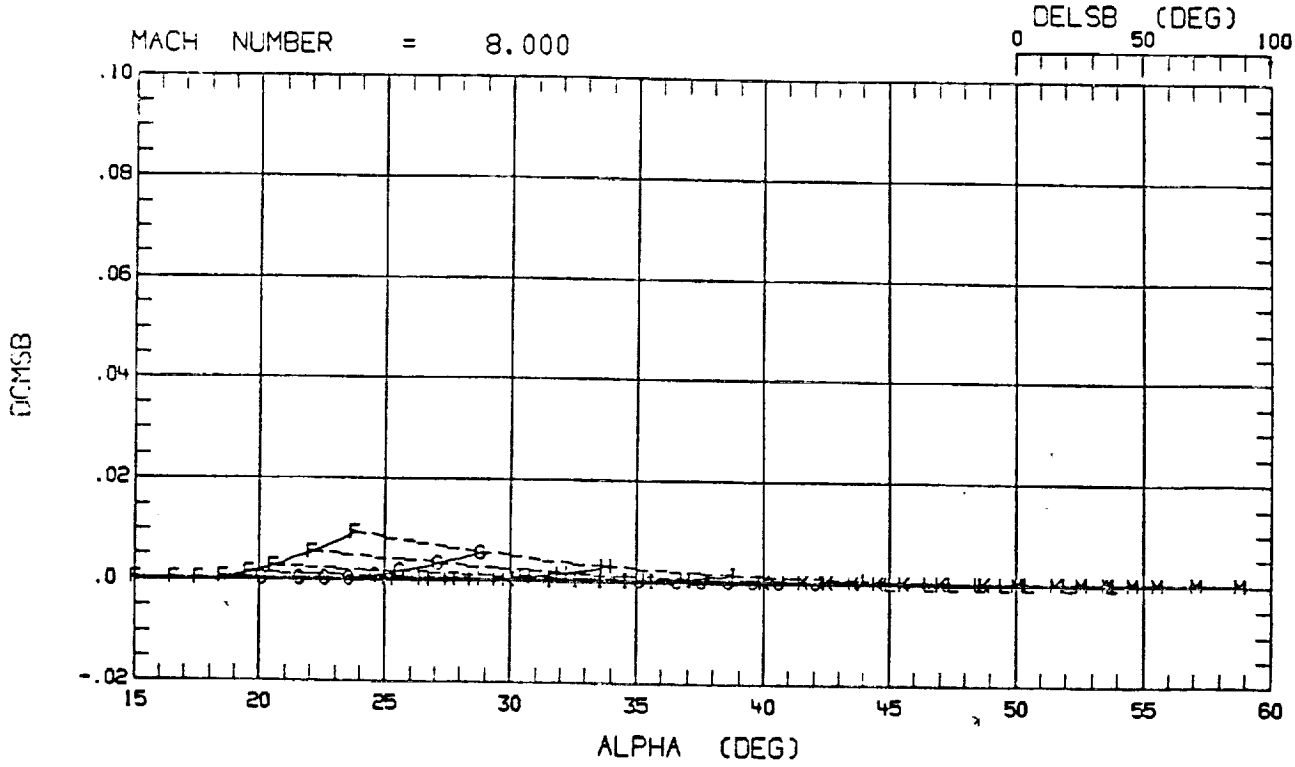


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00160	-0.00180	-0.00160	-0.00080	0.0	0.0	0.0	0.0
15.000	-0.00060	-0.00067	-0.00060	-0.00030	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00142	0.00138	0.00124	0.00108	0.00055	0.00032	0.00007	0.0
45.000	0.00355	0.00340	0.00320	0.00280	0.00190	0.00125	0.00070	0.00010
55.000	0.00648	0.00618	0.00575	0.00500	0.00392	0.00267	0.00150	0.00058
70.000	0.01345	0.01270	0.01155	0.00995	0.00800	0.00540	0.00310	0.00145
87.200	0.02770	0.02550	0.02210	0.01810	0.01370	0.00915	0.00530	0.00270

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-92
EFFECT OF SPEEDBRAKE

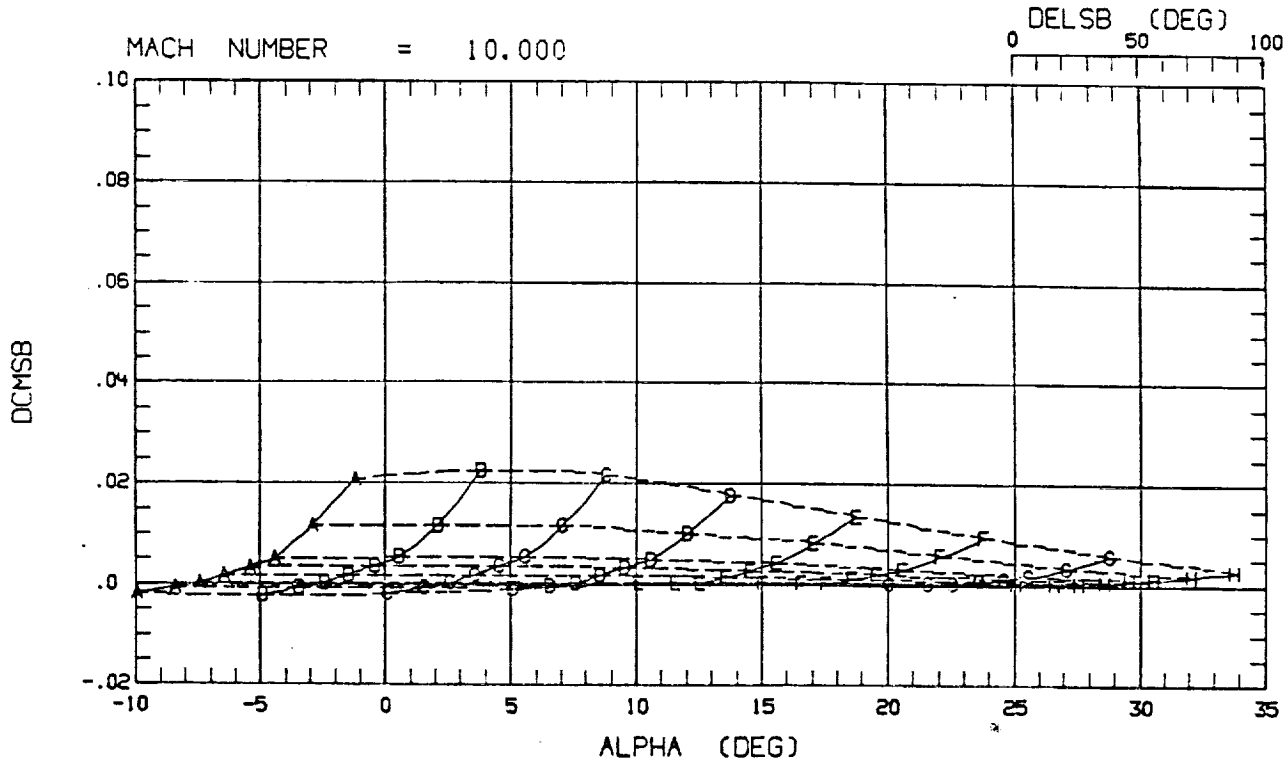


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00032	0.00007	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00125	0.00070	0.00010	0.0	0.0	0.0	0.0	0.0
55.000	0.00267	0.00150	0.00058	0.00010	0.0	0.0	0.0	0.0
70.000	0.00540	0.00310	0.00145	0.00055	0.00012	0.0	0.0	0.0
87.200	0.00915	0.00530	0.00270	0.00140	0.00060	0.0	0.0	0.0

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-93
EFFECT OF SPEEDBRAKE

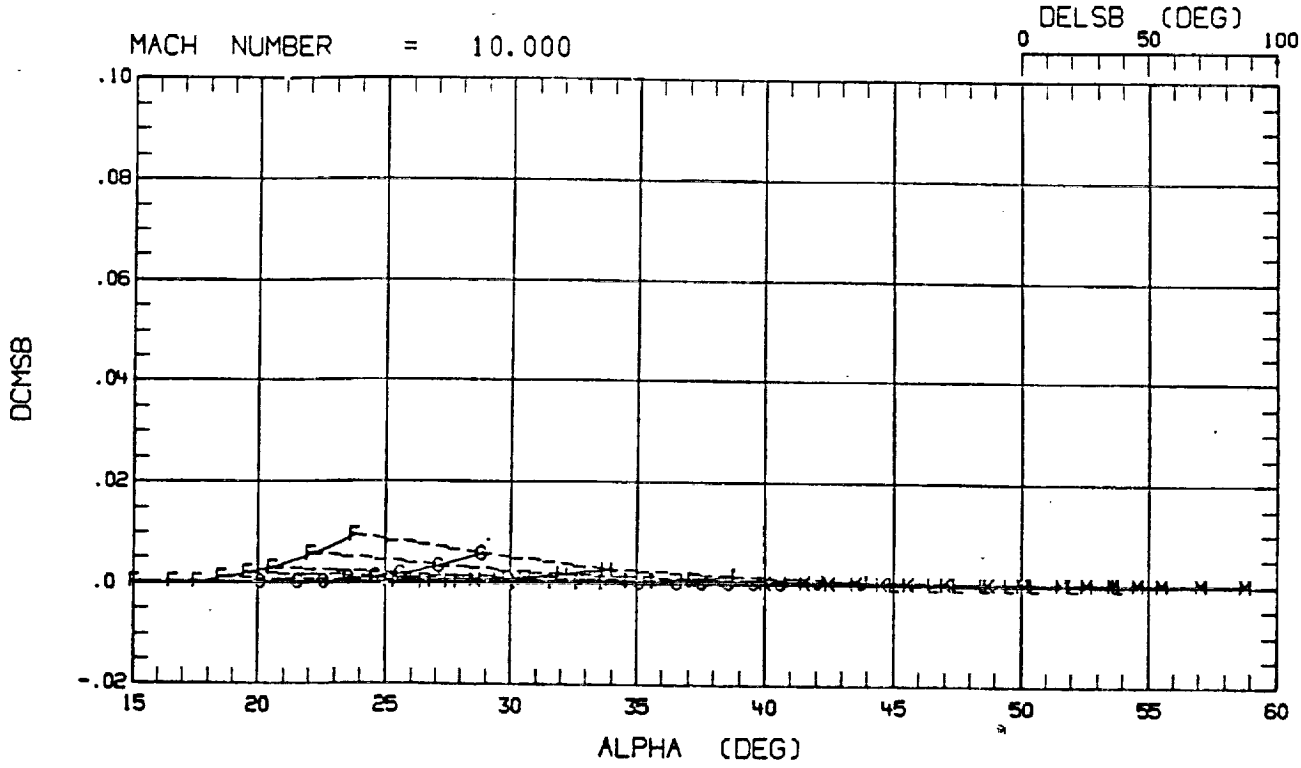


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00210	-0.00236	-0.00210	-0.00105	0.0	0.0	0.0	0.0
15.000	-0.00080	-0.00090	-0.00080	-0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00163	0.00173	0.00175	0.00160	0.00134	0.00097	0.00057	0.00029
45.000	0.00326	0.00346	0.00350	0.00320	0.00268	0.00194	0.00114	0.00058
55.000	0.00488	0.00518	0.00525	0.00480	0.00402	0.00290	0.00170	0.00088
70.000	0.01145	0.01135	0.01125	0.00980	0.00800	0.00548	0.00320	0.00165
87.200	0.02060	0.02238	0.02140	0.01755	0.01330	0.00909	0.00560	0.00260

ENGINEER DGD
DATE 9-02-85

FIGURE 4.1.1.3-94
EFFECT OF SPEEDBRAKE



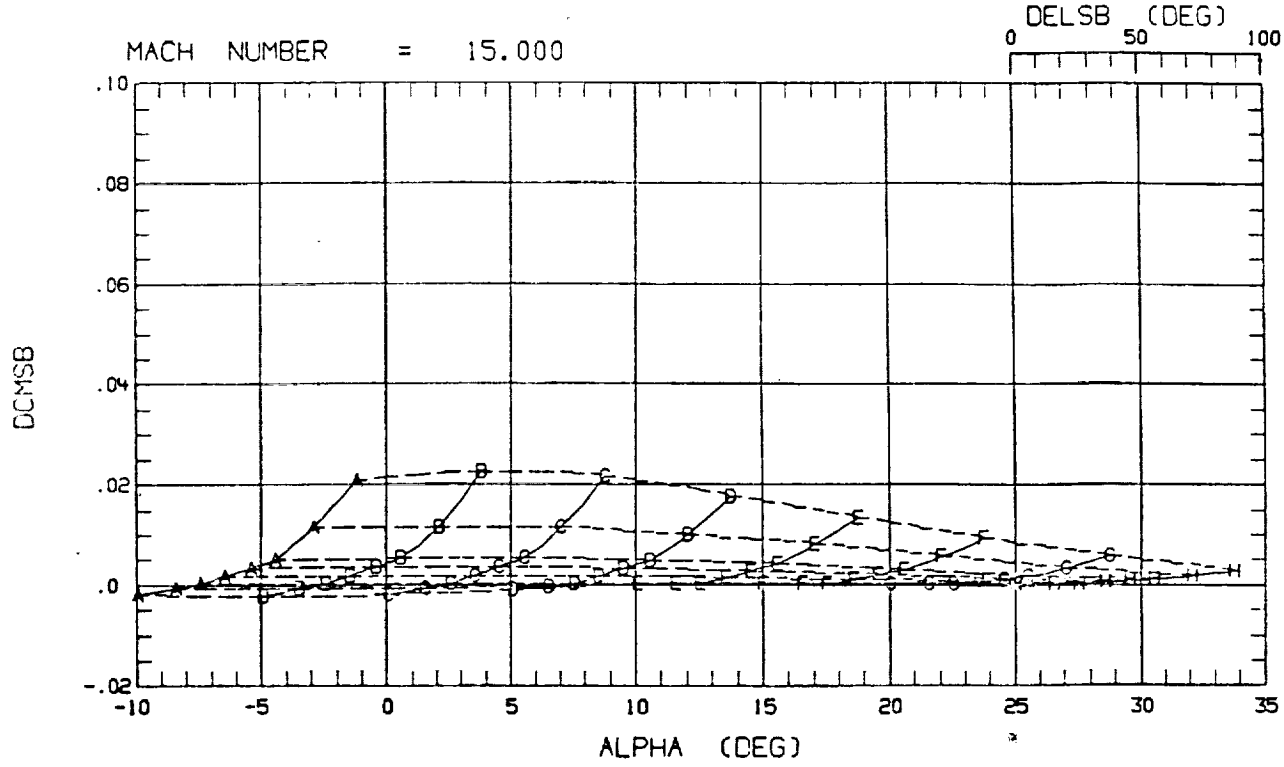
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00097	0.00057	0.00029	0.00010	0.0	0.0	0.0	0.0
45.000	0.00194	0.00114	0.00058	0.00027	0.0	0.0	0.0	0.0
55.000	0.00290	0.00170	0.00088	0.00040	0.00018	0.0	0.0	0.0
70.000	0.00548	0.00320	0.00165	0.00085	0.00034	0.0	0.0	0.0
87.200	0.00909	0.00560	0.00260	0.00130	0.00055	0.0	0.0	0.0

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.1.3-95
EFFECT OF SPEEDBRAKE



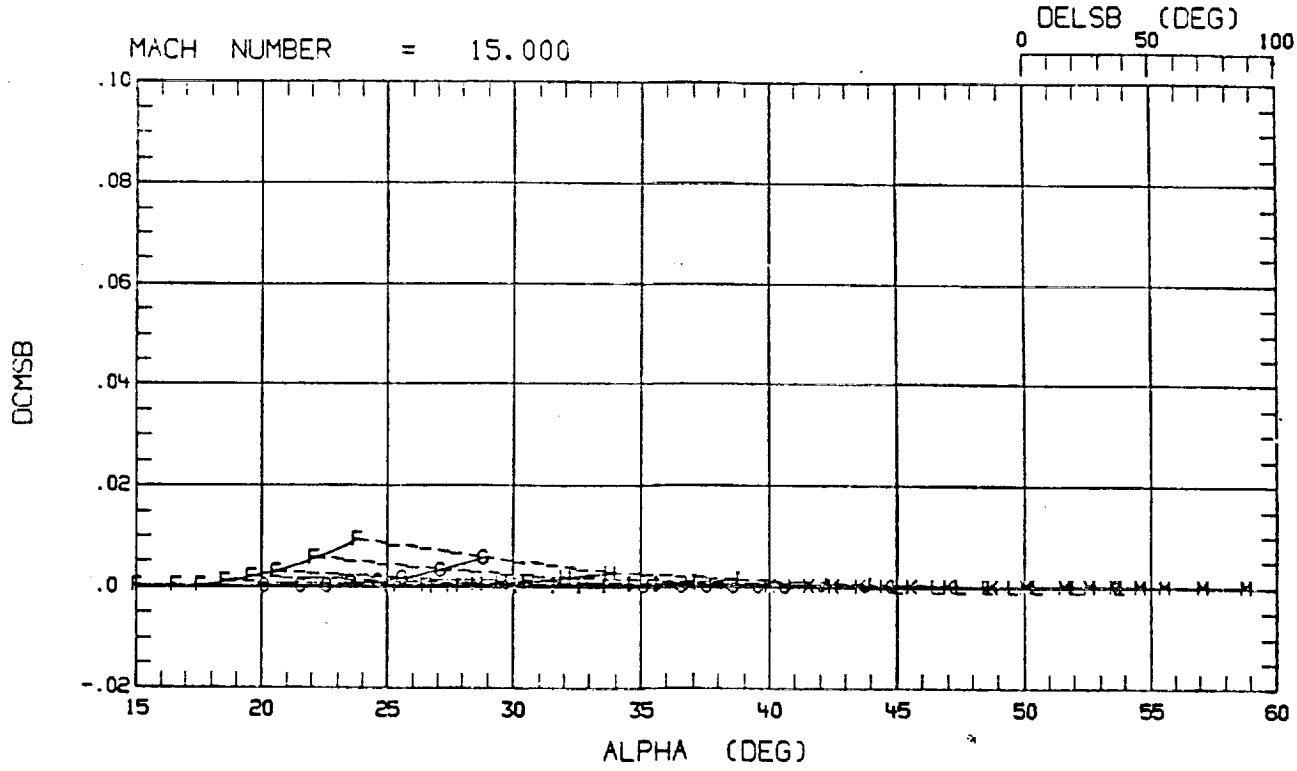
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00210	-0.00236	-0.00210	-0.00105	0.0	0.0	0.0	0.0
15.000	-0.00080	-0.00090	-0.00080	-0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00163	0.00173	0.00175	0.00160	0.00134	0.00097	0.00057	0.00029
45.000	0.00326	0.00346	0.00350	0.00320	0.00268	0.00194	0.00114	0.00058
55.000	0.00488	0.00518	0.00525	0.00480	0.00402	0.00290	0.00170	0.00088
70.000	0.01145	0.01135	0.01125	0.00980	0.00800	0.00548	0.00320	0.00165
87.200	0.02060	0.02238	0.02140	0.01755	0.01330	0.00909	0.00560	0.00260

ENGINEER DSD
DATE 9-15-78

FIGURE 4.1.1.3-96
EFFECT OF SPEEDBRAKE



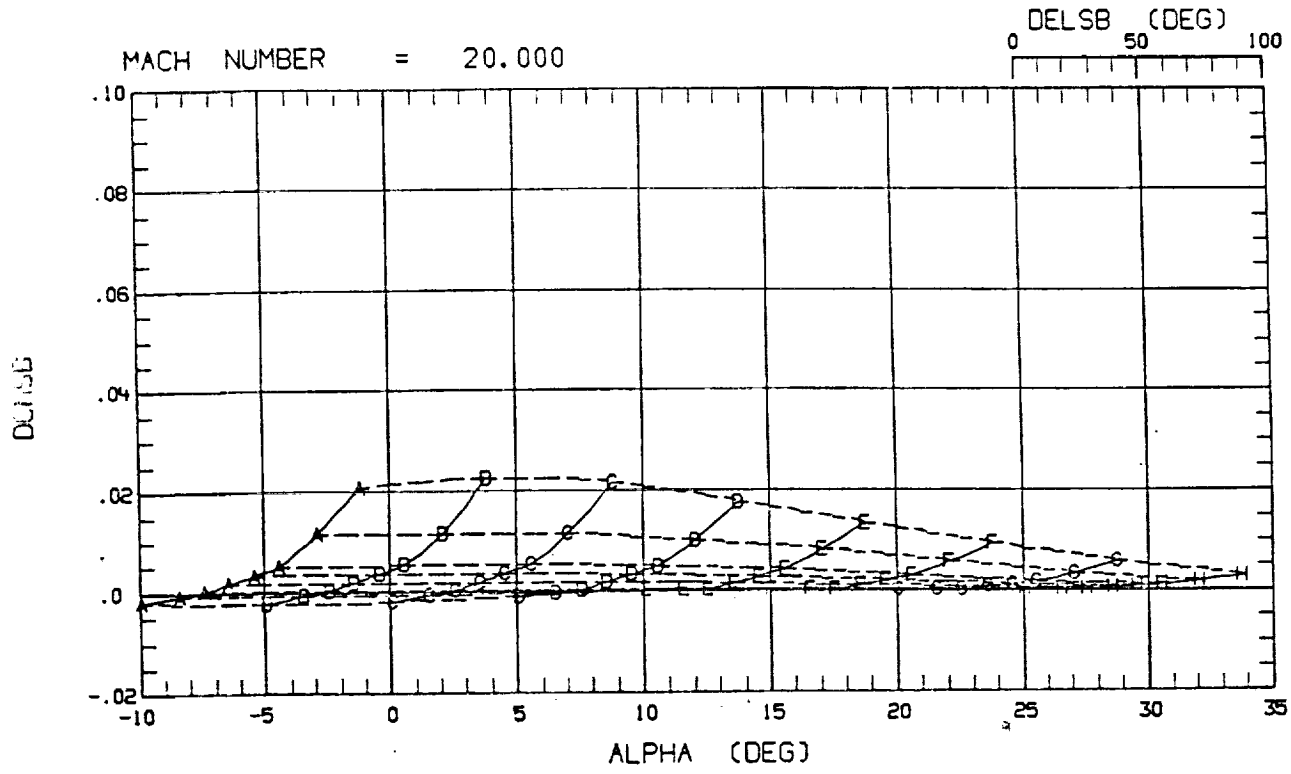
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00097	0.00057	0.00029	0.00010	0.0	0.0	0.0	0.0
45.000	0.00194	0.00114	0.00058	0.00027	0.0	0.0	0.0	0.0
55.000	0.00290	0.00170	0.00088	0.00040	0.00018	0.0	0.0	0.0
70.000	0.00548	0.00320	0.00165	0.00085	0.00034	0.0	0.0	0.0
87.200	0.00909	0.00560	0.00260	0.00130	0.00055	0.0	0.0	0.0

ENGINEER DSD
DATE 9-12-78

FIGURE 4.1.1.3-97
EFFECT OF SPEEDBRAKE



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

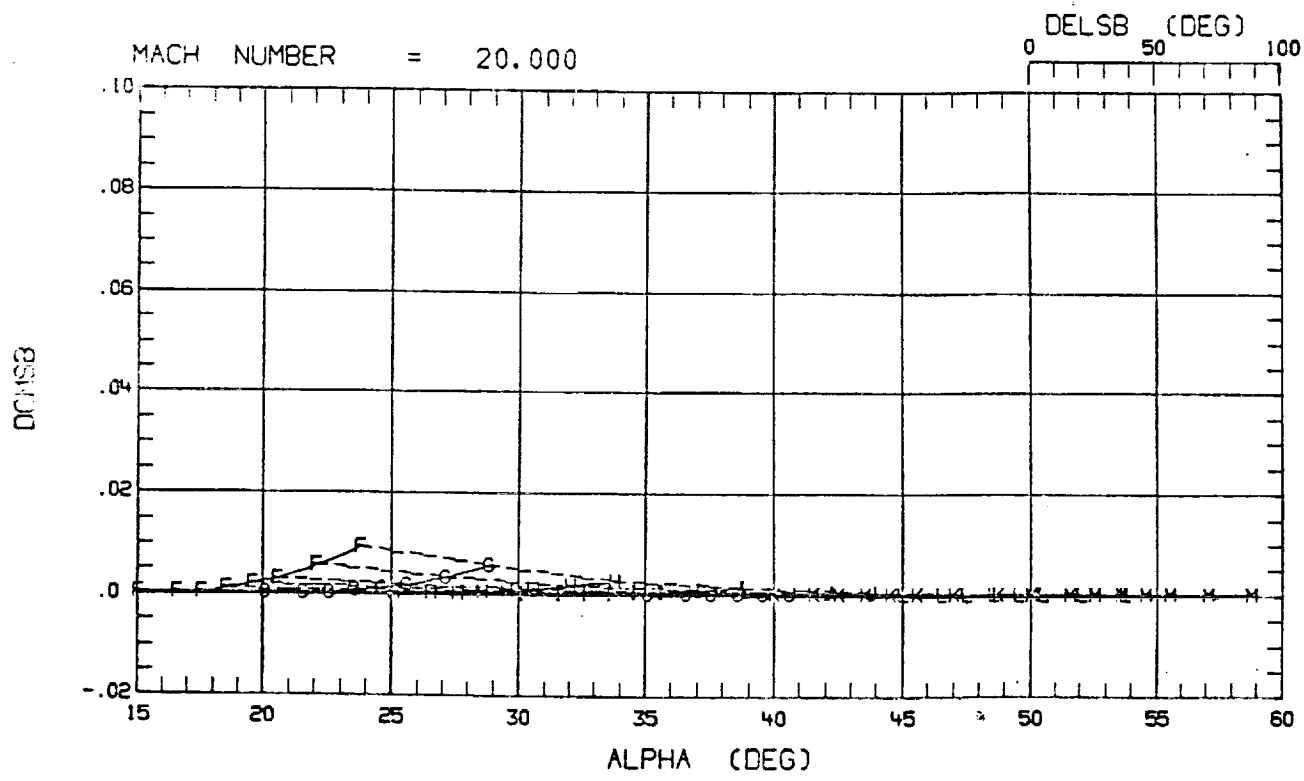
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	-0.00210	-0.00236	-0.00210	-0.00105	0.0	0.0	0.0	0.0
15.000	-0.00080	-0.00090	-0.00080	-0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00163	0.00173	0.00175	0.00160	0.00134	0.00097	0.00057	0.00029
45.000	0.00326	0.00346	0.00350	0.00320	0.00268	0.00194	0.00114	0.00058
55.000	0.00488	0.00518	0.00525	0.00480	0.00402	0.00290	0.00170	0.00088
70.000	0.01145	0.01135	0.01125	0.00980	0.00800	0.00548	0.00320	0.00165
87.200	0.02060	0.02238	0.02140	0.01755	0.01330	0.00909	0.00560	0.00260

ENGINEER DGD
DATE 9-15-78

FIGURE 4.1.1.3-98
EFFECT OF SPEEDBRAKE

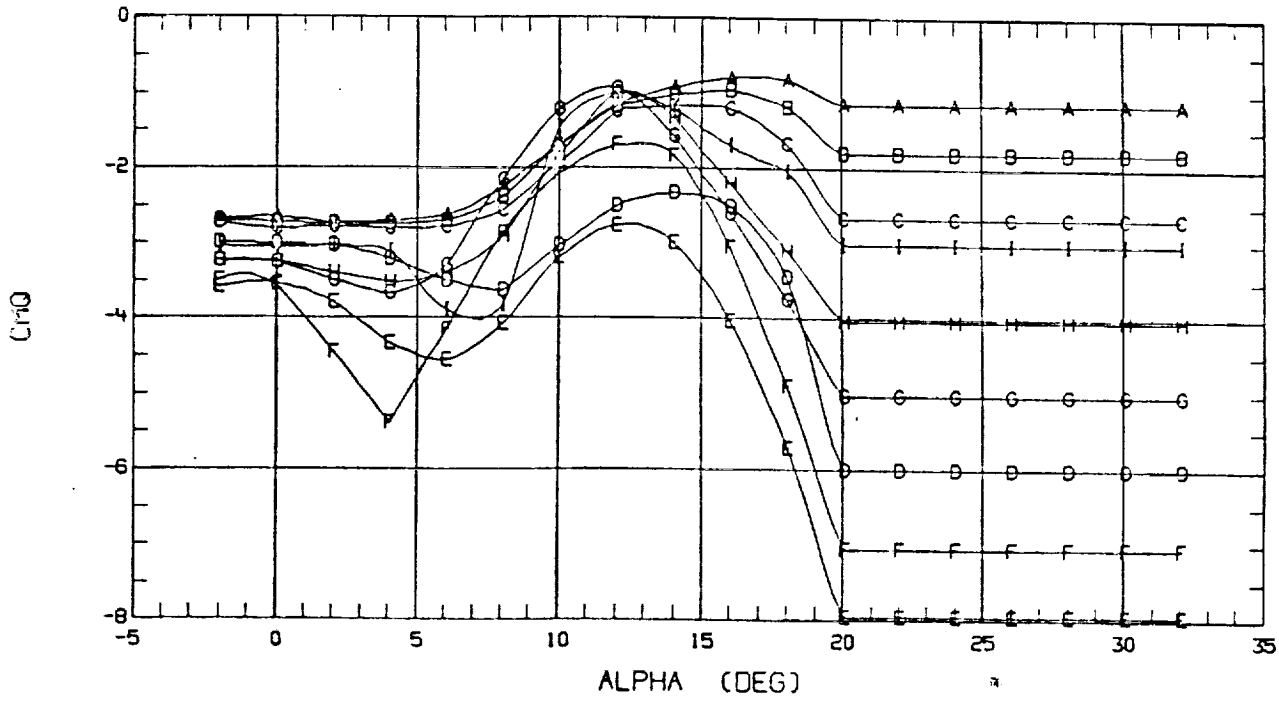


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PITCHING MOMENT INCR							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00097	0.00057	0.00029	0.00010	0.0	0.0	0.0	0.0
45.000	0.00194	0.00114	0.00058	0.00027	0.0	0.0	0.0	0.0
55.000	0.00290	0.00170	0.00088	0.00040	0.00018	0.0	0.0	0.0
70.000	0.00548	0.00320	0.00165	0.00085	0.00034	0.0	0.0	0.0
87.200	0.00909	0.00560	0.00260	0.00130	0.00055	0.0	0.0	0.0

ENGINEER DGD
DATE 9-13-78

FIGURE 4.1.1.3-99
EFFECT OF SPEEDBRAKE



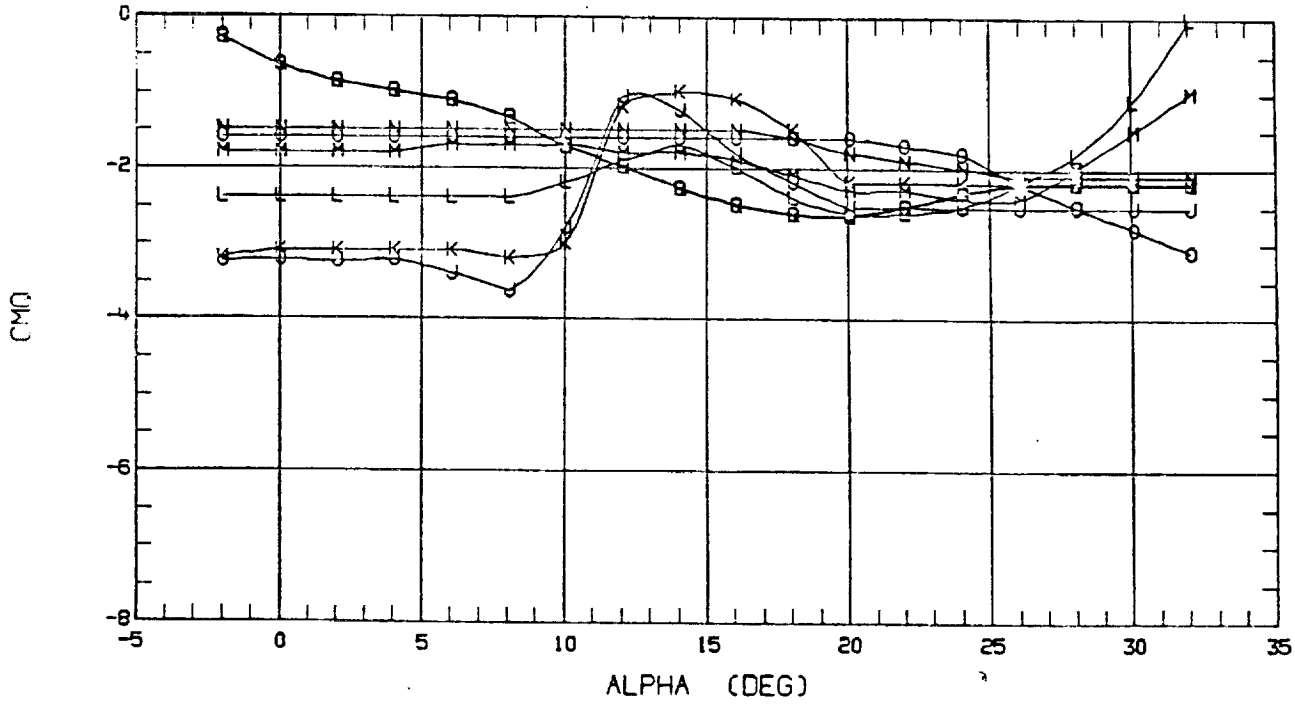
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	0.250	0.400	0.600	0.800	0.900	0.950	1.050	1.100	1.200
	A	B	C	D	E	F	G	H	I
ALPHA (DEG)	PITCH DAMPING								
-2.000	-2.69800	-2.71900	-2.74800	-3.00000	-3.60000	-3.50300	-3.25100	-3.25100	-3.05000
0.0	-2.67200	-2.73700	-2.82400	-3.02500	-3.55400	-3.58100	-3.27700	-3.27700	-3.07600
2.000	-2.74800	-2.76900	-2.79800	-3.05100	-3.80600	-4.46600	-3.50500	-3.40300	-3.05100
4.000	-2.72000	-2.76400	-2.82300	-3.22700	-4.33600	-5.39600	-3.68100	-3.52900	-3.12500
6.000	-2.64700	-2.71100	-2.79800	-3.50300	-4.56500	-4.15700	-3.30300	-3.40400	-3.30700
8.000	-2.26900	-2.39800	-2.57200	-3.63000	-4.08400	-2.87400	-2.16700	-2.92400	-3.83200
10.000	-1.68900	-1.71700	-1.94100	-3.05100	-3.20200	-2.09300	-1.23500	-1.84000	-1.46800
12.000	-1.16100	-1.20300	-1.26100	-2.52100	-2.77300	-1.71400	-0.95700	-1.00800	-1.00800
14.000	-0.93300	-1.04100	-1.18500	-2.34400	-3.00000	-1.84100	-1.58800	-1.33600	-1.23500
16.000	-0.80700	-0.97900	-1.20900	-2.52100	-4.03400	-3.07600	-2.62300	-2.21800	-1.71500
18.000	-0.83200	-1.19900	-1.68900	-3.45300	-5.72300	-4.91500	-3.75600	-3.10000	-2.04200
20.000	-1.15900	-1.80700	-2.67200	-6.00100	-7.96600	-7.05900	-5.04200	-4.03400	-3.02400
22.000	-1.15900	-1.80700	-2.67200	-6.00100	-7.96600	-7.05900	-5.04200	-4.03400	-3.02400
24.000	-1.15900	-1.80700	-2.67200	-6.00100	-7.96600	-7.05900	-5.04200	-4.03400	-3.02400
26.000	-1.15900	-1.80700	-2.67200	-6.00100	-7.96600	-7.05900	-5.04200	-4.03400	-3.02400
28.000	-1.15900	-1.80700	-2.67200	-6.00100	-7.96600	-7.05900	-5.04200	-4.03400	-3.02400
30.000	-1.15900	-1.80700	-2.67200	-6.00100	-7.96600	-7.05900	-5.04200	-4.03400	-3.02400
32.000	-1.15900	-1.80700	-2.67200	-6.00100	-7.96600	-7.05900	-5.04200	-4.03400	-3.02400

ENGINEER_____
DATE_____

FIGURE 4.1.1.3- 100
PITCH DAMPING



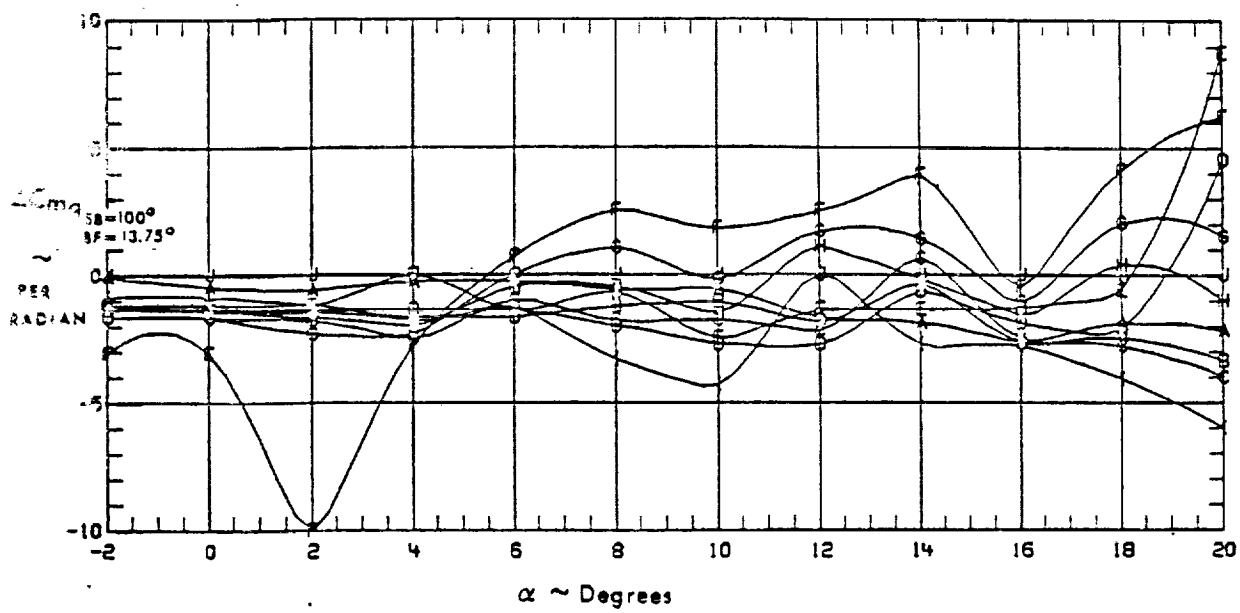
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	1.300 J	1.500 K	2.000 L	3.000 M	4.000 N	5.000 O	8.000 P	10.000 Q	20.000 R
ALPHA (DEG)	PITCH DAMPING								
-2.000	-3.25200	-3.20000	-2.40000	-1.80000	-1.50000	-1.60000	-0.27800	-0.27800	-0.27800
0.0	-3.22700	-3.10000	-2.40000	-1.80000	-1.50000	-1.60000	-0.65300	-0.65300	-0.65300
2.000	-3.25200	-3.10000	-2.40000	-1.80000	-1.50000	-1.60000	-0.87600	-0.87600	-0.87600
4.000	-3.22700	-3.10000	-2.40000	-1.80000	-1.50000	-1.60000	-0.99800	-0.99800	-0.99800
6.000	-3.40400	-3.10000	-2.40000	-1.70000	-1.50000	-1.60000	-1.12200	-1.12200	-1.12200
8.000	-3.63000	-3.20000	-2.40000	-1.70000	-1.50000	-1.60000	-1.34500	-1.34500	-1.34500
10.000	-2.79800	-3.00000	-2.20000	-1.70000	-1.50000	-1.60000	-1.72200	-1.72200	-1.72200
12.000	-1.05900	-1.20000	-1.90000	-1.80000	-1.50000	-1.60000	-1.99300	-1.99300	-1.99300
14.000	-1.23500	-1.00000	-1.70000	-1.80000	-1.50000	-1.60000	-2.26700	-2.26700	-2.26700
16.000	-1.81500	-1.10000	-2.00000	-1.90000	-1.50000	-1.60000	-2.49000	-2.49000	-2.49000
18.000	-2.19300	-1.50000	-2.40000	-2.10000	-1.60000	-1.60000	-2.61400	-2.61400	-2.61400
20.000	-2.52000	-2.20000	-2.60000	-2.30000	-1.80000	-1.60000	-2.63800	-2.63800	-2.63800
22.000	-2.52000	-2.20000	-2.60000	-2.30000	-1.90000	-1.70000	-2.51100	-2.51100	-2.51100
24.000	-2.52000	-2.20000	-2.50000	-2.40000	-2.00000	-1.80000	-2.32900	-2.32900	-2.32900
26.000	-2.52000	-2.20000	-2.20000	-2.40000	-2.10000	-2.20000	-2.20200	-2.20200	-2.20200
28.000	-2.52000	-2.20000	-1.80000	-2.00000	-2.10000	-2.50000	-2.20200	-2.20200	-2.20200
30.000	-2.52000	-2.20000	-1.10000	-1.50000	-2.10000	-2.80000	-2.20200	-2.20200	-2.20200
32.000	-2.52000	-2.20000	0.0	-1.00000	-2.10000	-3.10000	-2.20200	-2.20200	-2.20200

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-101
PITCH DAMPING



$$\Delta C_{m_{q_{\substack{SB \\ BF}}}} = \left[K_{SB}\left(\frac{\delta_{SB}-25}{75}\right) + \left(1-K_{SB}\right)\left(\frac{\delta_{BF}}{13.75}\right)\right]\Delta C_{m_{q_{\substack{SB=100° \\ BF=13.75°}}}}$$

NOTE: 1. For normal simulations, use $K_{SB} = 0.5$

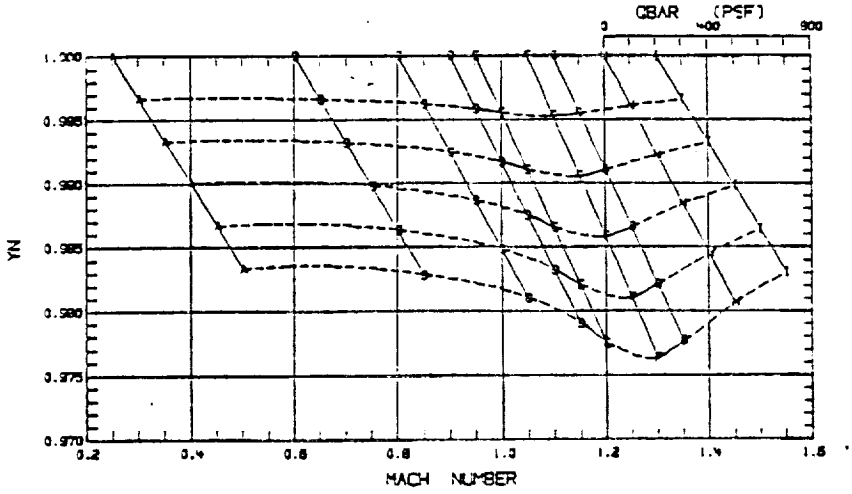
2. For sensitivity studies, assume K_{SB} can be either 0 or 1.

ALPHA (DEG)	MACH NUMBER 0.250 A	0.400 B	0.600 C	0.800 D	0.900 E	0.950 F	1.050 G	1.100 H	1.200 I	2.000 J
	SB - BF PITCH DAMPING INCREMENT									
-2.000	-0.10000	-1.22000	-1.70000	-1.40000	-1.20000	-3.10000	-1.70000	-1.40000	-0.90000	0.0
0.0	-0.50000	-1.42000	-1.70000	-1.40000	-1.20000	-3.10000	-1.70000	-1.40000	-0.90000	0.0
2.000	-0.60000	-1.50000	-1.80000	-1.40000	-1.20000	-10.00000	-2.30000	-1.70000	-1.20000	0.0
4.000	-0.30000	-1.67000	-2.50000	-1.40000	0.0	-2.80000	-2.30000	-2.00000	-1.80000	0.0
6.000	-0.30000	-1.65000	-1.00000	-1.40000	-1.40000	0.70000	0.0	-0.50000	-1.30000	0.0
8.000	-0.60000	-1.25000	-1.80000	-2.00000	-0.70000	2.50000	1.00000	-0.50000	-3.30000	0.0
10.000	-0.50000	-1.10000	-1.80000	-2.70000	-2.50000	1.80000	-0.20000	-1.50000	-4.30000	0.0
12.000	-1.70000	-1.85000	-2.20000	-2.70000	-1.40000	2.50000	1.70000	1.10000	0.0	0.0
14.000	-1.90000	-0.40000	0.60000	-0.70000	-1.40000	3.90000	1.40000	-0.20000	-2.70000	0.0
16.000	-2.60000	-2.65000	-2.50000	-1.90000	-1.30000	-0.50000	-1.10000	-1.60000	-2.80000	0.0
18.000	-1.90000	-2.50000	-2.80000	-2.10000	-0.60000	4.10000	2.00000	0.40000	-4.10000	0.0
20.000	-2.20000	-3.35000	-4.00000	4.50000	8.70000	6.20000	1.50000	-1.00000	-6.00000	0.0

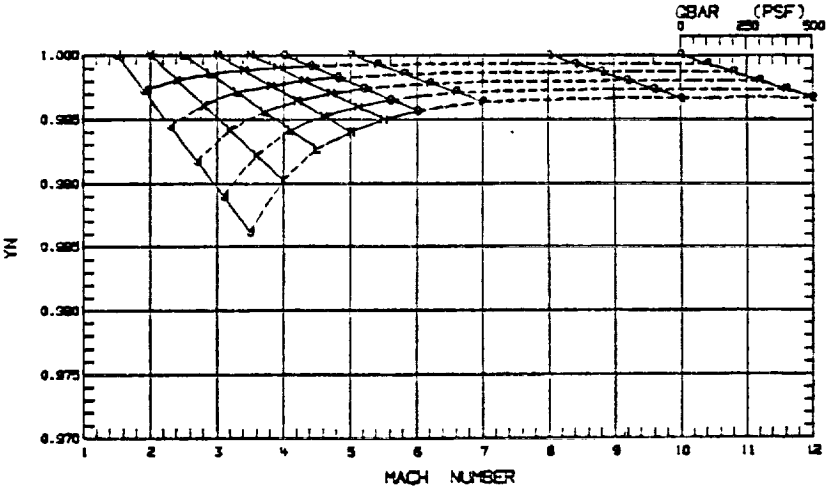
FIGURE 4.1.1.3-102
PITCH DAMPING INCREMENT

ENGINEER [illegible]
DATE 9/12/79

CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.3 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.



	MACH NUMBER								
	0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
QBAR (PSF)	F/R NORMAL FORCE (OR LIFT) SLOPE								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99887	0.99887	0.99820	0.99280	0.99250	0.99527	0.99253	0.99813	0.99880
200.000	0.99333	0.99313	0.99240	0.99160	0.99100	0.99053	0.99107	0.99227	0.99320
300.000	0.99000	0.98970	0.98880	0.98740	0.98650	0.98580	0.98680	0.98840	0.98980
400.000	0.98667	0.98627	0.98480	0.98320	0.98200	0.98107	0.98213	0.98453	0.98640
500.000	0.98333	0.98293	0.98100	0.97900	0.97750	0.97633	0.97787	0.98067	0.98300

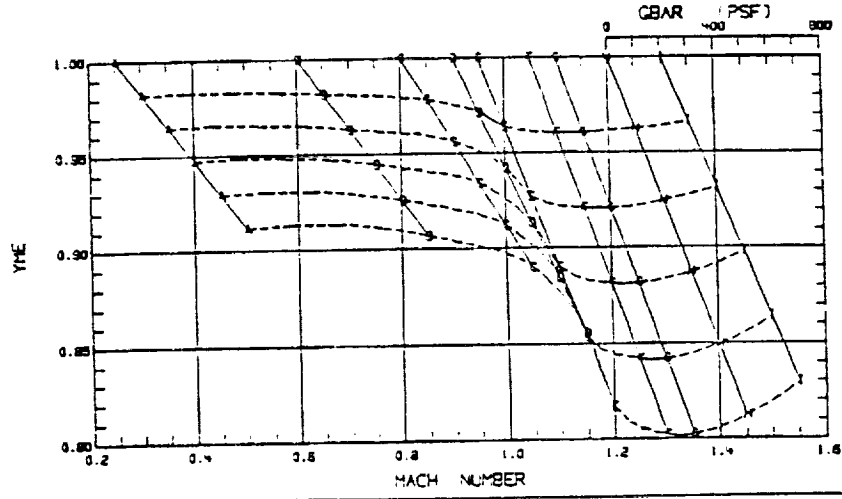


	MACH NUMBER								
	1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
QBAR (PSF)	F/R NORMAL FORCE (OR LIFT) SLOPE								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99723	0.99803	0.99853	0.99880	0.99900	0.99813	0.99827	0.99833	0.99833
200.000	0.99447	0.99607	0.99707	0.99760	0.99800	0.99627	0.99653	0.99667	0.99667
300.000	0.99170	0.99410	0.99560	0.99640	0.99700	0.99440	0.99480	0.99500	0.99500
400.000	0.98893	0.99213	0.99413	0.99520	0.99600	0.99253	0.99307	0.99333	0.99333
500.000	0.98617	0.99017	0.99267	0.99400	0.99500	0.99067	0.99133	0.99167	0.99167

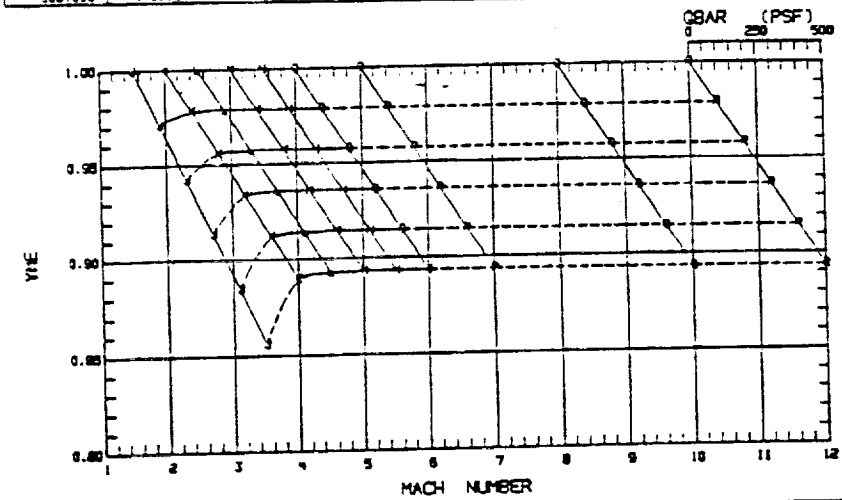
ENGINEER
DATE 4-2-72

FIGURE 4.1.1.3-103
FLEX/RIGID NORMAL FORCE (OR LIFT) SLOPE WITH ALPHA

CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XD = FS	1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YD = BL	0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZD = WL	375.0 IN.	M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.



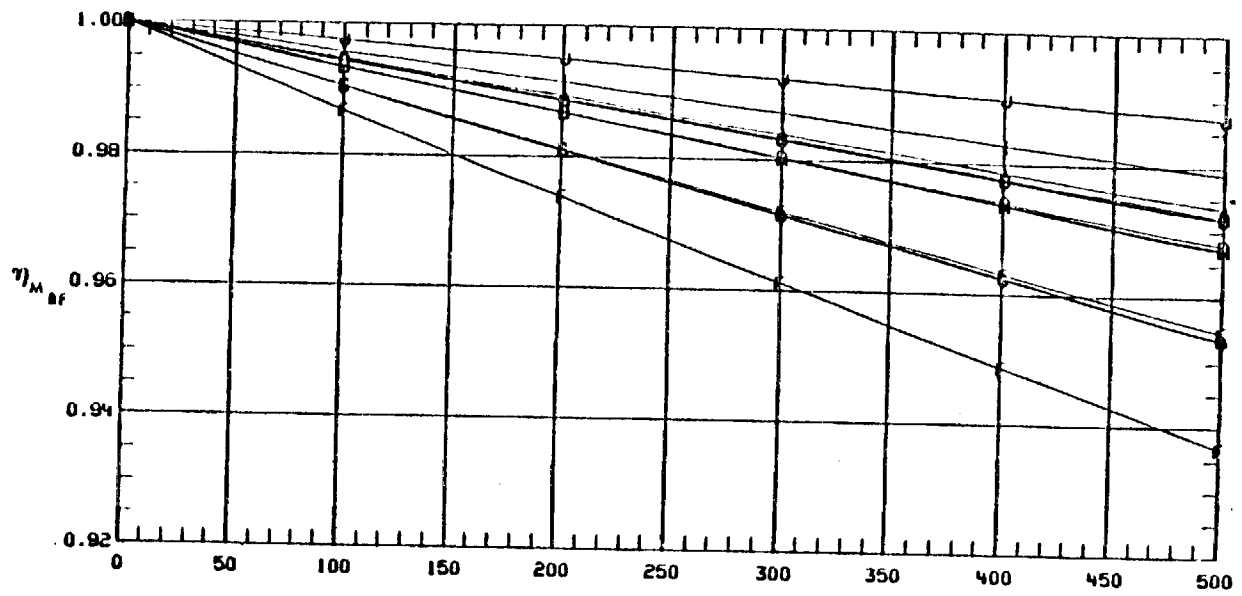
	MACH NUMBER								
	0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
QBAR (PSF)	F/R ELEVON PITCHING MOM EFFECT								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98233	0.98133	0.97800	0.97110	0.96333	0.96037	0.96050	0.96240	0.96583
200.000	0.96467	0.96267	0.95600	0.94220	0.92667	0.92073	0.92100	0.92480	0.93167
300.000	0.94700	0.94400	0.93400	0.91330	0.89000	0.88110	0.88150	0.88720	0.89750
400.000	0.92933	0.92533	0.91200	0.88440	0.85333	0.84147	0.84200	0.84960	0.86333
500.000	0.91167	0.90667	0.89000	0.85550	0.81667	0.80183	0.80250	0.81200	0.82917

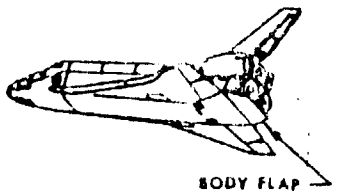


	MACH NUMBER								
	1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
QBAR (PSF)	F/R ELEVON PITCHING MOM EFFECT								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97117	0.97800	0.97680	0.97883	0.97887	0.97887	0.97887	0.97887	0.97857
200.000	0.94233	0.95600	0.95720	0.95767	0.95733	0.95733	0.95733	0.95733	0.95733
300.000	0.91350	0.93400	0.93580	0.93590	0.93600	0.93600	0.93600	0.93600	0.93600
400.000	0.88467	0.91200	0.91440	0.91453	0.91467	0.91467	0.91467	0.91467	0.91467
500.000	0.85583	0.89000	0.89300	0.89317	0.89333	0.89333	0.89333	0.89333	0.89333

ENGINEER
DATE 4-2-14

FIGURE 4.1.1.3-104
FLEXIBLE/RIGID ELEVON PITCHING MOMENT EFFECTIVENESS





Body Flap Effectiveness

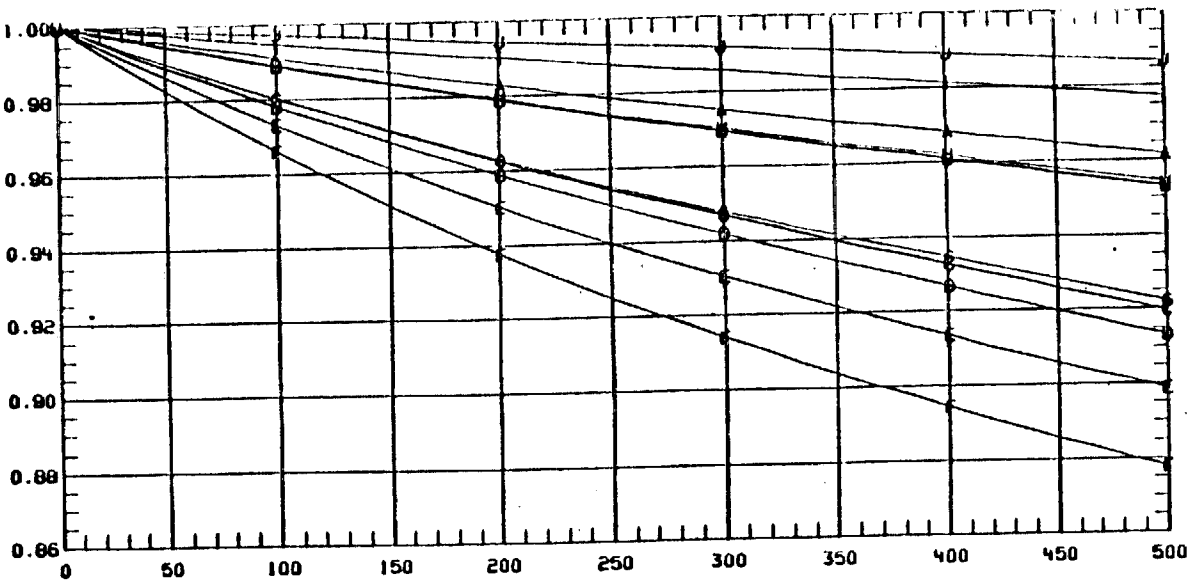
$$\eta_{M_{BF}} = \frac{C_{m_{\delta_{BF}}}^{F}}{C_{m_{\delta_{BF}}}^{R}}$$

$\bar{q}\sim$ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{M_{BF}}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99452	0.99427	0.99420	0.99331	0.99043	0.98665	0.99028	0.99325	0.99563	0.99738
200.000	0.98910	0.98862	0.98848	0.98673	0.98106	0.97365	0.98076	0.98659	0.99129	0.99478
300.000	0.98376	0.98303	0.98283	0.98025	0.97191	0.96100	0.97142	0.98002	0.98699	0.99219
400.000	0.97851	0.97753	0.97725	0.97388	0.96299	0.94873	0.96229	0.97352	0.98272	0.98961
500.800	0.97344	0.97205	0.97174	0.96779	0.95440	0.93671	0.95328	0.96704	0.97864	0.98709

ENGINEER: DTO
DATE: 9/2/77
REVISED:

Figure 4.1.1.3-105
AEROELASTIC RATIOS

Rockwell International
Space Division



Pitch Rate

$$\eta_{Mq} = \frac{C_{mq}^{f}}{C_{mq}^{R}}$$

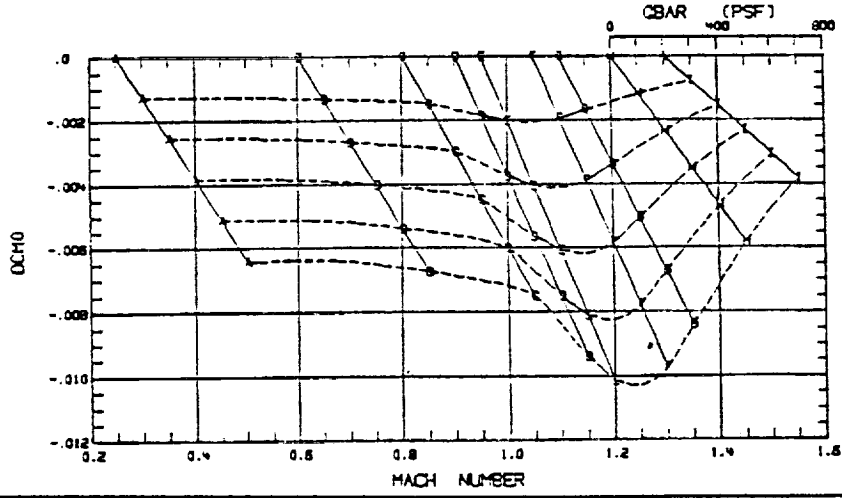
$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, η_{Mq}									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99095	0.98883	0.98010	0.97801	0.97295	0.96579	0.98008	0.98894	0.99478	0.99713
200.000	0.98264	0.97857	0.96231	0.95861	0.94981	0.93731	0.96270	0.97892	0.98996	0.99436
300.000	0.97502	0.96922	0.94649	0.94159	0.93018	0.91387	0.94757	0.96986	0.98547	0.99168
400.000	0.96801	0.96073	0.93236	0.92653	0.91330	0.89424	0.93419	0.96164	0.98121	0.98910
500.000	0.96148	0.95276	0.91970	0.91296	0.89864	0.87758	0.92214	0.95410	0.97718	0.98660

ENGINEER: DTD
DATE: 8/31/71
REVISED:

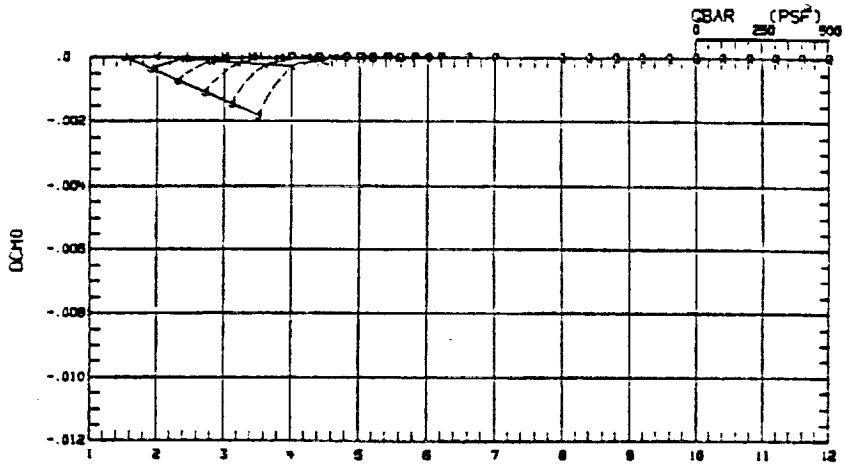
Figure 4.1.1.3-106
AEROELASTIC RATIOS

Rockwell International
Space Division

CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1078.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CM = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	



	MACH NUMBER								
	0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
QBAR (PSF)	FLEX PITCH MOM INCR AT ALPHA=0								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.00128	-0.00135	-0.00151	-0.00188	-0.00203	-0.00198	-0.00188	-0.00117	-0.00077
200.000	-0.00257	-0.00271	-0.00301	-0.00377	-0.00407	-0.00396	-0.00337	-0.00233	-0.00153
300.000	-0.00385	-0.00406	-0.00452	-0.00565	-0.00610	-0.00585	-0.00505	-0.00350	-0.00230
400.000	-0.00513	-0.00541	-0.00603	-0.00753	-0.00813	-0.00780	-0.00673	-0.00467	-0.00307
500.000	-0.00642	-0.00677	-0.00753	-0.00942	-0.01017	-0.00975	-0.00842	-0.00583	-0.00383

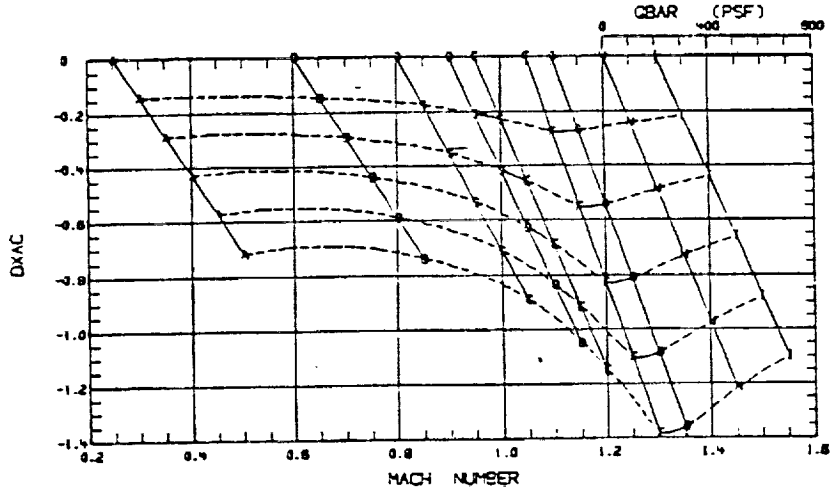


	MACH NUMBER								
	1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
QBAR (PSF)	FLEX PITCH MOM INCR AT ALPHA=0								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.00037	-0.00006	-0.00002	-0.00001	0.0	0.0	0.0	0.0	0.0
200.000	-0.00073	-0.00011	-0.00003	-0.00002	0.0	0.0	0.0	0.0	0.0
300.000	-0.00110	-0.00017	-0.00005	-0.00003	0.0	0.0	0.0	0.0	0.0
400.000	-0.00147	-0.00023	-0.00007	-0.00004	0.0	0.0	0.0	0.0	0.0
500.000	-0.00183	-0.00028	-0.00008	-0.00005	0.0	0.0	0.0	0.0	0.0

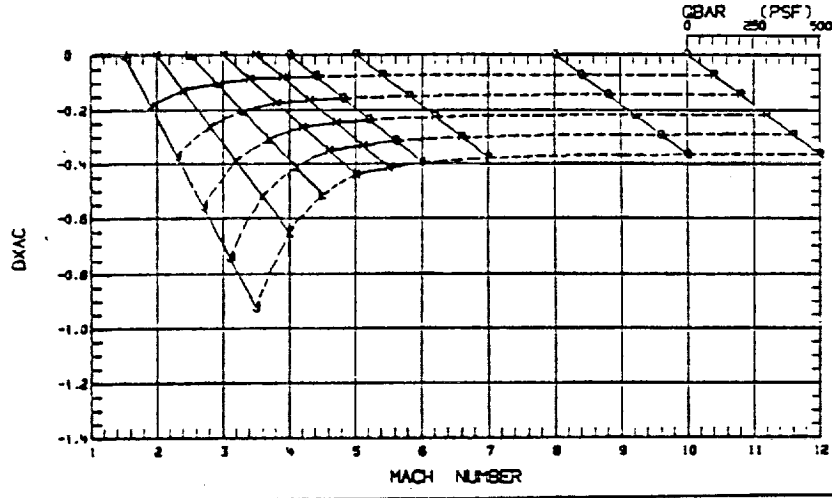
ENGINEER DTD
DATE 4-2-79

FIGURE 4.1.1.3-107
FLEX PITCHING MOMENT INCR. AT ZERO ANGLE OF ATTACK

CONFIGURATION			REFERENCE DIMENSIONS		
BASELINE ORBITER VEHICLE					
CENTER OF GRAVITY	XO = FS	1078.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT
			BODY LENGTH	LB = 1290.3	IN



	MACH NUMBER								
	0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
QBAR (PSF)	FLEX A.C. SHIFT (D MAC)								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.14333	-0.14833	-0.17833	-0.21000	-0.23000	-0.27667	-0.27167	-0.24333	-0.22000
200.000	-0.28667	-0.29667	-0.35667	-0.42000	-0.46000	-0.55333	-0.54333	-0.48667	-0.44000
300.000	-0.43000	-0.44500	-0.53500	-0.63000	-0.69000	-0.83000	-0.81500	-0.73000	-0.66000
400.000	-0.57333	-0.59333	-0.71333	-0.84000	-0.92000	-1.10667	-1.08667	-0.97333	-0.88000
500.000	-0.71667	-0.74167	-0.89167	-1.05000	-1.15000	-1.38333	-1.35833	-1.21667	-1.10000

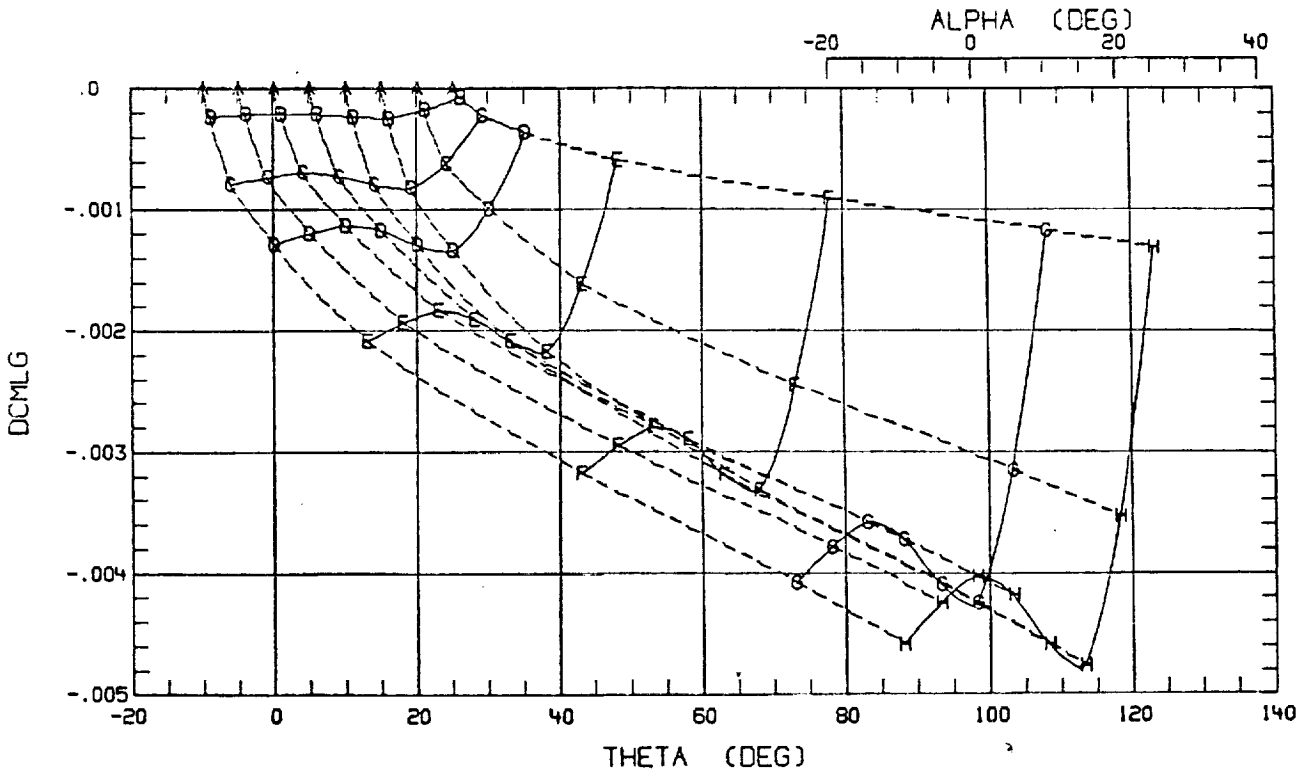


	MACH NUMBER								
	1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	6.000 Q	10.000 R
QBAR (PSF)	FLEX A.C. SHIFT (D MAC)								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.18667	-0.13667	-0.10333	-0.08833	-0.08333	-0.07833	-0.07800	-0.07333	-0.07333
200.000	-0.37133	-0.25133	-0.20667	-0.17667	-0.16667	-0.15667	-0.15200	-0.14667	-0.14667
300.000	-0.55700	-0.38200	-0.31000	-0.26500	-0.25000	-0.23800	-0.22800	-0.22000	-0.22000
400.000	-0.74267	-0.52267	-0.41333	-0.35333	-0.33333	-0.31733	-0.30400	-0.29333	-0.29333
500.000	-0.92933	-0.65333	-0.51667	-0.44167	-0.41667	-0.39667	-0.38000	-0.36667	-0.36667

ENGINEER [signature]
DATE 4-23-79

FIGURE 4.1.1.3-108
FLEX AERODYNAMIC CENTER SHIFT (□ MAC.- = FWD SHIFT)

SL 72-[illegible] IM



CONFIGURATION

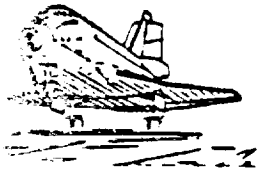
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	THETA (DEG)							
	0.0	1.000	4.000	10.000	23.000	53.000	83.000	98.000
	A	B	C	D	E	F	G	H
ALPHA (DEG)	LANDING GEAR P.M. INCREMENT							
-10.000	0.0	-0.00024	-0.00080	-0.00130	-0.00210	-0.00319	-0.00409	-0.00459
-5.000	0.0	-0.00022	-0.00074	-0.00120	-0.00194	-0.00296	-0.00379	-0.00425
0.0	0.0	-0.00021	-0.00070	-0.00114	-0.00184	-0.00280	-0.00359	-0.00403
5.000	0.0	-0.00022	-0.00073	-0.00118	-0.00191	-0.00291	-0.00373	-0.00419
10.000	0.0	-0.00024	-0.00080	-0.00130	-0.00210	-0.00320	-0.00410	-0.00460
15.000	0.0	-0.00025	-0.00083	-0.00135	-0.00218	-0.00332	-0.00425	-0.00477
20.000	0.0	-0.00018	-0.00062	-0.00100	-0.00162	-0.00246	-0.00316	-0.00354
25.000	0.0	-0.00007	-0.00023	-0.00037	-0.00060	-0.00092	-0.00118	-0.00132

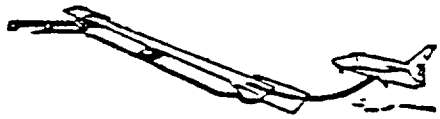
ENGINEER [signature]
DATE 9/21/78

FIGURE 4.1.1.3-109
LANDING GEAR PITCHING MOMENT COEFFICIENT INCREMENT

Landing Gear Down



$$\Delta Cm_{GROUND\ EFFECT} = Cm_{GROUND\ EFFECT} - Cm_{FREE\ STREAM}$$



CONFIGURATION

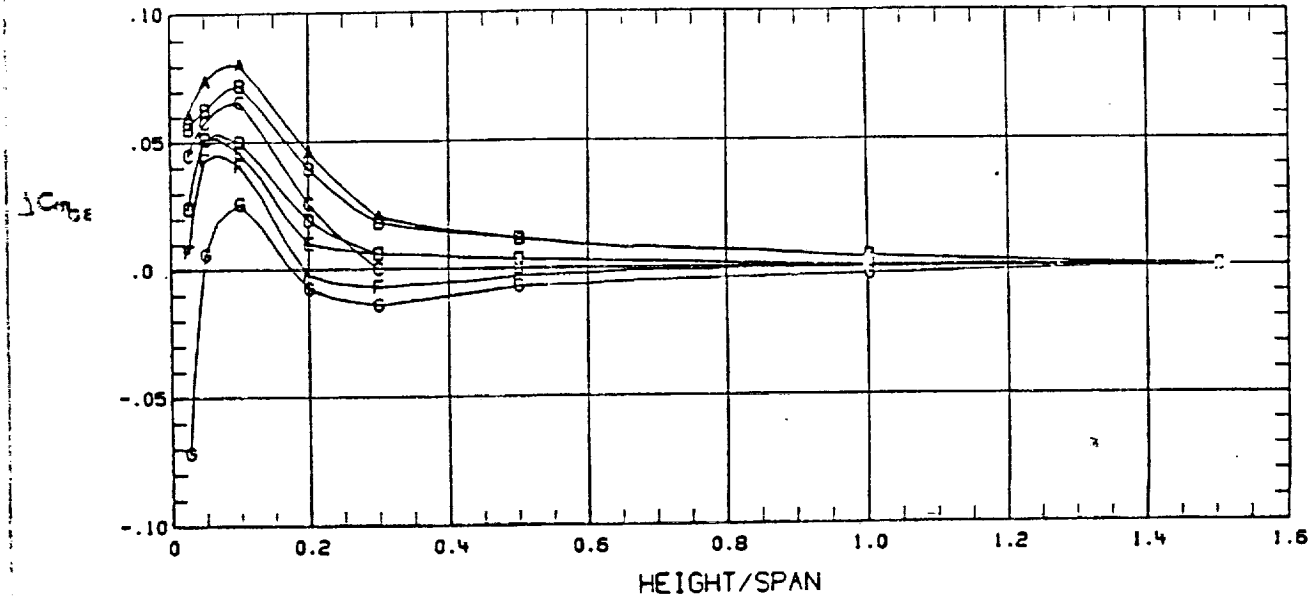
BASELINE ORBITER VEHICLE

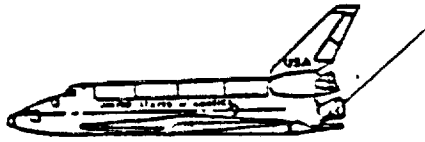
CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = FS 1078.73; Y_{cg} = BL 0.00; Z_{cg} = WL 375.38

REFERENCE DIMENSIONS

AREA	S_{ref} = 2690.000 ft²
SPAN	b_{ref} = 78.056 ft
MAC	c_{ref} = 39.550 ft
BODY LENGTH	L_B = 1290.300 in

δ_e = -40.000° $\quad \delta_{BF}$ = -11.7° $\quad \delta_{SB}$ = All



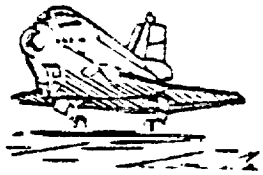


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta Cm_{GRND\ EFFECT}$						
0.025	0.06000	0.05470	0.04400	0.02400	0.02400	0.00670	-0.07200
0.050	0.07340	0.06270	0.05740	0.05070	0.05070	0.04270	0.00540
0.100	0.08010	0.07210	0.06550	0.04950	0.04550	0.04010	0.02550
0.200	0.04560	0.03890	0.02560	0.01890	0.00960	-0.00240	-0.00780
0.300	0.02040	0.01770	0.0	0.00570	0.00570	-0.00760	-0.01430
0.500	0.01130	0.01130	0.0	0.00330	0.00330	-0.00340	-0.00740
1.000	0.00400	0.00400	0.0	0.0	0.0	0.0	-0.00300
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

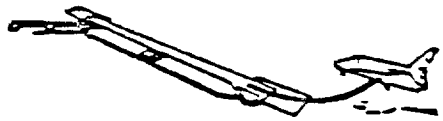
ENGINEER:
DATE 6/14/77
REVISED:

Figure 4.1.1.3-110
GROUND EFFECT

Landing Gear Down



$$\Delta C_{m_{GROUND\ EFFECT}} = C_{m_{GROUND\ EFFECT}} - C_{m_{FREE\ STREAM}}$$



CONFIGURATION

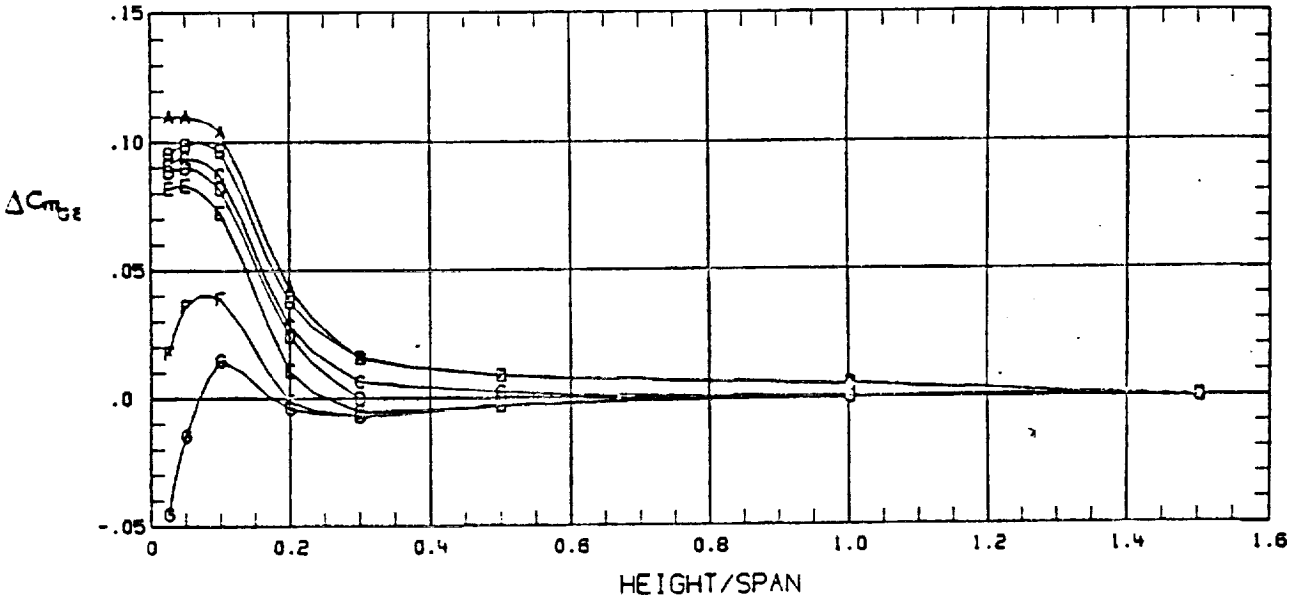
BASELINE ORBITER VEHICLE

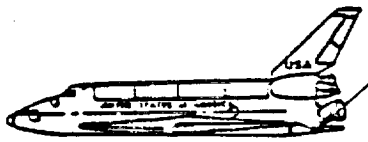
CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = 1076.70, Y_{cg} = 0.00, Z_{cg} = 375.00

REFERENCE DIMENSIONS

AREA = 2690.000 ft²
SPAN = 78.056 ft
MAC = 39.550 ft
BODY LENGTH = 1296.300 in

δ_e = -30.000° δ_{3F} = -11.7° δ_{SB} = All





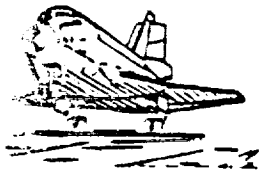
Reference Point for h/b
X_e 1506.84
Z_e 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.10930	0.09460	0.09060	0.08800	0.08130	0.01730	-0.04540
0.050	0.10930	0.09860	0.09330	0.08930	0.08260	0.03590	-0.01470
0.100	0.10390	0.09590	0.08650	0.08120	0.07190	0.03850	0.01450
0.200	0.04240	0.03710	0.02780	0.02380	0.01040	-0.00160	-0.00420
0.300	0.01560	0.01560	0.00630	0.0	-0.00570	-0.00700	-0.00700
0.500	0.00870	0.00870	0.00210	0.0	-0.00330	-0.00330	-0.00330
1.000	0.00500	0.00500	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

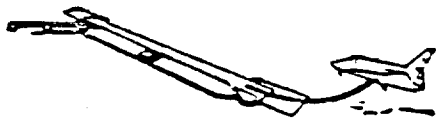
ENGINEER:
DATE: 5/24/77
REVISED:

Figure 4.1.1.3-111
GROUND EFFECT

Landing Gear Down



$$\Delta Cm_{GROUND\ EFFECT} = Cm_{GROUND\ EFFECT} - Cm_{FREE\ STREAM}$$



CONFIGURATION

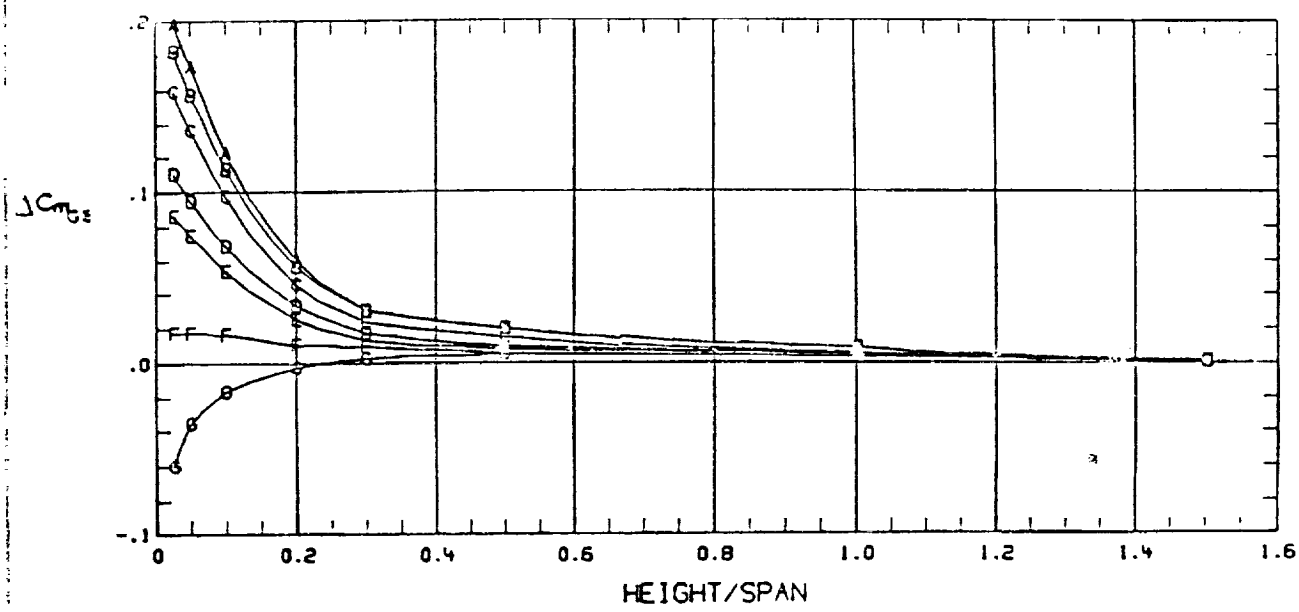
BASELINE ORBITER VEHICLE

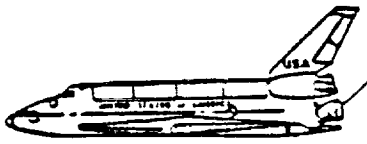
CENTER OF GRAVITY	X_{cg} = FS	1076.30
OR	Y_{cg} = BL	0.00
MOMENT REFERENCE	Z_{cg} = WL	375.00

REFERENCE DIMENSIONS

AREA	S_{ref} =	2690.000 ft²
SPAN	b_{ref} =	78.056 ft
MAC	c_{ref} =	39.560 ft
BODY LENGTH	L_B =	1290.300 in

$\delta_e = -20.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} = All$





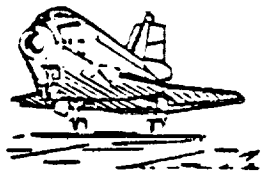
Reference Point for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta Cm_{GRND\ EFFECT}$						
0.025	0.19860	0.18260	0.15860	0.11060	0.08530	0.01730	-0.06000
0.050	0.17330	0.15730	0.13590	0.09460	0.07460	0.01730	-0.03610
0.100	0.12250	0.11320	0.09720	0.06790	0.05320	0.01590	-0.01750
0.200	0.05980	0.05580	0.04510	0.03310	0.02510	0.01040	-0.00290
0.300	0.03030	0.03030	0.02360	0.01700	0.01300	0.00900	0.00230
0.500	0.01940	0.01940	0.01410	0.00870	0.00740	0.00470	0.00470
1.000	0.00800	0.00800	0.00500	0.00500	0.00500	0.00300	0.00300
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE 9-14-77
REVISED:

Figure 4.1.1.3-112
GROUND EFFECT

Landing Gear Down



$$\Delta C_{m_{\substack{\text{GROUND}\\\text{EFFECT}}}} = C_{m_{\substack{\text{GROUND}\\\text{EFFECT}}}} - C_{m_{\substack{\text{FREE}\\\text{STREAM}}}}$$

CONFIGURATION

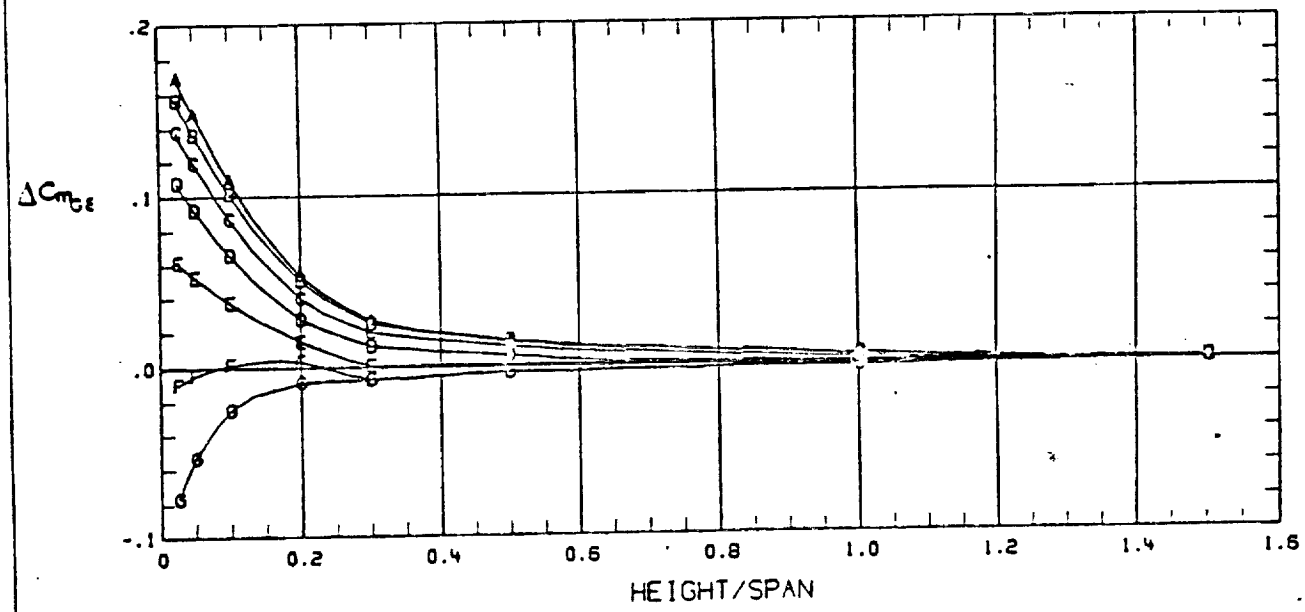
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.20, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

AREA	S_w = 2690.000 ft²
SPAN	b_w = 78.056 ft
MAC	c_w = 39.560 in
BODY LENGTH	l_B = 1290.300 in

$\delta_e = -15.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} = All$



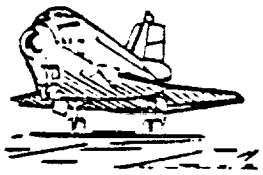
Reference Point for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.16930	0.15600	0.13730	0.10800	0.06130	-0.01070	-0.07730
0.050	0.14800	0.13600	0.11870	0.09200	0.05200	-0.00530	-0.05330
0.100	0.10930	0.10130	0.08670	0.06530	0.03730	0.00130	-0.02530
0.200	0.05330	0.05070	0.04000	0.02800	0.01470	0.00270	-0.00930
0.300	0.02670	0.02530	0.02000	0.01200	0.0	-0.00800	-0.00800
0.500	0.01330	0.01470	0.01070	0.00530	0.0	-0.00400	-0.00400
1.000	0.00500	0.00500	0.00300	0.0	0.0	-0.00200	-0.00200
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JS
DATE: 9-14-77
REVISED:

Figure 4.1.1.3-113
GROUND EFFECT

Landing Gear Down



$$\Delta C_{m_{GROUND\ EFFECT}} = C_{m_{GROUND\ EFFECT}} - C_{m_{FREE\ STREAM}}$$

CONFIGURATION

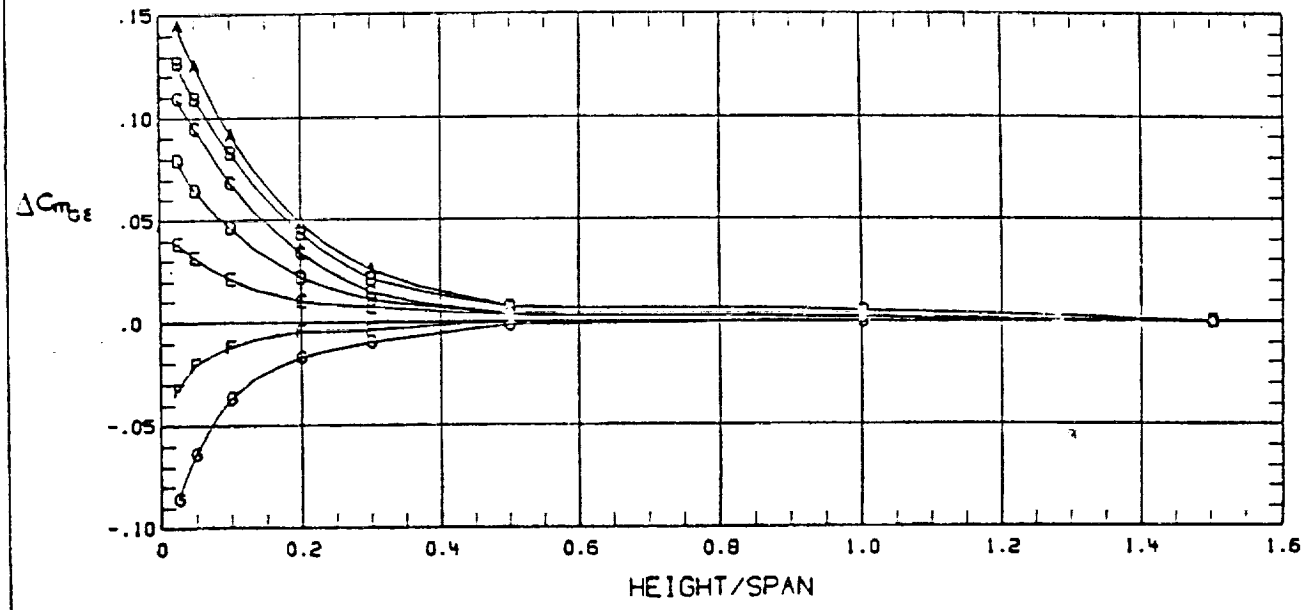
BASELINE ORBITER VEHICLE

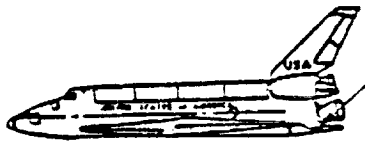
CENTER OF GRAVITY
OR
MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -10.000°$ $\delta_{BF} = -11.7°$ δ_{SB} = All





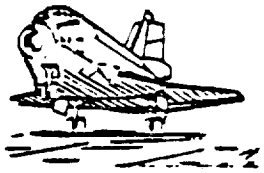
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.14470	0.12620	0.10910	0.07890	0.03800	-0.03300	-0.08600
0.050	0.12480	0.10900	0.09460	0.06430	0.03100	-0.02100	-0.06400
0.100	0.09170	0.08250	0.06810	0.04570	0.02070	-0.01200	-0.03700
0.200	0.04800	0.04270	0.03350	0.02160	0.01000	-0.00500	-0.01700
0.300	0.02520	0.02130	0.01470	0.01080	0.00700	-0.00400	-0.01000
0.500	0.00740	0.00740	0.00350	0.00350	0.00350	0.0	-0.00200
1.000	0.00500	0.00500	0.00200	0.00200	0.00200	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JB
DATE 9-14-77
REVISED:

Figure 4.1.1.3-114
GROUND EFFECT

Landing Gear Down



$$\Delta C_{m_{GROUND\ EFFECT}} = C_{m_{GROUND\ EFFECT}} - C_{m_{FREE\ STREAM}}$$

CONFIGURATION

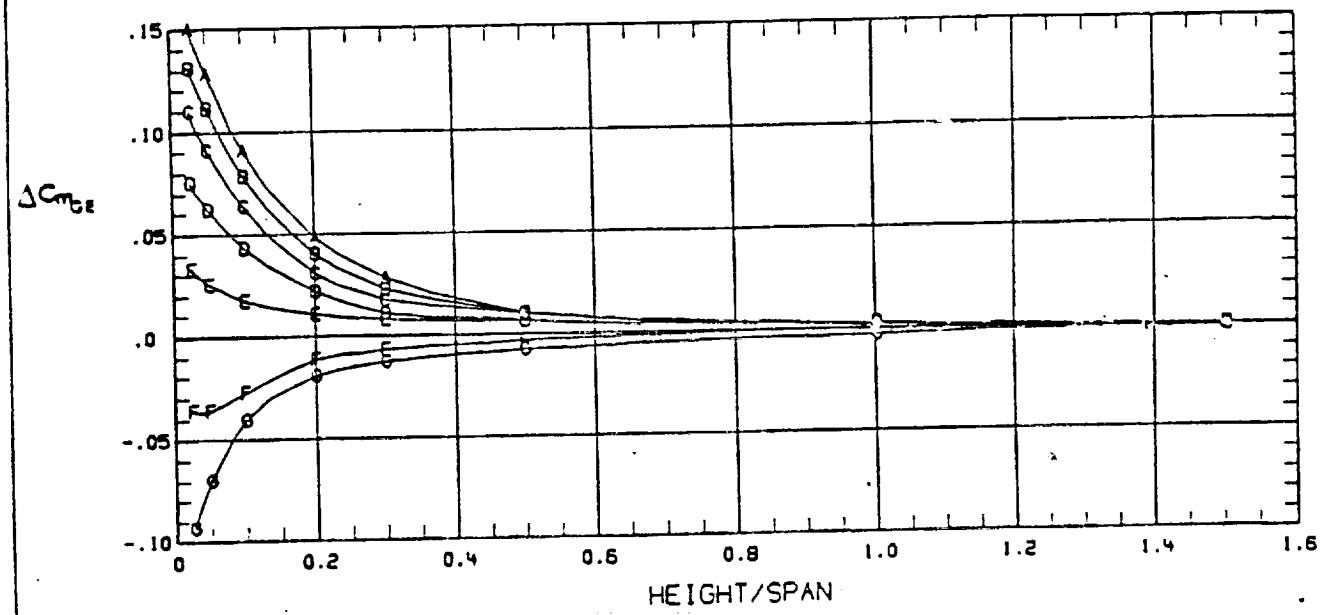
BASELINE ORBITER VEHICLE

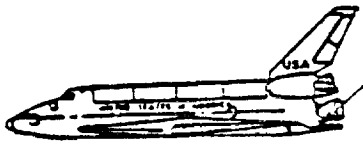
CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA	2690.000 ft²
SPAN	78.056 ft
MAC	39.550 ft
BODY LENGTH	1296.300 in

$\delta_e = -5.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} = All$





Reference Point for h/b
X_o 1506.84
Z_o 282.71

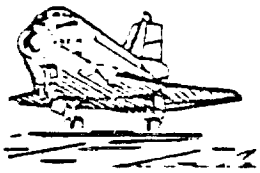
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.15000	0.13110	0.10940	0.07500	0.03240	-0.03650	-0.09330
0.050	0.12830	0.11080	0.09050	0.06200	0.02560	-0.03650	-0.07030
0.100	0.09040	0.07830	0.06340	0.04300	0.01740	-0.02720	-0.04070
0.200	0.04840	0.04030	0.03080	0.02200	0.01060	-0.01110	-0.01920
0.300	0.02800	0.02260	0.01720	0.01100	0.00770	-0.00710	-0.01250
0.500	0.01020	0.01020	0.01020	0.00610	0.00810	-0.00330	-0.00740
1.000	0.00250	0.00250	0.00250	0.00200	0.00200	0.0	-0.00300
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: F. 3
DATE: 4-14-72
REVISED:

Figure 4.1.1.3-115
GROUND EFFECT

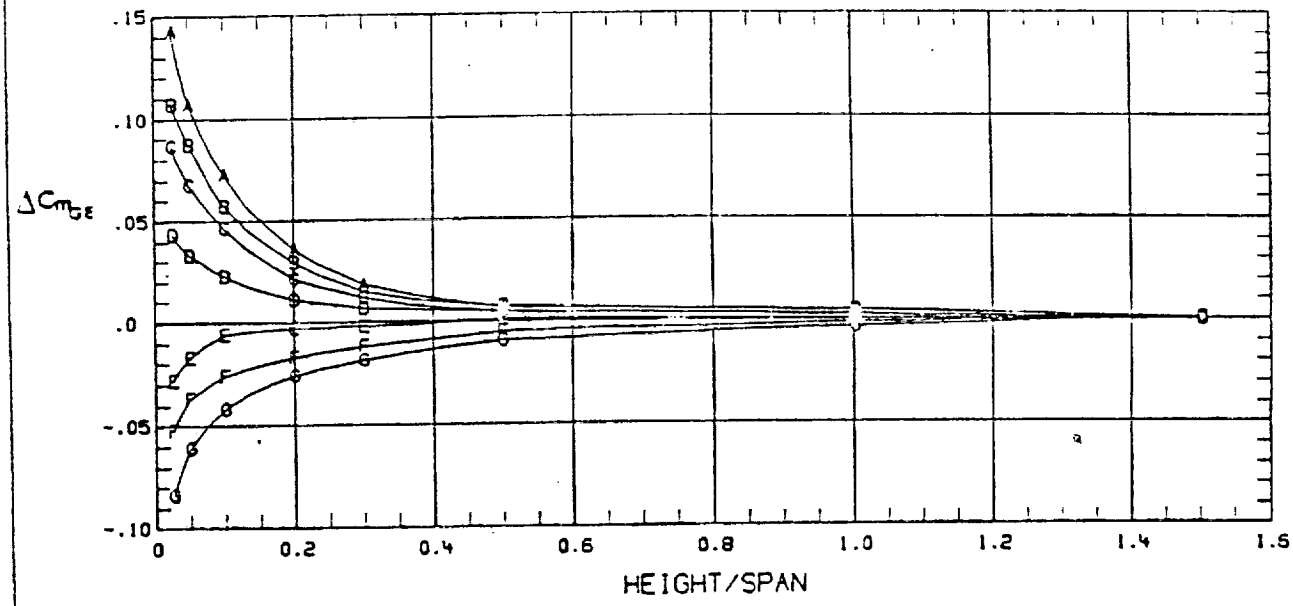
Landing Gear Down

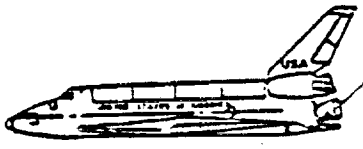
$$\Delta Cm_{GROUND\ EFFECT} = Cm_{GROUND\ EFFECT} - Cm_{FREE\ STREAM}$$



CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY OR MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 0.0°$ $\delta_{3F} = -11.7°$ δ_{SB} = All





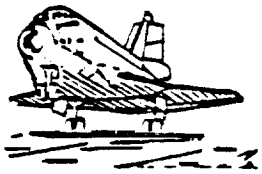
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta Cm_{GRND\ EFFECT}$						
0.025	0.14300	0.10700	0.08600	0.04300	-0.02800	-0.05200	-0.08400
0.050	0.10700	0.08700	0.06700	0.03300	-0.01700	-0.03730	-0.06150
0.100	0.07200	0.05700	0.04600	0.02230	-0.00650	-0.02600	-0.04180
0.200	0.03550	0.02910	0.02130	0.01070	-0.00350	-0.01720	-0.02570
0.300	0.01820	0.01460	0.01140	0.00650	-0.00240	-0.01220	-0.01880
0.500	0.00660	0.00670	0.00400	0.00400	0.00020	-0.00570	-0.00960
1.000	0.00400	0.00400	0.00200	0.00200	0.0	-0.00200	-0.00400
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

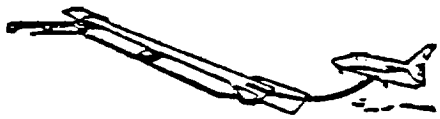
ENGINEER: [illegible]
DATE 9-14-77
REVISED:

Figure 4.1.1.3-116
GROUND EFFECT

Landing Gear Down



$$\Delta C_{m_{GROUND\ EFFECT}} = C_{m_{GROUND\ EFFECT}} - C_{m_{FREE\ STREAM}}$$



CONFIGURATION

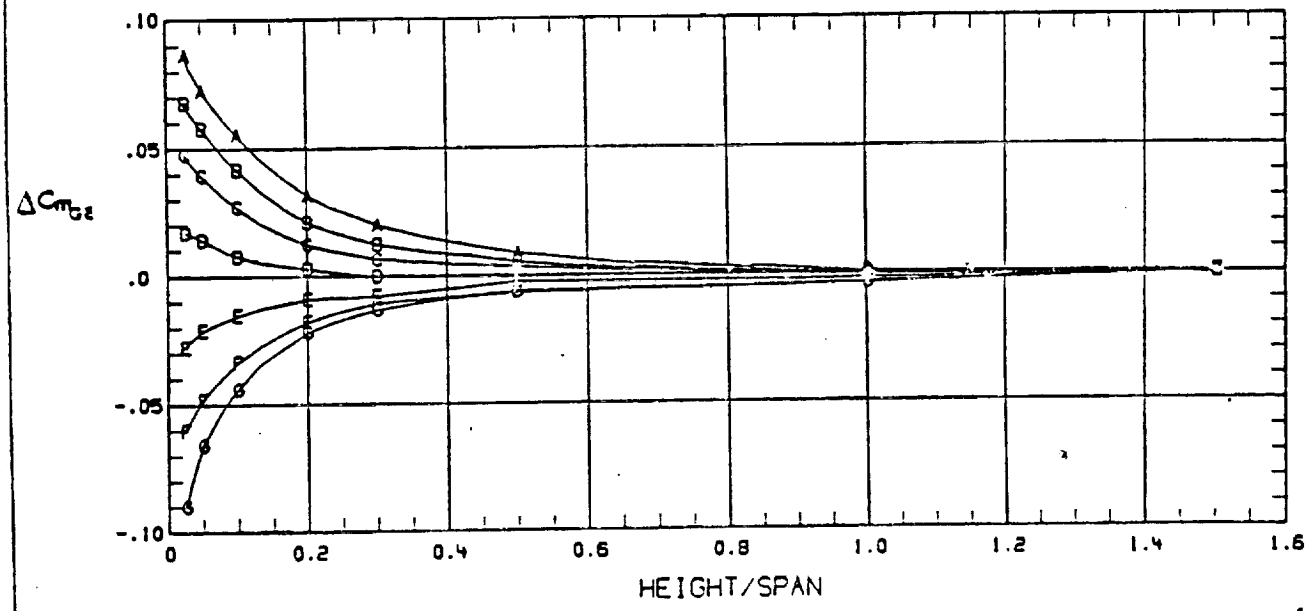
BASELINE ORBITER VEHICLE

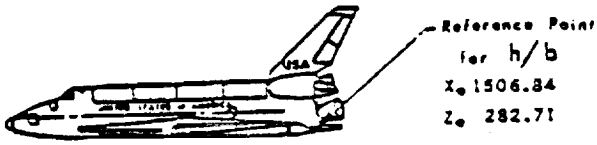
CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = FS 1076.70, Y_{cg} = BL 0.00, Z_{cg} = WL 375.00

REFERENCE DIMENSIONS

AREA S_w = 2690.000 ft²
SPAN b_w = 78.056 ft
MAC c_w = 39.550 in
BODY LENGTH l_B = 1296.300 in

δ_e = 5.000° δ_{BF} = -11.7° δ_{SB} = All



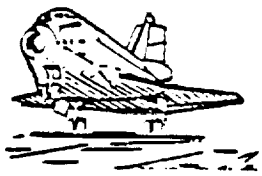


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.08600	0.06700	0.04700	0.01700	-0.02800	-0.06000	-0.09000
0.050	0.07200	0.05700	0.03900	0.01360	-0.02120	-0.04840	-0.06620
0.100	0.05500	0.04140	0.02670	0.00710	-0.01550	-0.03390	-0.04410
0.200	0.03110	0.02060	0.01190	0.00240	-0.00930	-0.01770	-0.02200
0.300	0.01970	0.01220	0.00640	-0.00020	-0.00790	-0.01080	-0.01310
0.500	0.00860	0.00520	0.00320	-0.00010	-0.00290	-0.00690	-0.00640
1.000	0.00100	0.00050	0.00050	0.0	-0.00200	-0.00400	-0.00400
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

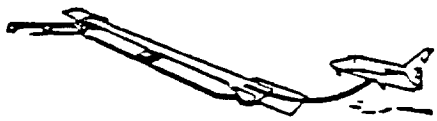
ENGINEER:
DATE: 9-14-77
REVISED:

Figure 4.1.1.3-117
GROUND EFFECT

Landing Gear Down

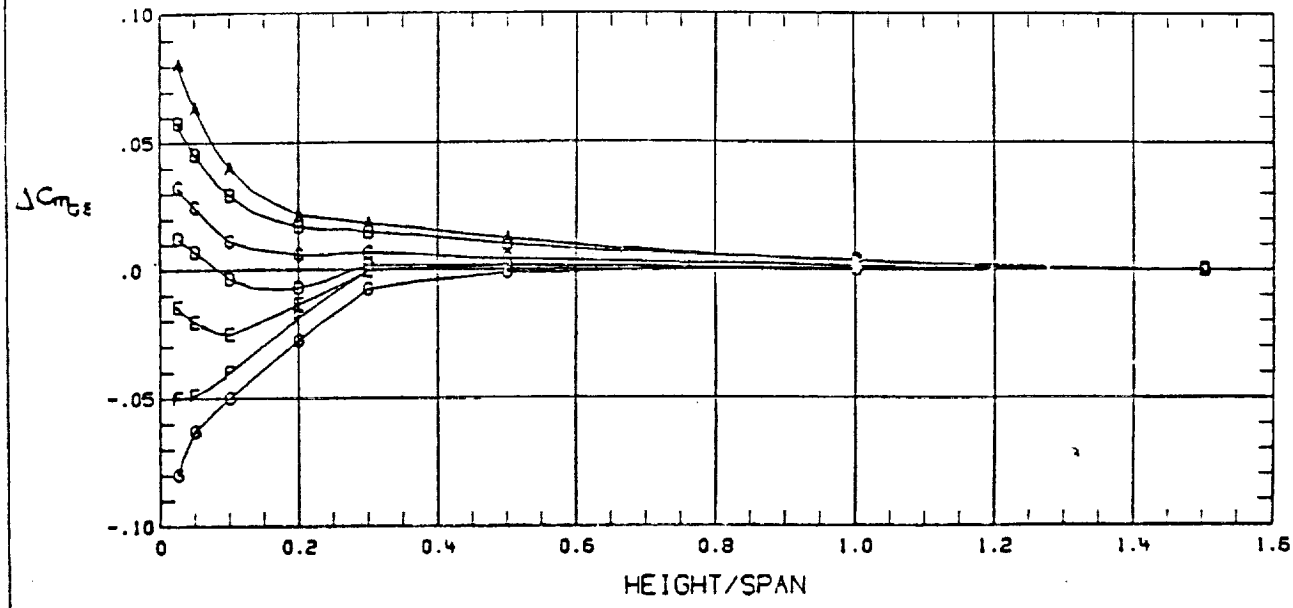


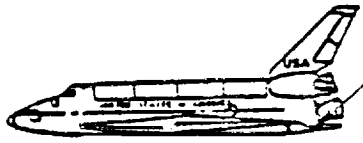
$$\Delta C_{m_{GROUND\ EFFECT}} = C_{m_{GROUND\ EFFECT}} - C_{m_{FREE\ STREAM}}$$



CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA S_w = 2690.000 ft²
SPAN b_w = 78.056 ft
MAC c_w = 39.560 ft
BODY LENGTH L_B = 1296.300 in

δ_e = 10.000° δ_{BF} = -11.7° δ_{SB} = All





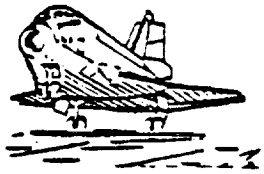
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.08000	0.05700	0.03200	0.01200	-0.01500	-0.05000	-0.08000
0.050	0.06310	0.04500	0.02410	0.00700	-0.02100	-0.04920	-0.06330
0.100	0.03960	0.02890	0.01110	-0.00400	-0.02530	-0.04040	-0.05020
0.200	0.02130	0.01650	0.00580	-0.00740	-0.01390	-0.01900	-0.02800
0.300	0.01810	0.01460	0.00590	0.00130	-0.00100	-0.00110	-0.00800
0.500	0.01180	0.00980	0.00400	0.00130	0.00130	0.00150	-0.00160
1.000	0.00300	0.00300	0.00100	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER:
DATE: 9-14-77
REVISED:

Figure 4.1.1.3-118
GROUND EFFECT

Landing Gear Down

$$\Delta C_{m_{GROUND\ EFFECT}} = C_{m_{GROUND\ EFFECT}} - C_{m_{FREE\ STREAM}}$$



CONFIGURATION

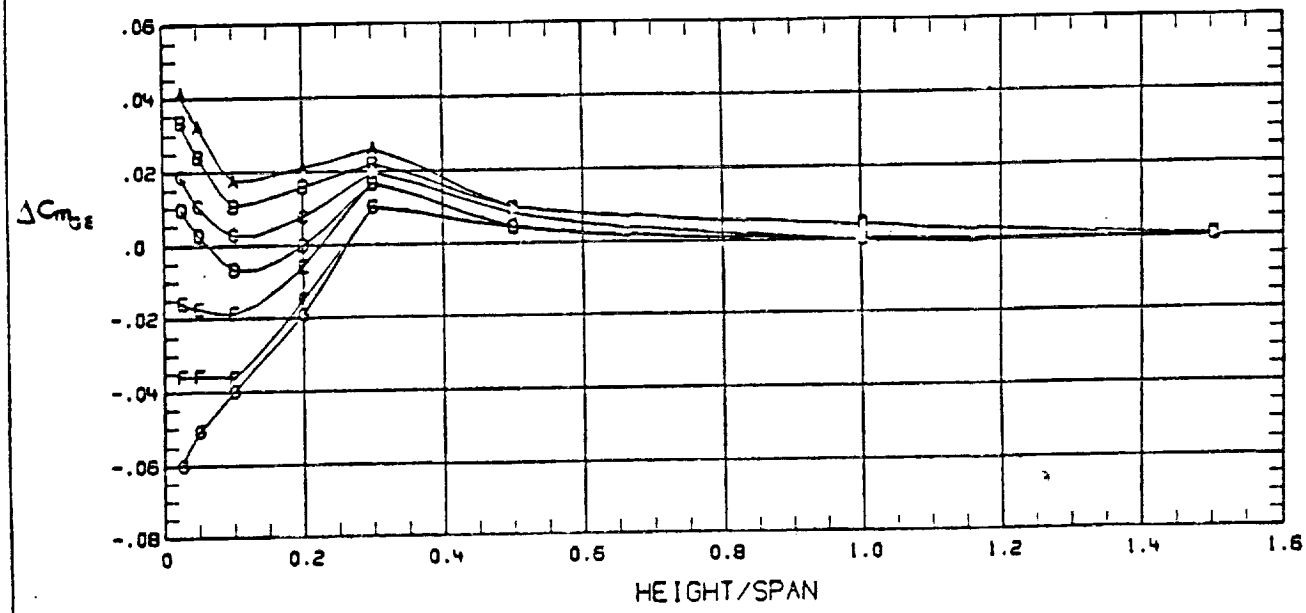
BASELINE ORBITER VEHICLE

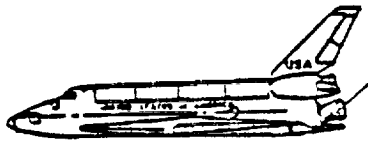
CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA	S_{ref} = 2690.000 ft²
SPAN	b_{ref} = 78.056 ft
MAC	$\bar{c}_{ref}$ = 39.560 ft
BODY LENGTH	L_B = 1296.300 in

δ_e = 15.000° δ_{BF} = -11.7° δ_{SB} = All



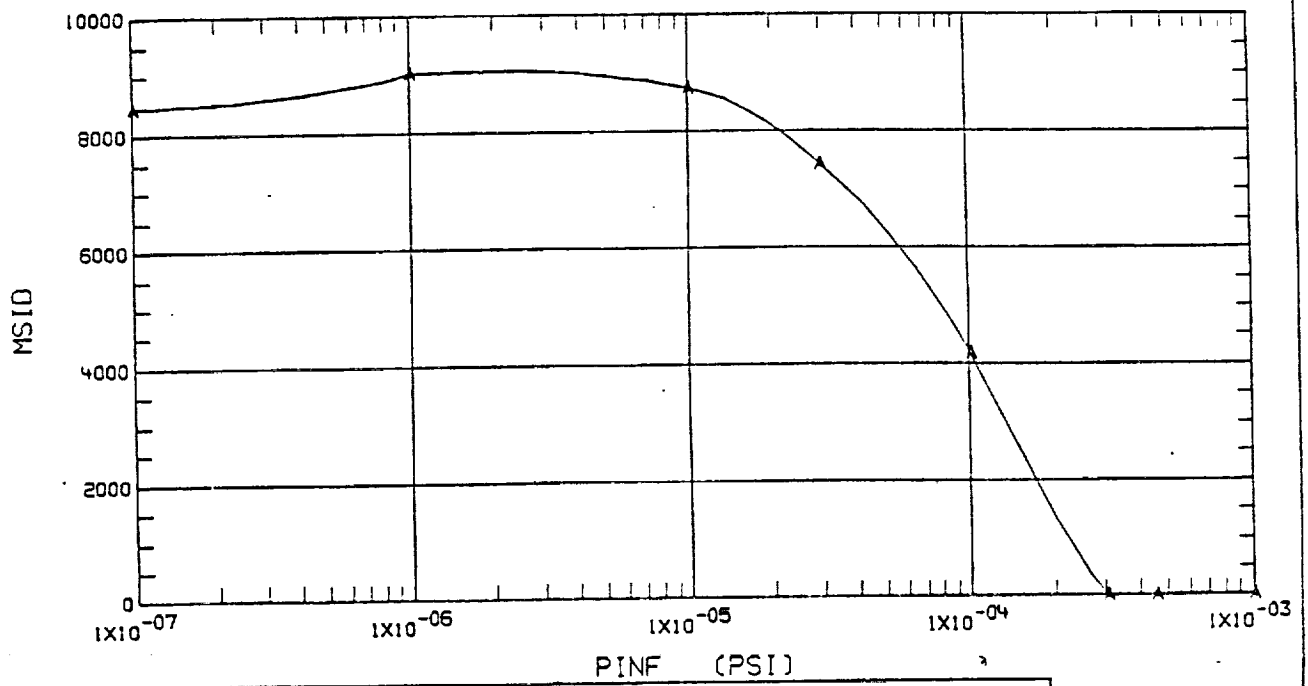


Reference Point for h/b
x_e 1506.84
z_e 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.04130	0.03330	0.01860	0.00930	-0.01610	-0.03610	-0.06010
0.050	0.03190	0.02390	0.01050	0.00250	-0.01750	-0.03610	-0.05080
0.100	0.01710	0.01040	0.00240	-0.00690	-0.01890	-0.03630	-0.04030
0.200	0.02080	0.01550	0.00750	-0.00050	-0.00590	-0.01520	-0.01920
0.300	0.02590	0.02190	0.01920	0.01650	0.01650	0.00990	0.00990
0.500	0.00930	0.00930	0.00800	0.00400	0.00400	0.00400	0.00400
1.000	0.00400	0.00400	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER:
DATE: 4-14-77
REVISED:

Figure 4.1.1.3-119
GROUND EFFECT

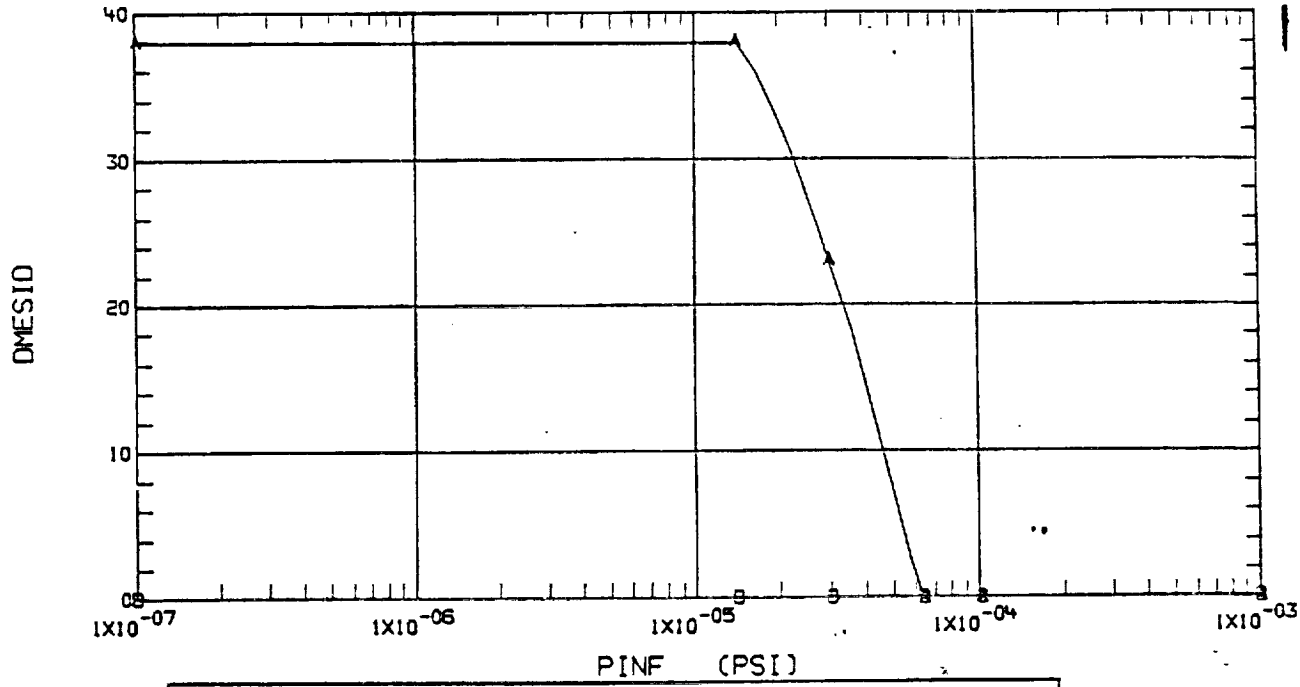


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$M_{SURF\ IMP}$ ft-lb/rad PITCHING M
1.000E-07	8469.000
1.000E-06	9015.000
1.000E-05	8742.500
3.000E-05	7430.801
1.000E-04	4152.602
3.000E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-120
PITCHING MOMENT SURFACE IMPINGEMENT, DOWN-FIRING

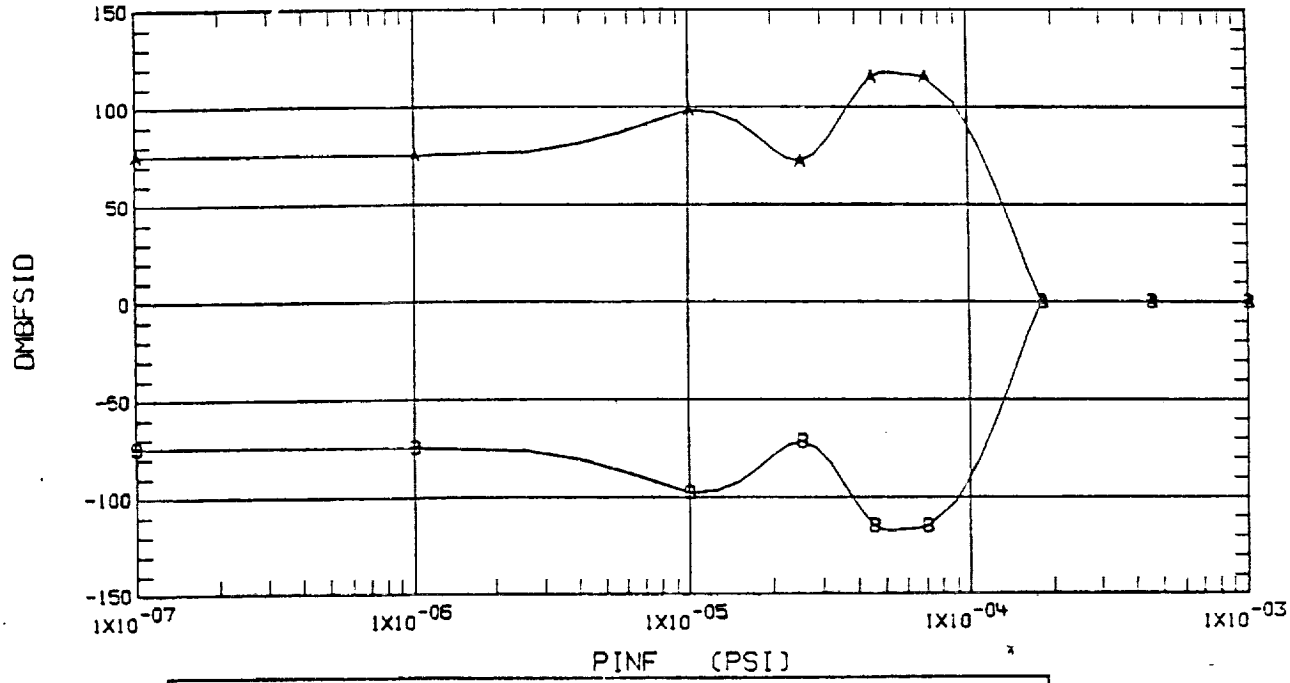


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	$\partial M/\partial \delta_e \sim$ ft lb / n-deg	
	$\delta_e < 0$	$\delta_e > 0$
PINF (PSI)	DE PITCHING MOMENT SI	
1.000E-07	38.000	0.0
1.400E-05	38.000	0.0
3.000E-05	23.000	0.0
6.300E-05	0.0	0.0
1.000E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-121
ELEVON PITCHING MOMENT SURFACE IMPINGEMENT, DOWN-FIRING

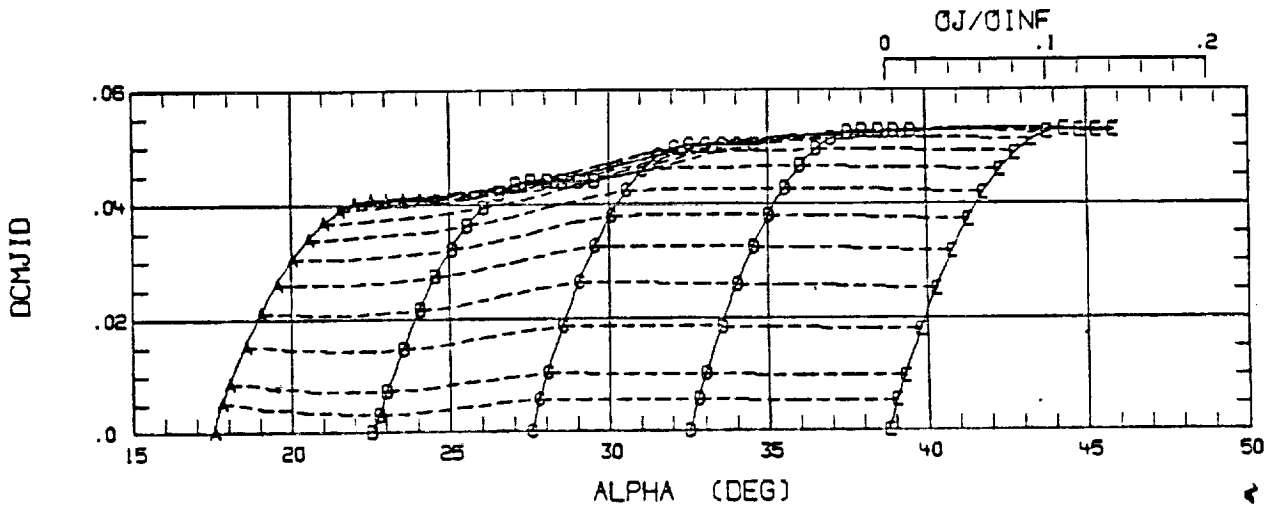


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	$\partial M/\partial \delta_{BF} \sim \frac{ft\ lb}{n\text{-}deg}$	
	$\delta_{BF} < 0$	$\delta_{BF} > 0$
PINF (PSI)	DBF PITCHING MOMENT S	
1.000E-07	75.000	-75.000
1.000E-06	75.000	-75.000
1.000E-05	98.000	-98.000
2.500E-05	72.000	-72.000
4.500E-05	115.000	-115.000
7.000E-05	115.000	-115.000
1.800E-04	0.0	0.0
4.500E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-122
BODYFLAP PITCHING MOMENT SURFACE IMPINGEMENT, ON-FIRING



QJ/QINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	PITCHING MOMENT JET				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00496	0.00300	0.00563	0.00544	0.00518
0.0100	0.00852	0.00709	0.01021	0.00996	0.00955
0.0200	0.01509	0.01462	0.01863	0.01830	0.01766
0.0300	0.02091	0.02130	0.02606	0.02574	0.02494
0.0400	0.02599	0.02712	0.03249	0.03228	0.03138
0.0500	0.03032	0.03207	0.03792	0.03790	0.03697
0.0600	0.03391	0.03618	0.04237	0.04262	0.04174
0.0700	0.03675	0.03942	0.04582	0.04642	0.04568
0.0800	0.03885	0.04180	0.04827	0.04933	0.04874
0.0900	0.04020	0.04333	0.04973	0.05132	0.05099
0.1000	0.04080	0.04400	0.05020	0.05240	0.05240
0.1100	0.04080	0.04400	0.05020	0.05260	0.05297
0.1200	0.04080	0.04400	0.05020	0.05260	0.05270
0.1300	0.04080	0.04400	0.05020	0.05260	0.05270
0.1400	0.04080	0.04400	0.05020	0.05260	0.05270

$$\frac{\Phi_j}{\Phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

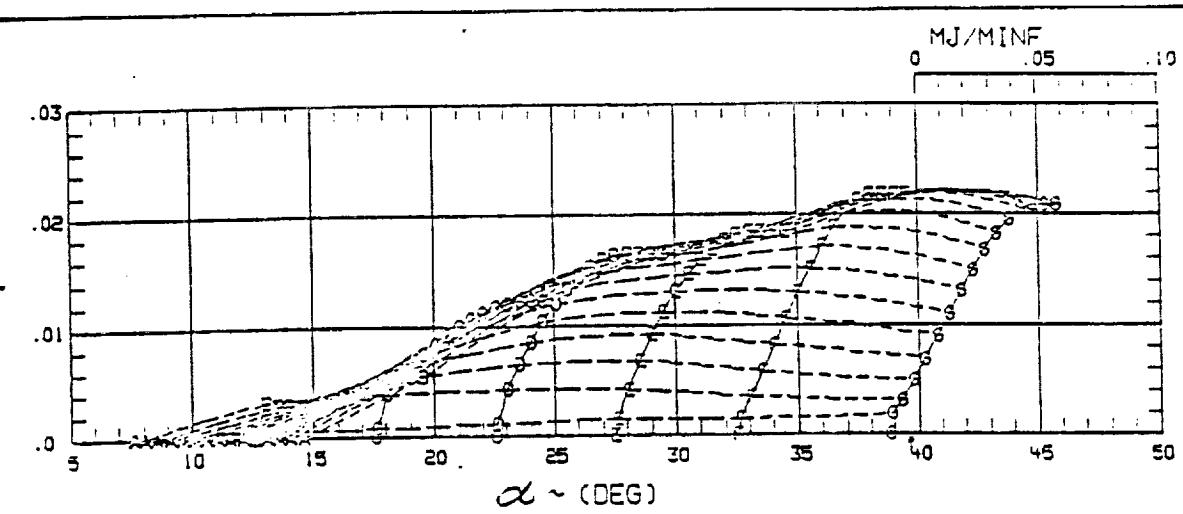
$$\Delta C_{m_{JI}} = A_0 + A_1\left(\frac{\Phi_j}{\Phi_\infty}\right) + A_2\left(\frac{\Phi_j}{\Phi_\infty}\right)^2 + A_3\left(\frac{\Phi_j}{\Phi_\infty}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\Phi_j/\Phi_\infty)_{MIN}$	$(\Phi_j/\Phi_\infty)_{MAX}$
	PITCHING MOMENT JET					
17.500	0.0012	0.7690	-3.7300	0.0	0.0050	0.1000
22.500	-0.0013	0.8820	+4.2900	0.0	0.0050	0.1000
27.500	0.0008	0.9910	+4.9700	0.0	0.0050	0.1000
32.500	0.0007	0.9710	+4.5400	0.0	0.0050	0.1050
38.750	0.0006	0.9370	+4.1900	0.0	0.0050	0.1200

ENGINEER HP
DATE 7/30/79

FIGURE 4.1.1.3-123
PITCHING MOMENT JET INTERACTION, DOWN-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	PITCHING MOMENT JI,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.0	0.00063	0.00076	0.00110	0.00150	0.00150	0.00180
0.005	0.0	0.00314	0.00379	0.00420	0.00415	0.00343	0.00310
0.010	0.0	0.00296	0.00508	0.00647	0.00675	0.00571	0.00484
0.015	0.0	0.00295	0.00625	0.00851	0.00903	0.00808	0.00676
0.020	0.0	0.00284	0.00734	0.01032	0.01116	0.01046	0.00879
0.025	0.0	0.00289	0.00831	0.01189	0.01297	0.01279	0.01085
0.030	0.0	0.00303	0.00917	0.01323	0.01452	0.01500	0.01269
0.035	0.0	0.00324	0.00993	0.01433	0.01581	0.01701	0.01464
0.040	0.0	0.00353	0.01058	0.01520	0.01634	0.01876	0.01662
0.045	0.0	0.00390	0.01113	0.01584	0.01761	0.02018	0.01817
0.050	0.0	0.00435	0.01158	0.01625	0.01813	0.02119	0.01942
0.055	0.0	0.00487	0.01191	0.01642	0.01837	0.02173	0.02031
0.060	0.0	0.00548	0.01214	0.01636	0.01837	0.02173	0.02077
0.065	0.0	0.00548	0.01214	0.01636	0.01837	0.02173	0.02077
0.070	0.0	0.00548	0.01214	0.01636	0.01837	0.02173	0.02077

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{a_\infty}\right)$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{m_{JI}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003,MIN,MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	PITCHING MOMENT JI,SF					
7.500	0.0	0.0	0.0	0.0	0.00500	0.06000
12.500	0.00340	-0.05940	1.56690	0.0	0.00500	0.06000
17.500	0.00240	0.28900	-2.11000	0.0	0.00500	0.06000
22.500	0.00170	0.32400	-4.66000	0.0	0.00500	0.06000
27.500	0.00130	0.59700	-5.21000	0.0	0.00500	0.05500
32.500	0.00130	0.40500	4.52000	-93.30000	0.00500	0.05500
38.750	0.00160	0.27100	6.22000	-90.20000	0.00500	0.06000

$K_{JI} = 1.0$

Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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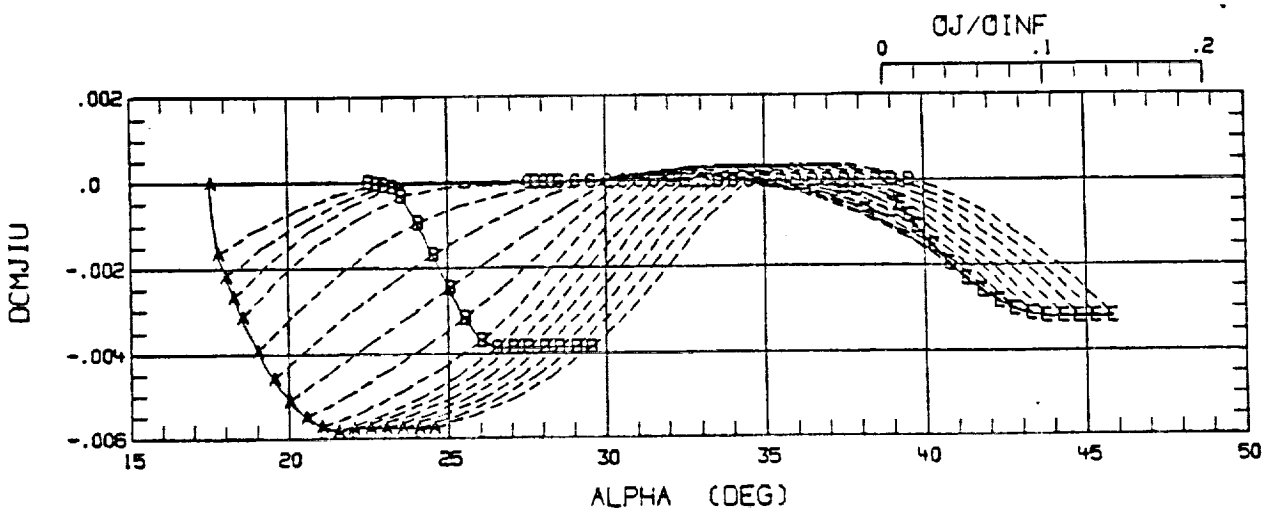
FIGURE 4.1.1.3-124
PITCHING MOMENT JET INTERACTION, SIDE-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	PITCHING MOMENT JET OF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00166	-0.00004	0.0	0.0	-0.00030
0.0100	-0.00219	-0.00008	0.0	0.0	-0.00058
0.0150	-0.00268	-0.00012	0.0	0.0	-0.00085
0.0200	-0.00313	-0.00034	0.0	0.0	-0.00110
0.0300	-0.00394	-0.00095	0.0	0.0	-0.00157
0.0400	-0.00460	-0.00171	0.0	0.0	-0.00198
0.0500	-0.00511	-0.00249	0.0	0.0	-0.00233
0.0600	-0.00549	-0.00319	0.0	0.0	-0.00262
0.0700	-0.00572	-0.00370	0.0	0.0	-0.00285
0.0800	-0.00581	-0.00388	0.0	0.0	-0.00303
0.0900	-0.00576	-0.00388	0.0	0.0	-0.00315
0.1000	-0.00576	-0.00388	0.0	0.0	-0.00321
0.1100	-0.00576	-0.00388	0.0	0.0	-0.00321
0.1200	-0.00576	-0.00388	0.0	0.0	-0.00321
0.1300	-0.00576	-0.00388	0.0	0.0	-0.00321
0.1400	-0.00576	-0.00388	0.0	0.0	-0.00321

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$

$S_{ref} = 2690\ ft^2$

$$\Delta C_{m_{jt}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	PITCHING MOMENT JET OF					
17.500	-0.0011	-0.1160	0.7140	0.0	0.0050	0.0900
22.500	0.0	0.0244	-2.4400	19.1000	0.0150	0.0800
27.500	0.0	0.0	0.0	0.0	0.0050	0.1200
32.500	0.0	0.0	0.0	0.0	0.0050	0.1200
38.750	0.0	-0.0610	0.2950	0.0	0.0050	0.1000

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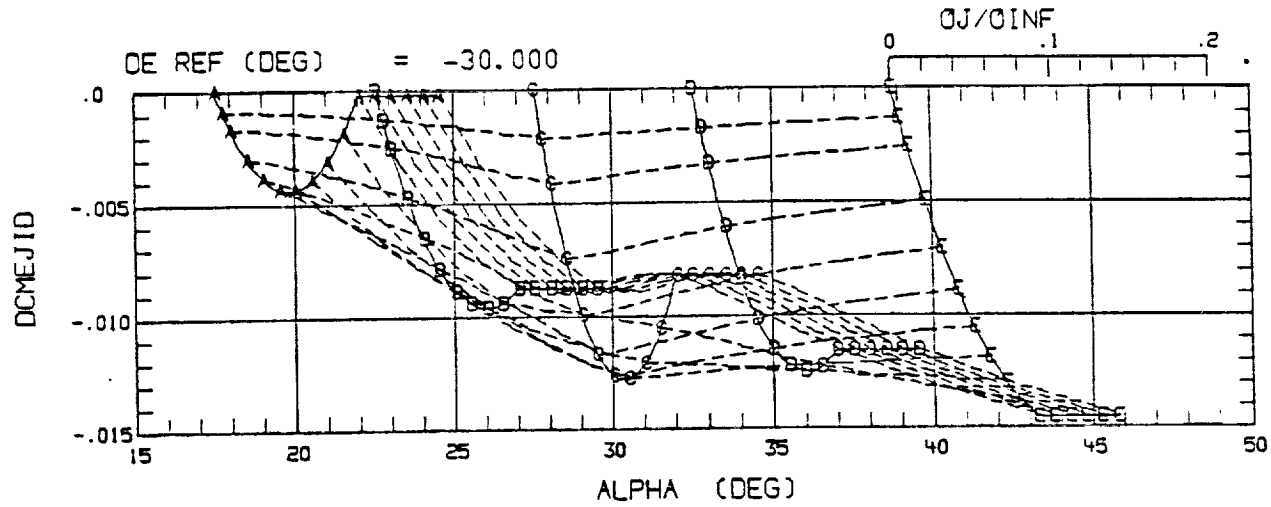
FIGURE 4.1.1.3-125
PITCHING MOMENT JET INTERACTION.UP-FIRING



DJ/DINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE PITCHING MOMENT DJ,DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00091	-0.00134	-0.00215	-0.00172	-0.00133
0.0100	-0.00172	-0.00258	-0.00413	-0.00331	-0.00261
0.0200	-0.00302	-0.00476	-0.00746	-0.00611	-0.00496
0.0300	-0.00389	-0.00654	-0.00998	-0.00840	-0.00707
0.0400	-0.00434	-0.00792	-0.01170	-0.01019	-0.00894
0.0500	-0.00437	-0.00830	-0.01263	-0.01148	-0.01055
0.0600	-0.00397	-0.00948	-0.01274	-0.01224	-0.01192
0.0700	-0.00315	-0.00966	-0.01206	-0.01262	-0.01303
0.0800	-0.00190	-0.00944	-0.01058	-0.01229	-0.01390
0.0900	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1000	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1100	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1200	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1300	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1400	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453

$$\frac{\Phi_j}{\Phi_\infty} = \left(\frac{\dot{m}_j v_j}{q_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{q_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$(\Delta C_m)_{\delta_{e_{REF}}=-30^\circ} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2_\alpha + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE PITCHING MOMENT DJ,DF					
17.500	0.0	-0.1934	2.1200	0.0	0.0050	0.0900
22.500	0.0	-0.2780	2.0000	0.0	0.0050	0.0900
27.500	0.0	-0.4530	4.0100	0.0	0.0050	0.0900
32.500	0.0	-0.3560	2.5300	0.0	0.0050	0.0900
38.750	0.0	-0.2730	1.2400	0.0	0.0050	0.0900

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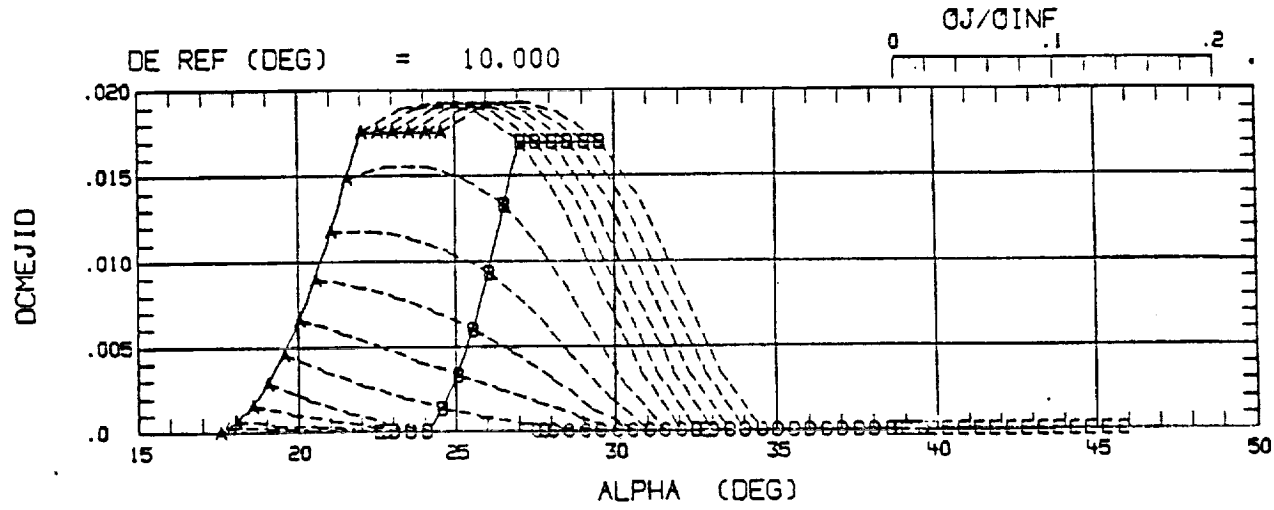
FIGURE 4.1.1.3-126
ELEVON PITCHING MOMENT JET INTERACTION, DOWN-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE PITCHING MOMENT JLOF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00025	0.0	0.0	0.0	0.0
0.0100	0.00059	0.0	0.0	0.0	0.0
0.0200	0.00154	0.0	0.0	0.0	0.0
0.0300	0.00285	0.0	0.0	0.0	0.0
0.0400	0.00462	0.00129	0.0	0.0	0.0
0.0500	0.00655	0.00327	0.0	0.0	0.0
0.0600	0.00894	0.00593	0.0	0.0	0.0
0.0700	0.01169	0.00925	0.0	0.0	0.0
0.0800	0.01480	0.01323	0.0	0.0	0.0
0.0900	0.01755	0.01690	0.0	0.0	0.0
0.1000	0.01755	0.01690	0.0	0.0	0.0
0.1100	0.01755	0.01690	0.0	0.0	0.0
0.1200	0.01755	0.01690	0.0	0.0	0.0
0.1300	0.01755	0.01690	0.0	0.0	0.0
0.1400	0.01755	0.01690	0.0	0.0	0.0

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\left(\Delta C_m\right)_{\delta_{e_{REF}}=+10^\circ} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE PITCHING MOMENT JLOF					
17.500	0.0	0.0410	1.8000	0.0	0.0050	0.0880
22.500	0.0	-0.1010	3.3300	0.0	0.0300	0.0880
27.500	0.0	0.0	0.0	0.0	0.0050	0.1000
32.500	0.0	0.0	0.0	0.0	0.0050	0.1000
38.750	0.0	0.0	0.0	0.0	0.0050	0.1000

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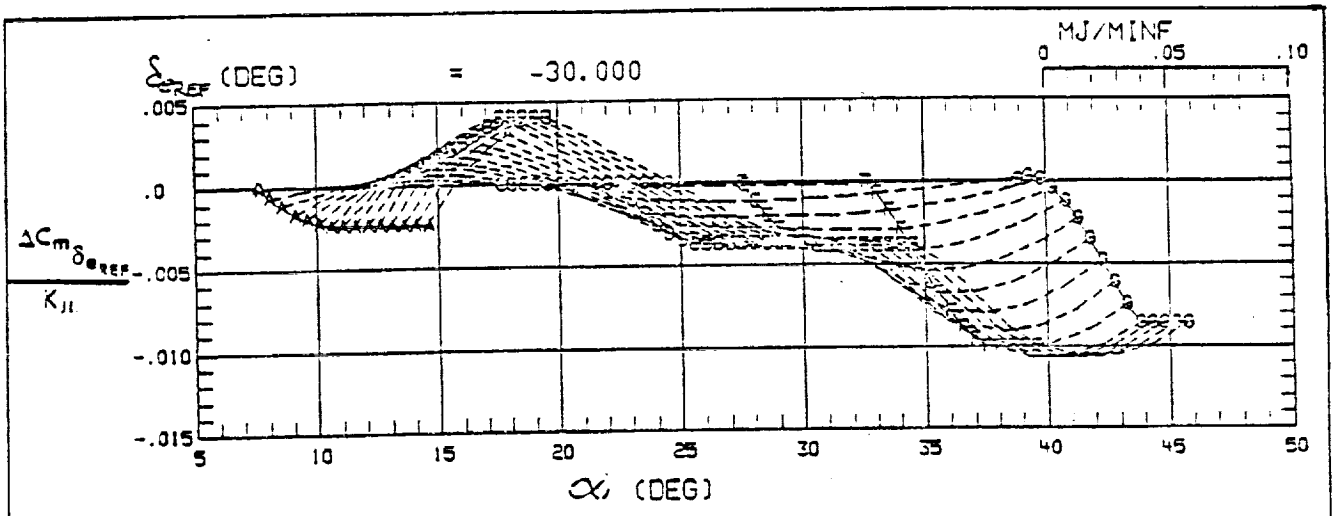
FIGURE 4.1.1.3-127
ELEVON PITCHING MOMENT JET INTERACTION. DOWN-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE PITCHING MOMENT JI,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00013	0.00005	0.0	-0.00020	-0.00023	-0.00015	0.00005
0.005	-0.00066	0.00027	0.0	-0.00101	-0.00114	-0.00076	0.00025
0.010	-0.00121	0.00057	0.0	-0.00186	-0.00209	-0.00177	0.00009
0.015	-0.00166	0.00090	0.0	-0.00255	-0.00294	-0.00294	-0.00044
0.020	-0.00200	0.00126	0.0	-0.00309	-0.00339	-0.00421	-0.00127
0.025	-0.00223	0.00165	0.0	-0.00346	-0.00375	-0.00552	-0.00233
0.030	-0.00236	0.00207	0.0	-0.00368	-0.00391	-0.00678	-0.00356
0.035	-0.00237	0.00252	0.0	-0.00374	-0.00392	-0.00793	-0.00487
0.040	-0.00237	0.00301	0.0	-0.00374	-0.00392	-0.00891	-0.00621
0.045	-0.00237	0.00352	0.0	-0.00374	-0.00392	-0.00963	-0.00751
0.050	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870
0.055	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870
0.060	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870
0.065	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870
0.070	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{a_\infty}\right)$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{m_{\delta_{e_{REF}}}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	ADD3, MIN, MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE PITCHING MOMENT JI,SF					
7.500	0.0	-0.14250	2.14620	0.0	0.00500	0.03530
12.500	0.0	0.05090	0.60590	0.0	0.00500	0.05000
17.500	0.0	0.0	0.0	0.0	0.00500	0.05000
22.500	0.0	-0.21800	3.18000	0.0	0.00500	0.03420
27.500	0.0	-0.24800	3.92000	0.0	0.00500	0.03160
32.500	0.0	-0.12400	-6.20000	93.30000	0.00500	0.05000
38.750	0.0	0.10000	-9.99000	90.20000	0.00500	0.05000

$K_{JI} = 1.0$

Interpolate for α's not shown after calculation. of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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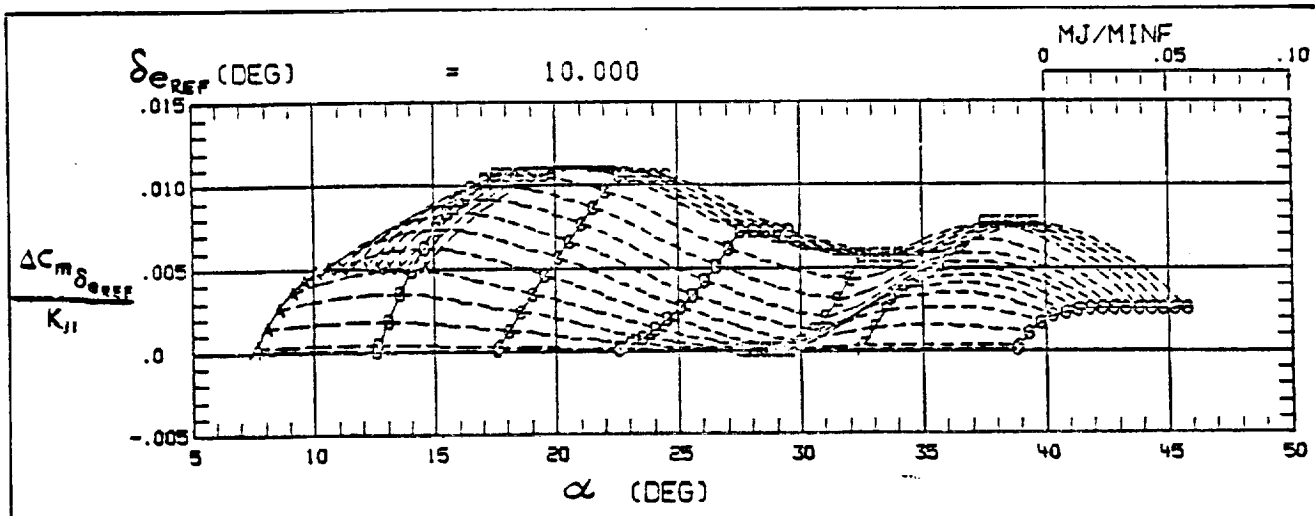
FIGURE 4.1.1.3-128
ELEVON PITCHING MOMENT JET INTERACTION, SIDE-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE PITCHING MOMENT JI,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.00029	0.00036	0.00023	0.00007	0.0	0.00027	0.00019
0.005	0.00142	0.00180	0.00116	0.00034	0.0	0.00137	0.00095
0.010	0.00260	0.00344	0.00229	0.00077	0.00001	0.00242	0.00159
0.015	0.00355	0.00491	0.00340	0.00127	0.00001	0.00322	0.00201
0.020	0.00428	0.00621	0.00449	0.00186	0.00002	0.00383	0.00235
0.025	0.00477	0.00736	0.00555	0.00254	0.00049	0.00433	0.00240
0.030	0.00503	0.00833	0.00658	0.00329	0.00115	0.00479	0.00252
0.035	0.00507	0.00914	0.00760	0.00413	0.00199	0.00528	0.00252
0.040	0.00507	0.00979	0.00858	0.00506	0.00302	0.00587	0.00252
0.045	0.00507	0.01027	0.00955	0.00606	0.00424	0.00662	0.00252
0.050	0.00507	0.01059	0.01049	0.00715	0.00564	0.00761	0.00252
0.055	0.00507	0.01059	0.01049	0.00715	0.00564	0.00761	0.00252
0.060	0.00507	0.01059	0.01049	0.00715	0.00564	0.00761	0.00252
0.065	0.00507	0.01059	0.01049	0.00715	0.00564	0.00761	0.00252
0.070	0.00507	0.01059	0.01049	0.00715	0.00564	0.00761	0.00252

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_{\infty 2}}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_{\infty_c}}{a_\infty}\right)$$

v_j = exit velocity ~ fps
$v_{\infty 2}$ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{m\delta_{eREF}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003,MIN,MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE PITCHING MOMENT JI,SF					
7.500	0.0	0.30640	-4.62700	0.0	0.00500	0.03310
12.500	0.0	0.37660	-3.29520	0.0	0.00500	0.05000
17.500	0.0	0.23400	-0.48500	0.0	0.00500	0.05000
22.500	0.0	0.06000	1.55000	0.0	0.00500	0.05000
27.500	0.0	-0.07360	3.73000	0.0	0.02000	0.05000
32.500	0.0	0.31100	-7.84000	93.30000	0.00500	0.05000
38.750	0.0	0.22400	-7.37000	90.20000	0.00500	0.03000

$K_{JI} = 1.0$

Interpolate for α's not shown *after* calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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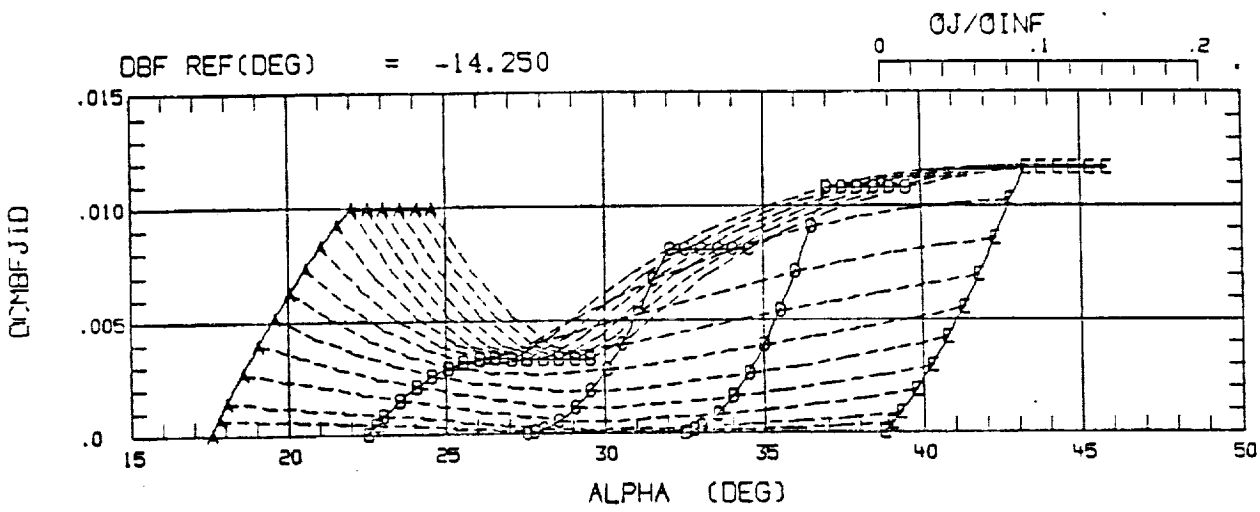
FIGURE 4.1.1.3-129
ELEVON PITCHING MOMENT JET INTERACTION, SIDE-FIRING



DJ/DINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DBF PITCHING MOMENT JT.DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00069	0.00040	0.00006	0.00011	0.00042
0.0100	0.00136	0.00078	0.00018	0.00029	0.00086
0.0200	0.00266	0.00146	0.00054	0.00092	0.00184
0.0300	0.00390	0.00203	0.00110	0.00159	0.00294
0.0400	0.00508	0.00250	0.00164	0.00260	0.00416
0.0500	0.00620	0.00286	0.00277	0.00384	0.00549
0.0600	0.00725	0.00311	0.00390	0.00533	0.00696
0.0700	0.00826	0.00326	0.00521	0.00706	0.00852
0.0800	0.00920	0.00331	0.00671	0.00903	0.01021
0.0900	0.00991	0.00327	0.00805	0.01078	0.01165
0.1000	0.00991	0.00327	0.00805	0.01078	0.01165
0.1100	0.00991	0.00327	0.00805	0.01078	0.01165
0.1200	0.00991	0.00327	0.00805	0.01078	0.01165
0.1300	0.00991	0.00327	0.00805	0.01078	0.01165
0.1400	0.00991	0.00327	0.00805	0.01078	0.01165

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

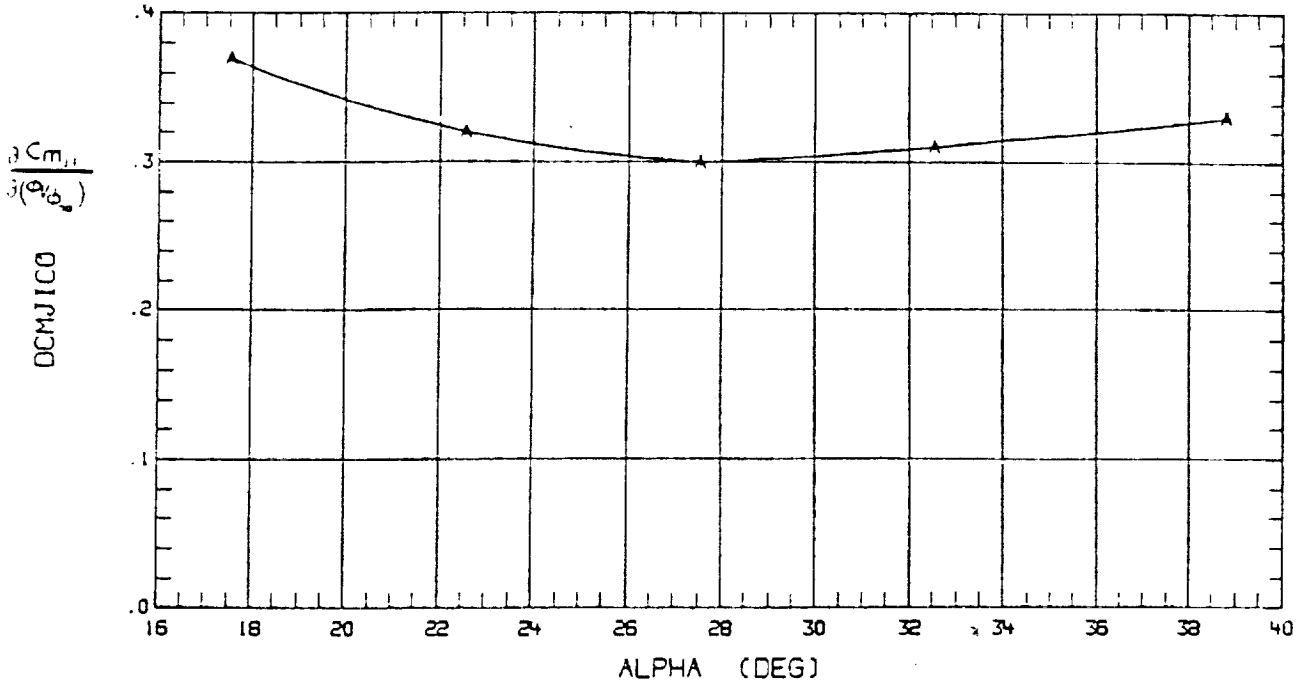
$$\Delta C_{m_{\delta_{BF_{REF}=-14.25°}}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DBF PITCHING MOMENT JT.DF					
17.500	0.0	0.1390	-0.3000	0.0	0.0050	0.0880
22.500	0.0	0.0835	-0.5270	0.0	0.0050	0.0880
27.500	0.0	0.0081	0.9470	0.0	0.0050	-0.0880
32.500	0.0	0.0169	1.2000	0.0	0.0050	0.0880
38.750	0.0	0.0802	0.5930	0.0	0.0050	0.0880

ENGINEER MD
DATE 7/31/85

FIGURE 4.1.1.3-130
BODYFLAP PITCHING MOMENT JET INTERACTION, DOWN-FIRING



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

$\frac{\partial C_{m_{jj}}}{\partial(\phi_j/\phi_\infty)} = 0$ if down firing jet group is inoperative on one side.

ALPHA (DEG)	$\frac{\partial C_{m_{jj}}}{\partial(\phi_j/\phi_\infty)}$ PITCHING M
17.500	0.37000
22.500	0.32000
27.500	0.30000
32.500	0.31000
38.750	0.33000

$$\left(\frac{\overline{\phi_j}}{\phi_\infty}\right) = \frac{1}{2}\left[\left(\frac{\phi_j}{\phi_\infty}\right)_{LH_D} + \left(\frac{\phi_j}{\phi_\infty}\right)_{RH_D}\right]$$

$$0 < \left(\frac{\overline{\phi_j}}{\phi_\infty}\right) \leq 0.03$$

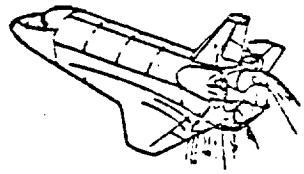


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FIGURE 4.1.1.3-131
PITCHING MOMENT JET INTERACTION CARRYOVER, DOWN-FIRING

SD 72-SH-0060-M

4.1.1.4 TRIM AND STABILITY. This section presents the trim and stability characteristics of the Orbiter Vehicle (OV102) in a manner considered useful for determining the longitudinal trim and stability limits.

Trim and stability limits are presented for the speed brake and body flap control schedules given on Figure 4.1.1.4-1 (b & c) for both forward (0.65 L_B) and aft (0.675 L_B) design centers-of-gravity. The control schedules presented on this figure are for determining maximum obtainable trim limits and do not reflect actual flight control system schedules. A reserve for maneuvering, trimming spanwise center of gravity offset (ΔY_{CG}), manufacturing misalignments, and aerodynamic uncertainties has been applied to the limits of the elevon effectiveness data to establish the limits shown on Figures 4.1.1.4-2 through 4.1.1.4-11.

For a positive elevon deflection, the aforementioned reserve is equivalent to five-degrees of elevon. Therefore, aft center of gravity trim limits are based on a positive elevon deflection of 15-degrees for Mach numbers less than or equal to 10. A positive elevon deflection of 10-degrees was used for Mach numbers greater than 10 due to thermal protection system design limits during maximum heating conditions. Forward center-of-gravity trim limits are based on an incremental pitching moment coefficient reserve of 0.015 for Mach numbers less than or equal to 10 and 0.020 for Mach numbers greater than 10. The longitudinal trim limits are presented as functions of angle of attack. For a summary of these trim limits see Section 2.2. This summary has been presented for the TPS design trajectory (14414.1) angle of attack schedule shown on Figure 4.1.1.4-1(a).

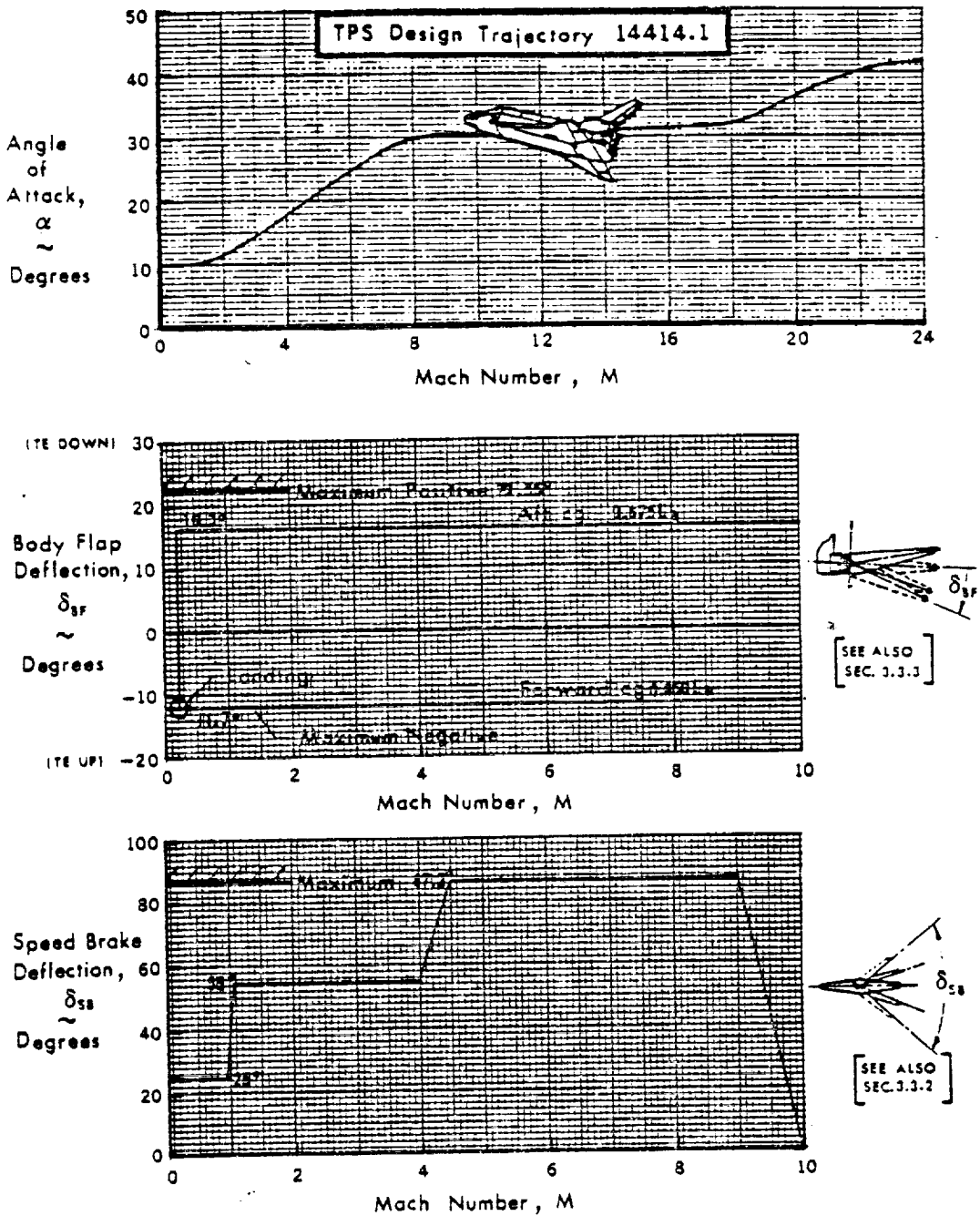
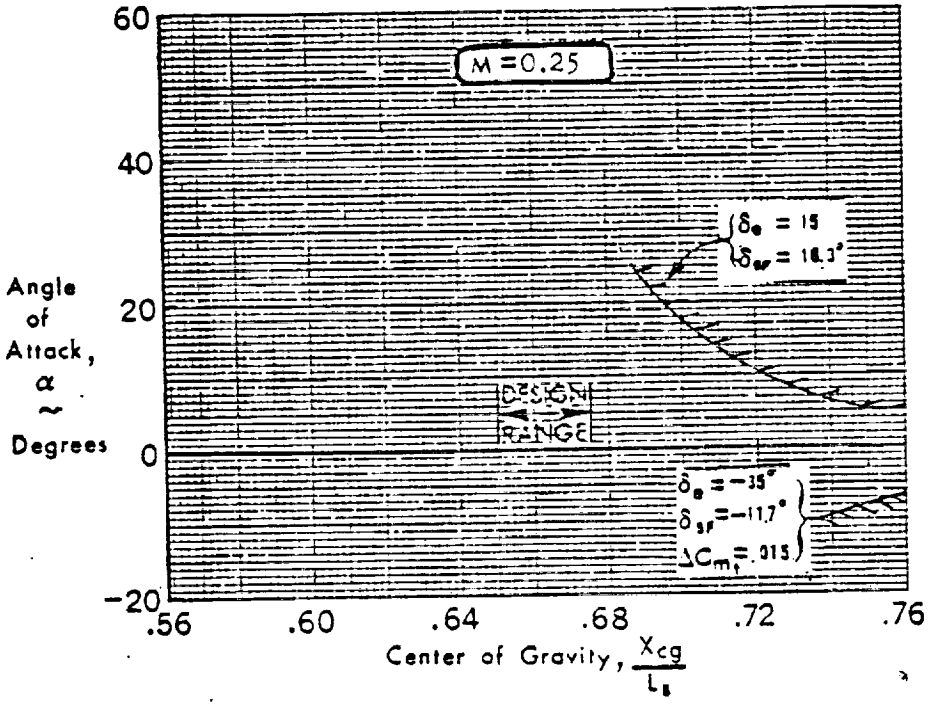


Figure 4.1.1.4-1
CONTROL SCHEDULES



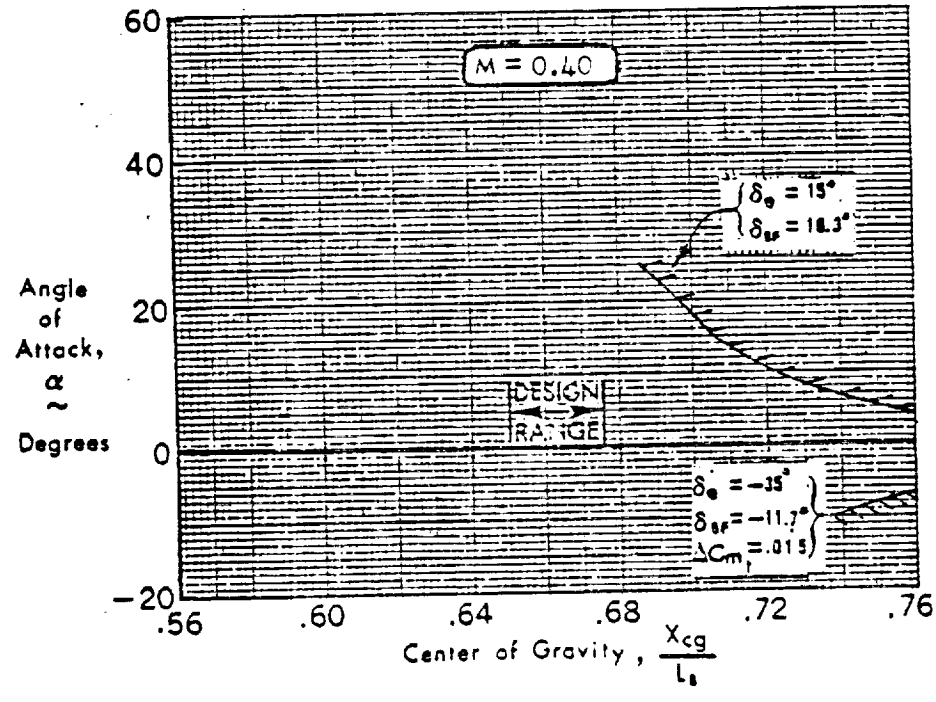
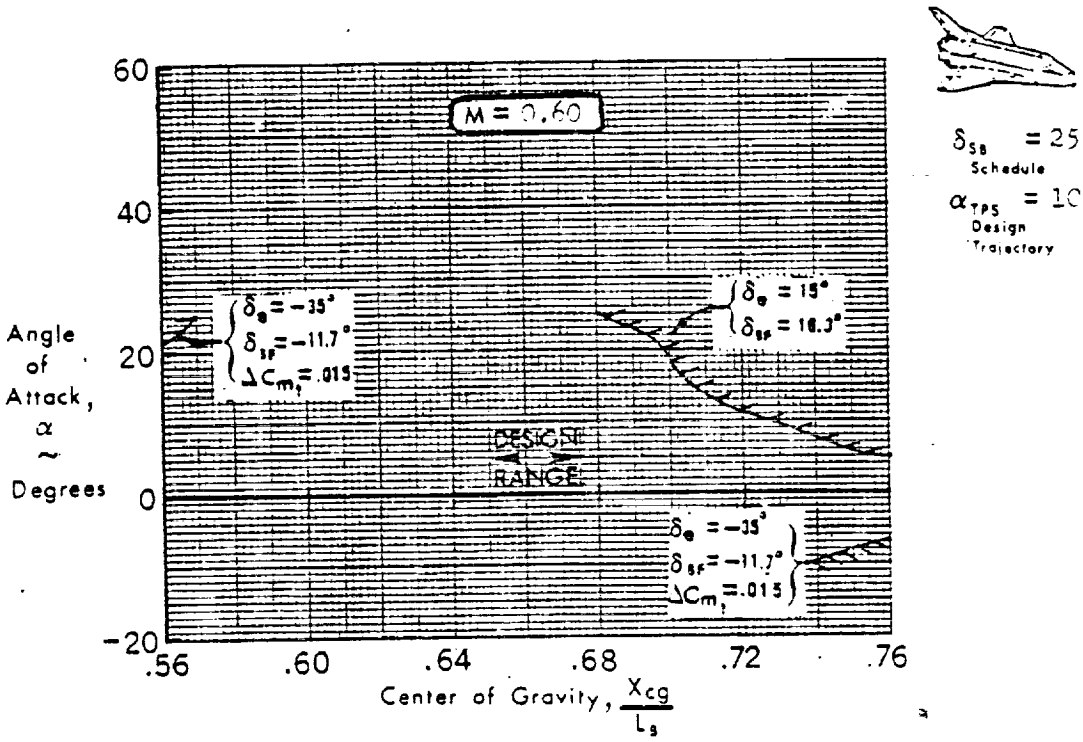


Figure 4.1.1.4-2
STATIC TRIM CAPABILITY

DED 6-6-79



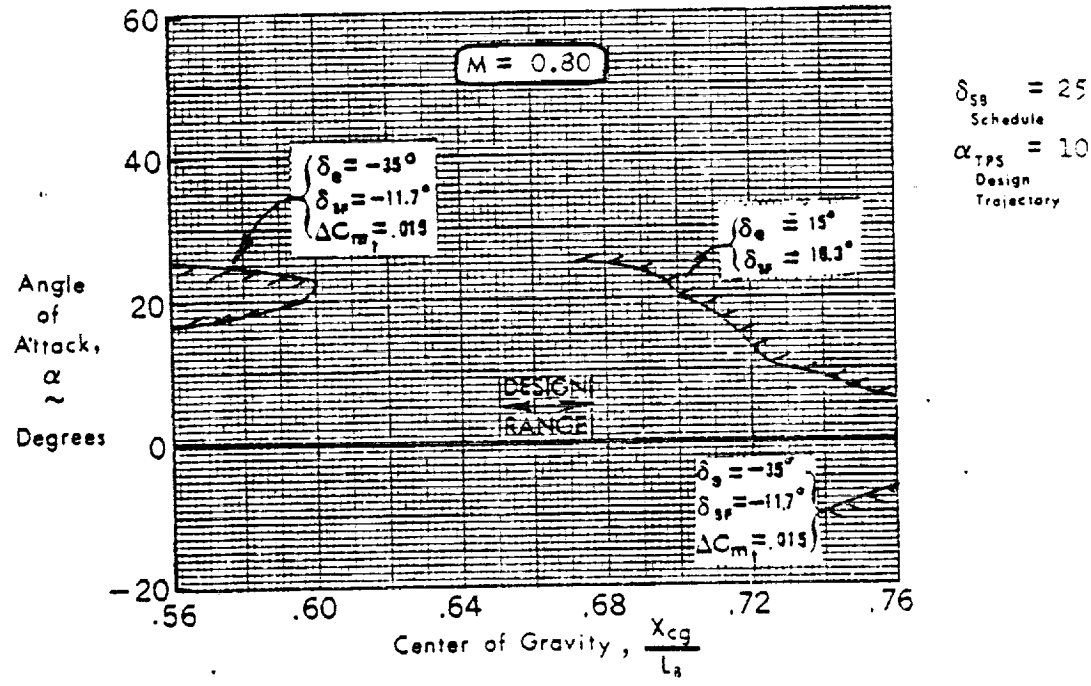


Figure 4.1.1.4-3
STATIC TRIM CAPABILITY

I6D 6-6-79

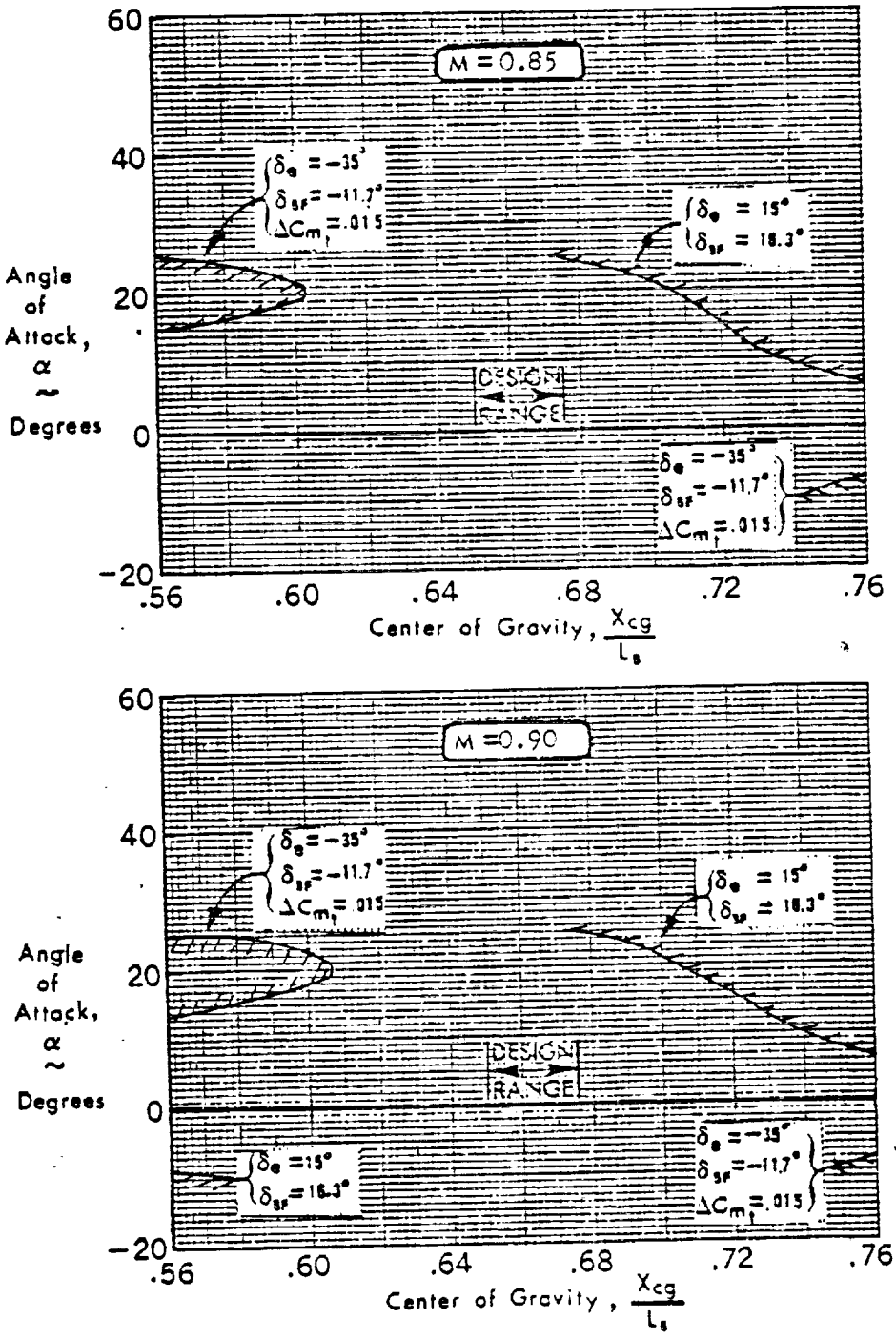
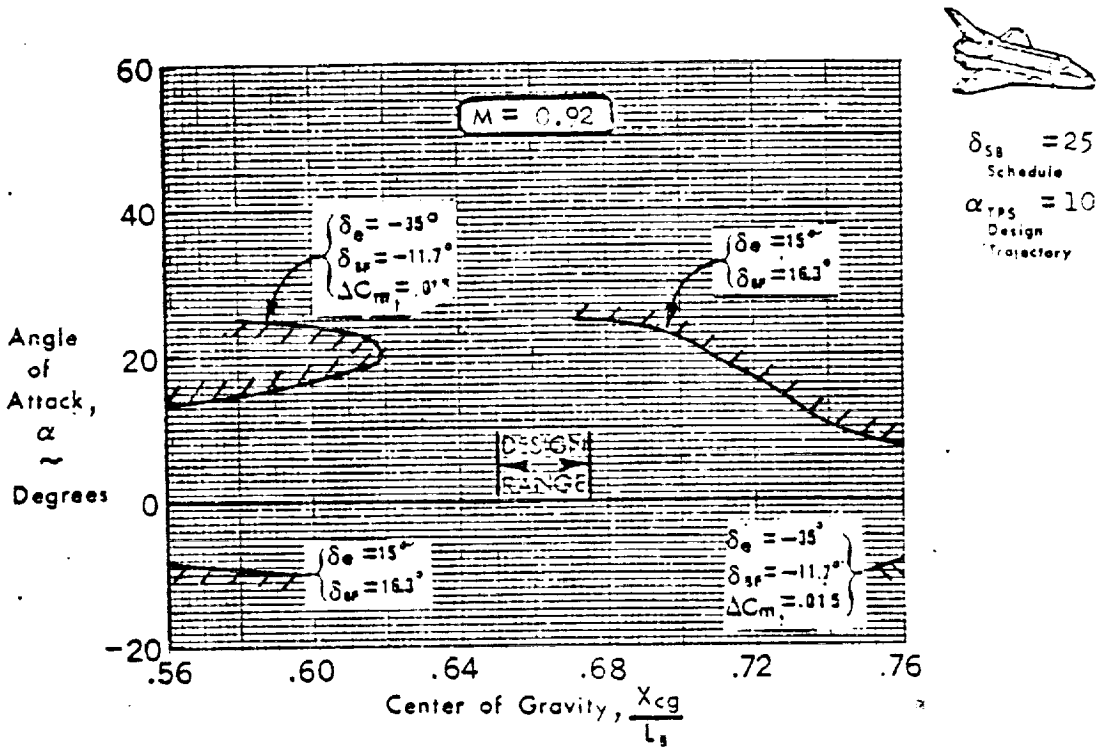


Figure 4.1.1.4-4
STATIC TRIM CAPABILITY

DAD 6-6-79



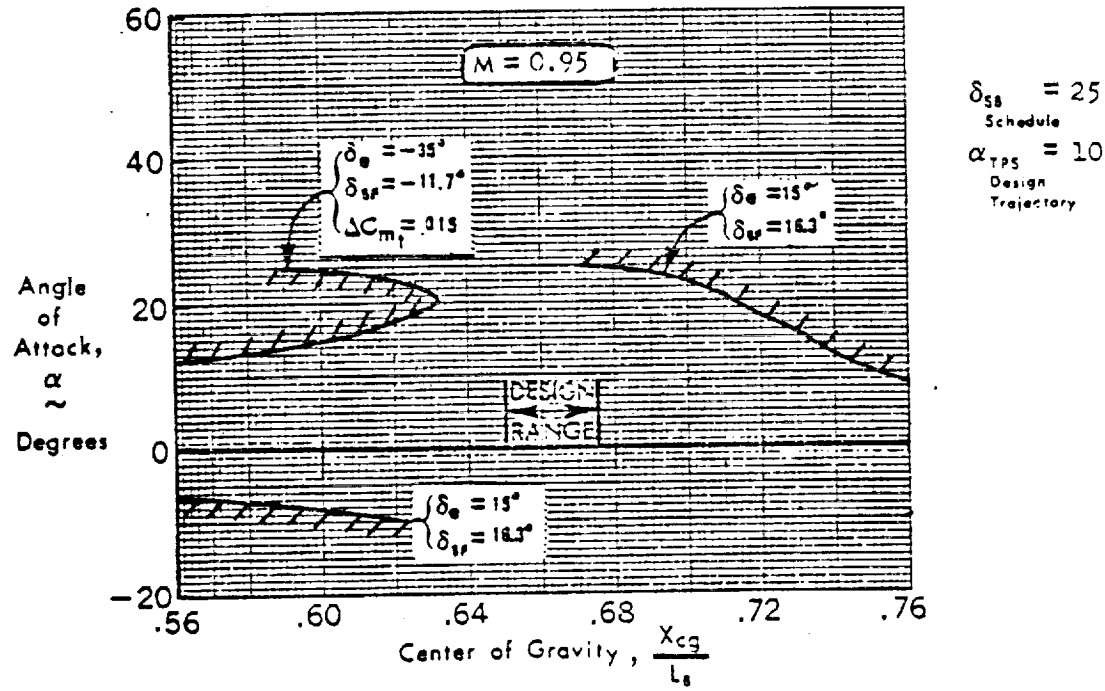
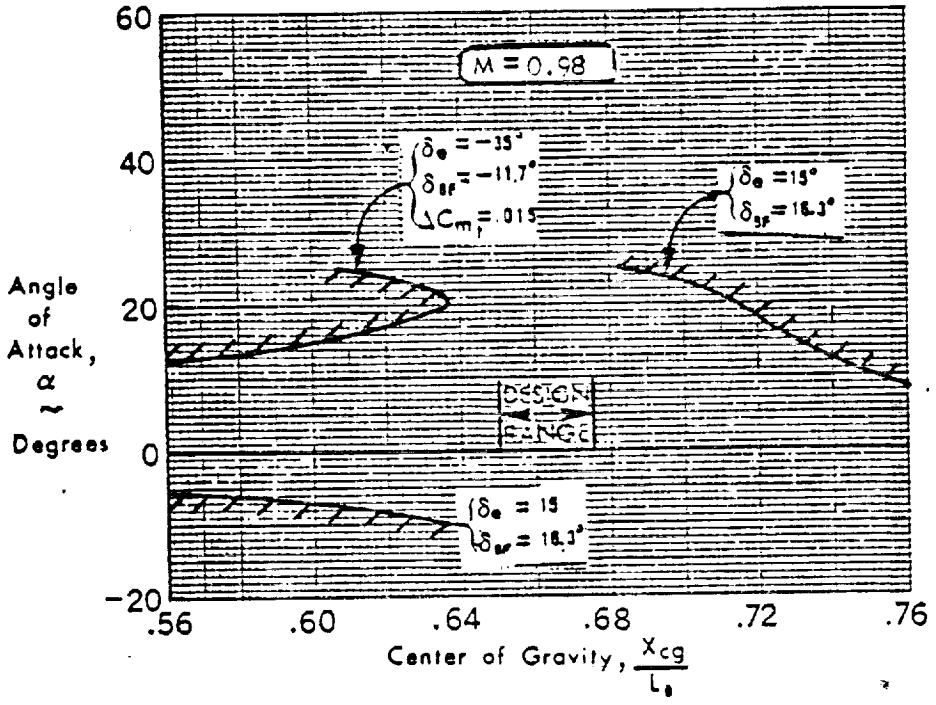


Figure 4.1.1.4-5
STATIC TRIM CAPABILITY

DGD 5-5-79



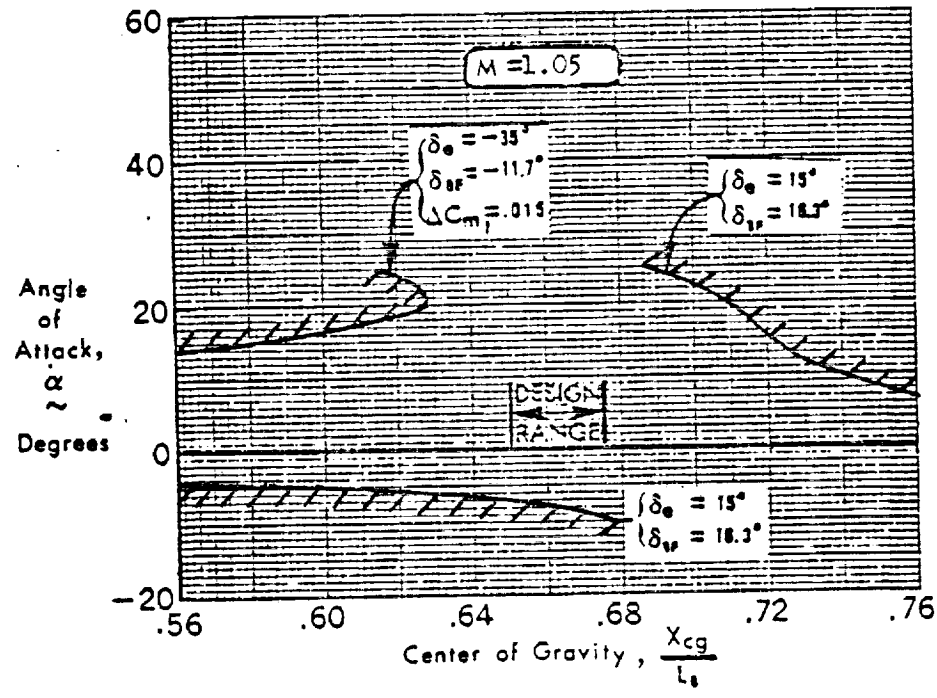


Figure 4.1.1.4-6
STATIC TRIM CAPABILITY

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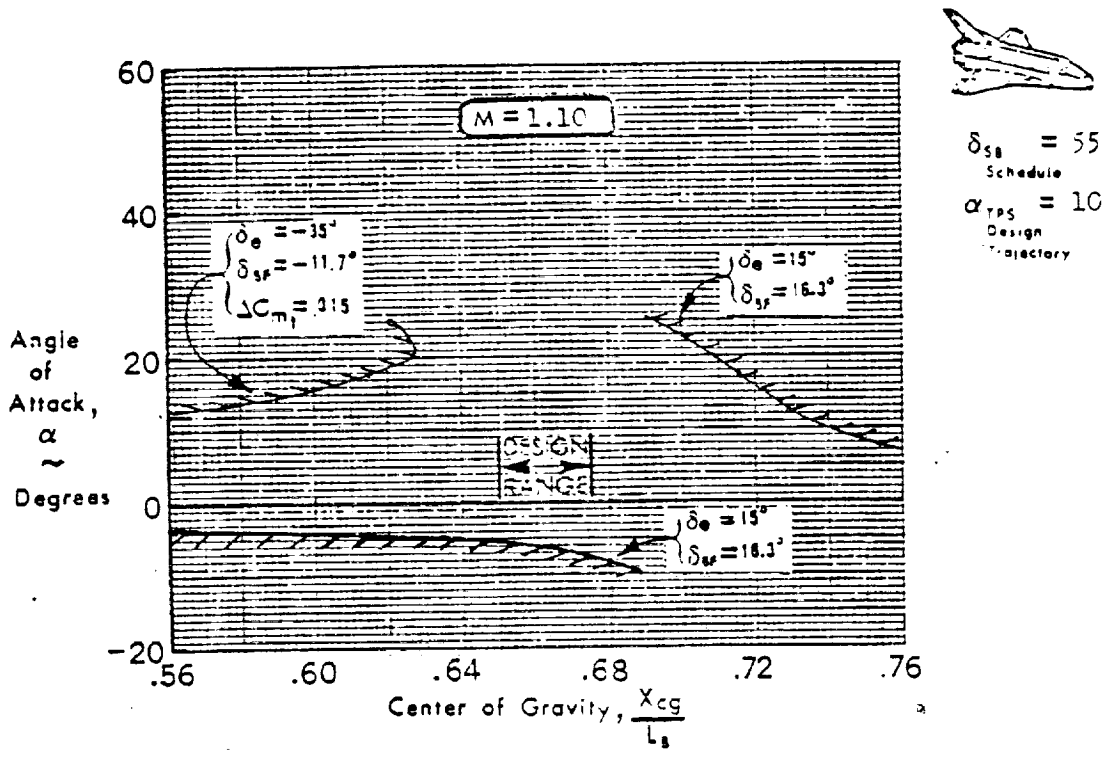

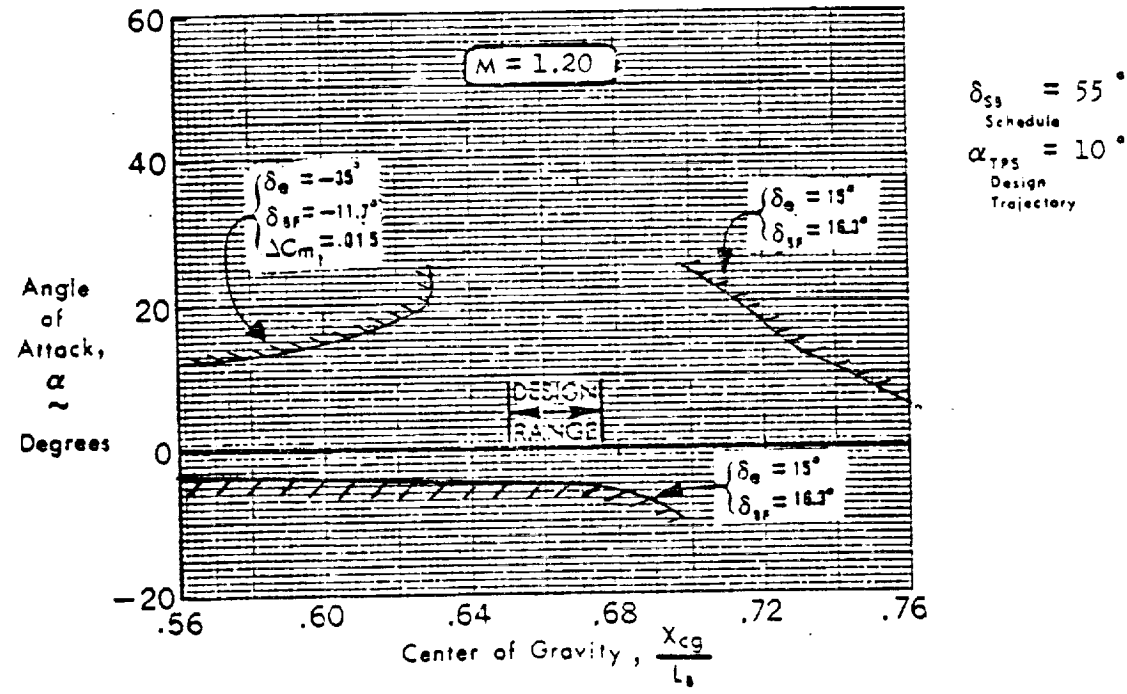

Figure 4.1.1.4-7
STATIC TRIM CAPABILITY

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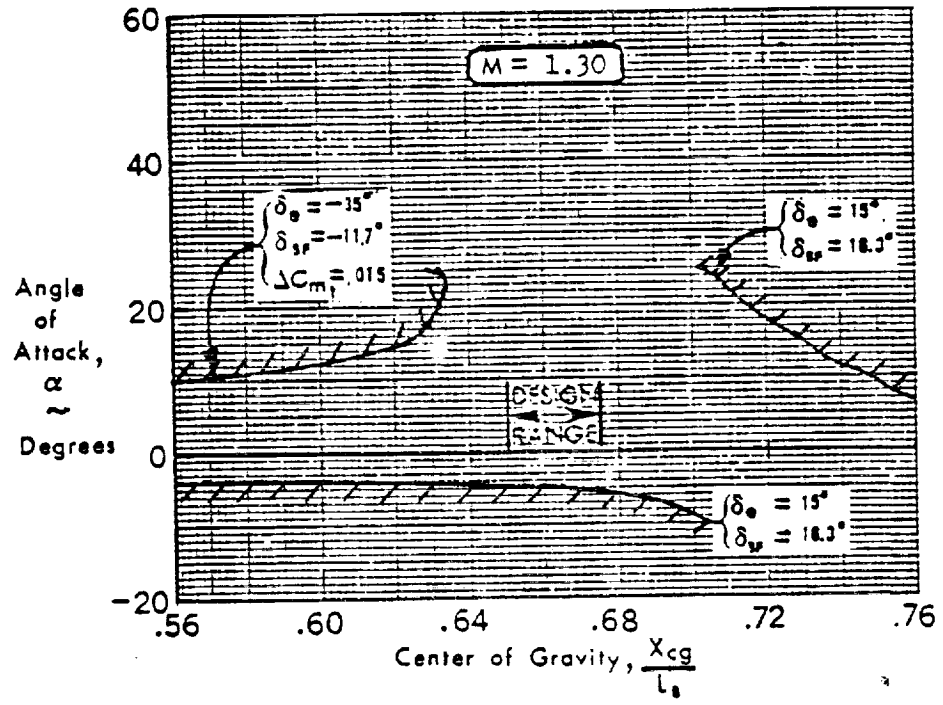


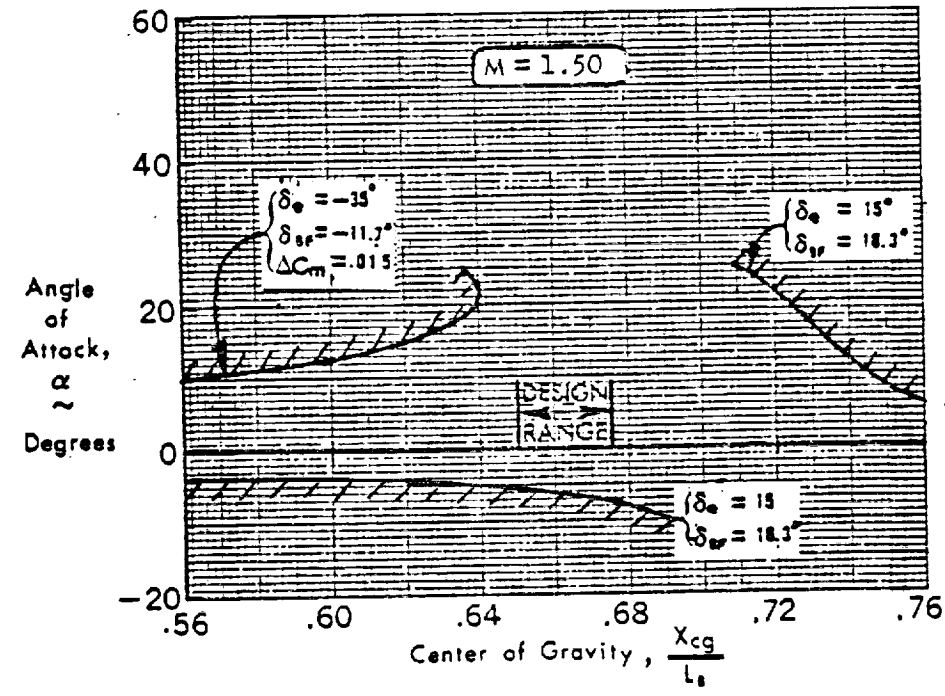


Figure 4.1.1.4-8
STATIC TRIM CAPABILITY

DGD 6-6-79

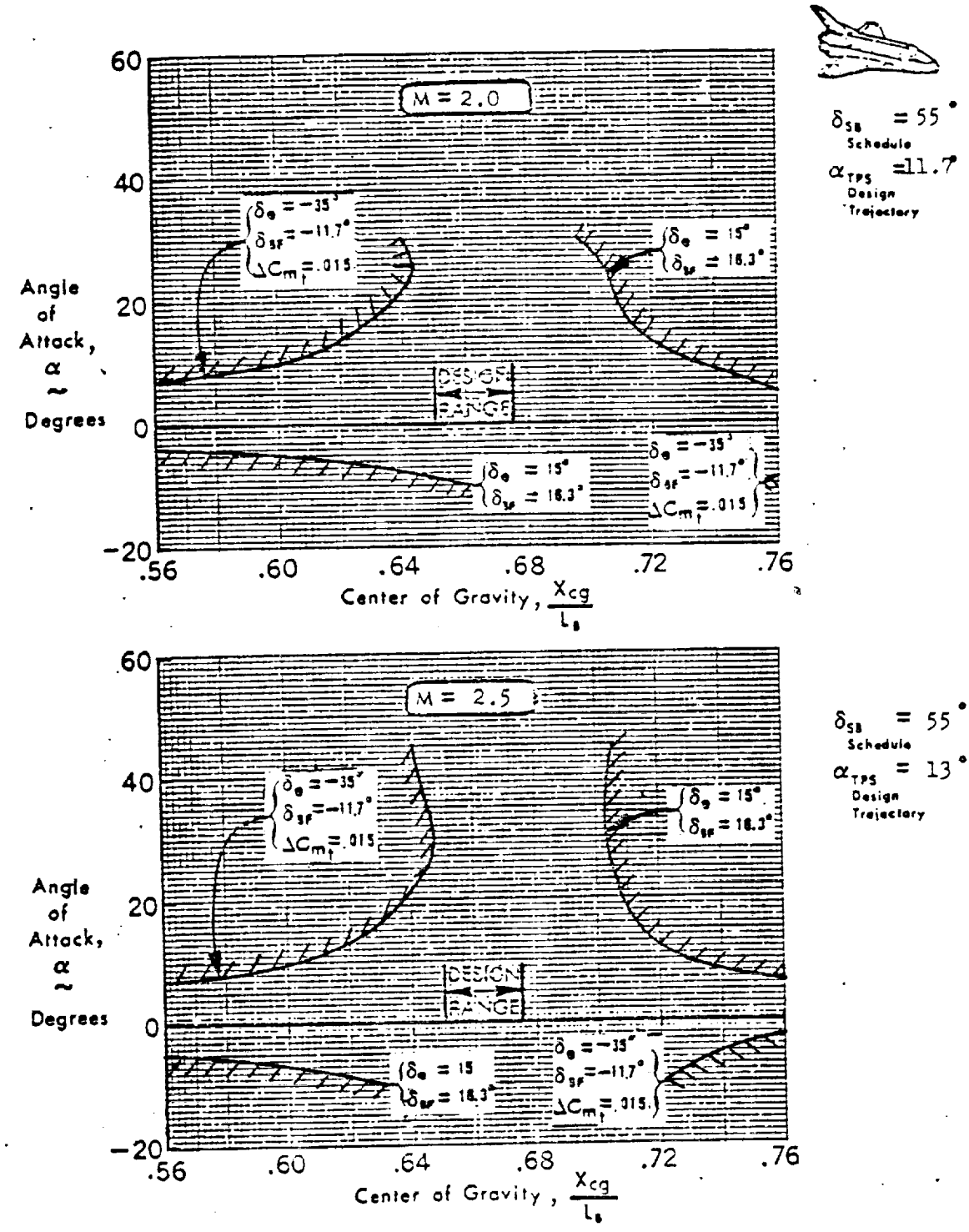


Figure 4.1.1.4-9
STATIC TRIM CAPABILITY

DJD 6-6-79

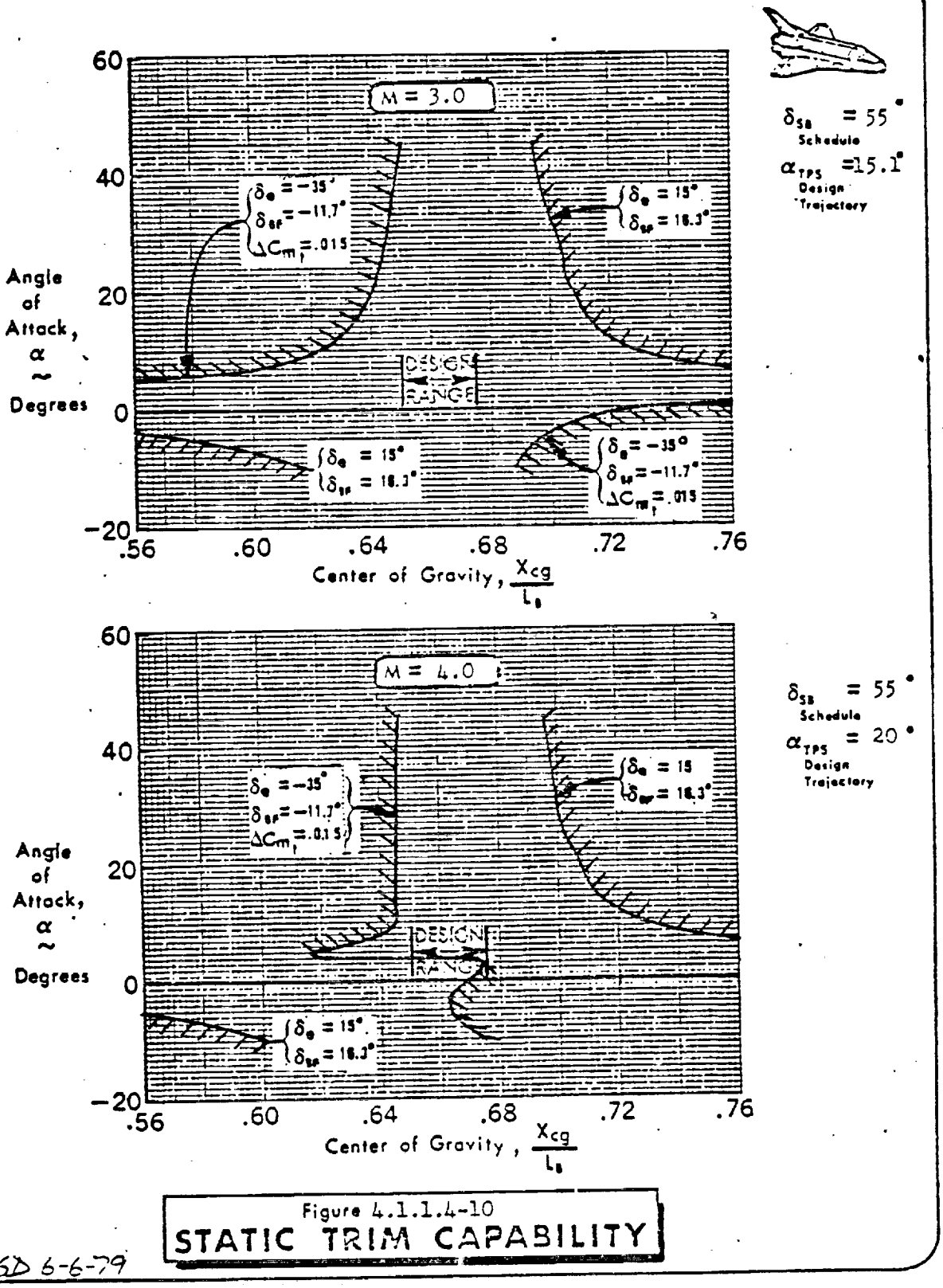
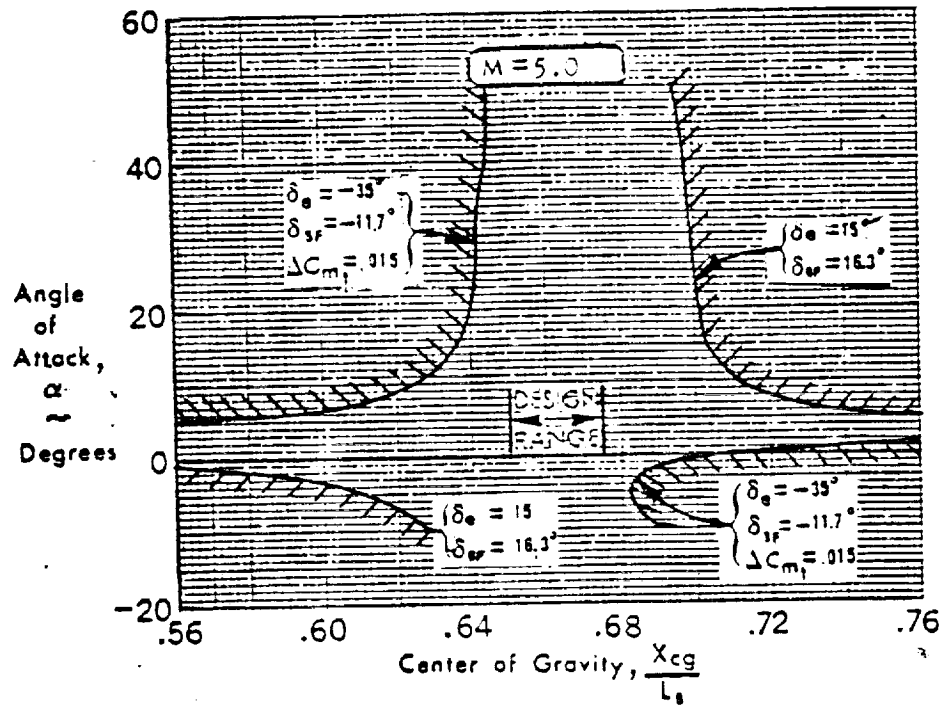


Figure 4.1.1.4-10
STATIC TRIM CAPABILITY

DSD 6-6-79



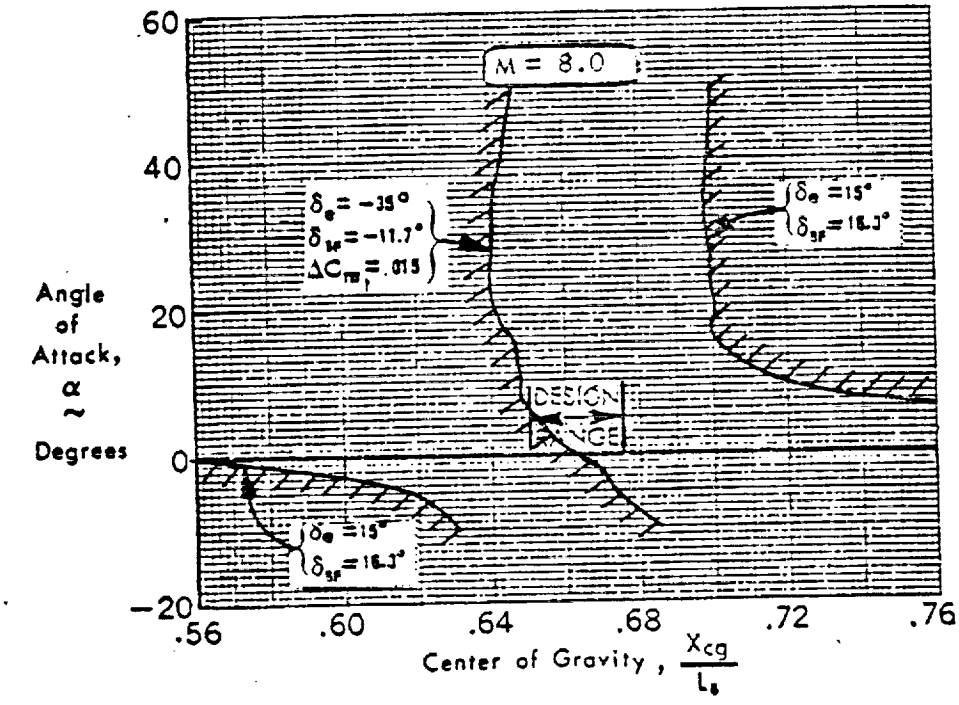
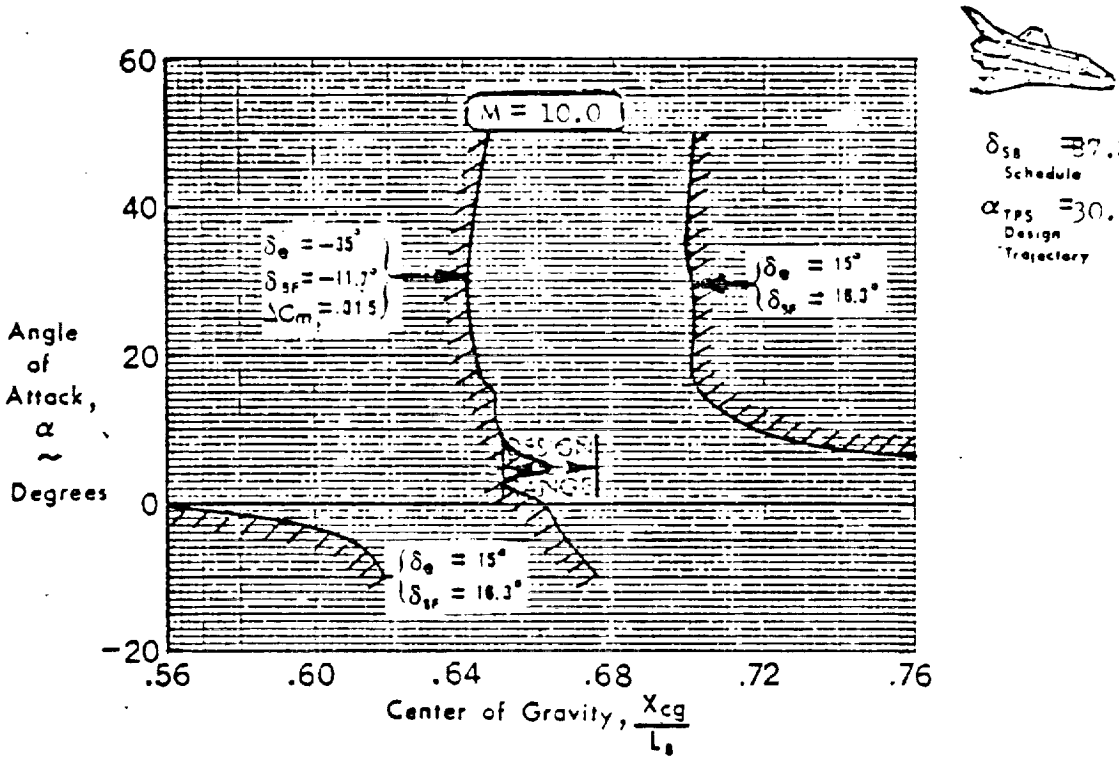


Figure 4.1.1.4-11
STATIC TRIM CAPABILITY

DAD 6-6-79



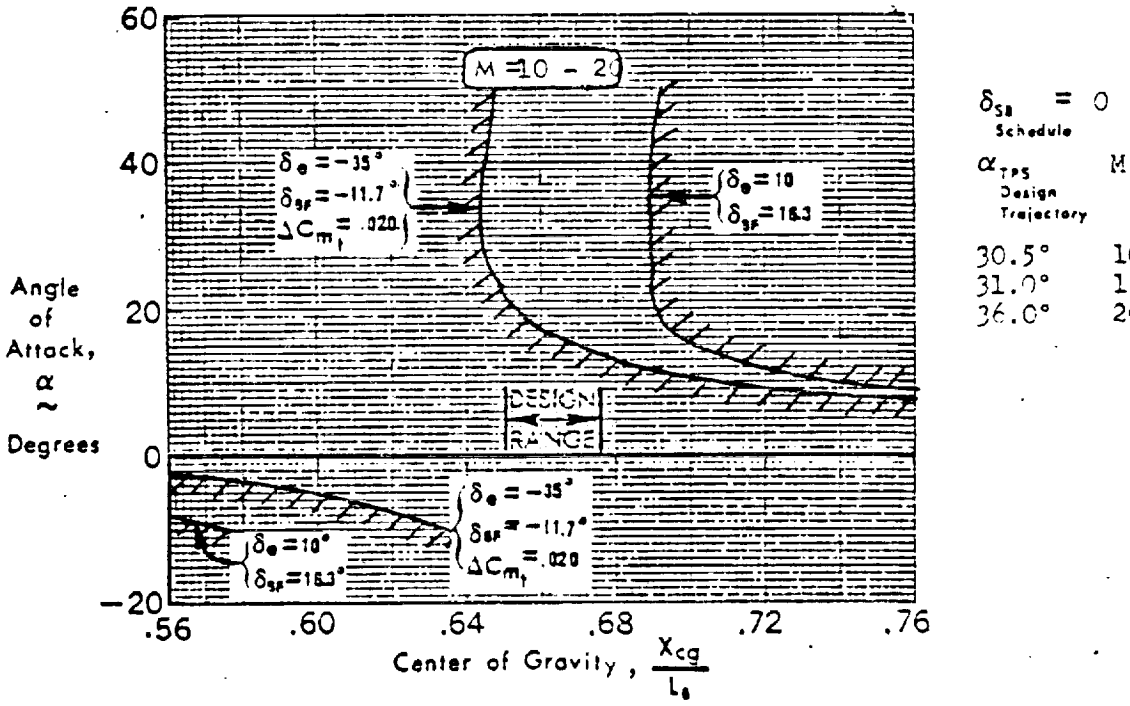


Figure 4.1.1.4-12
STATIC TRIM CAPABILITY

DGD 6-6-79

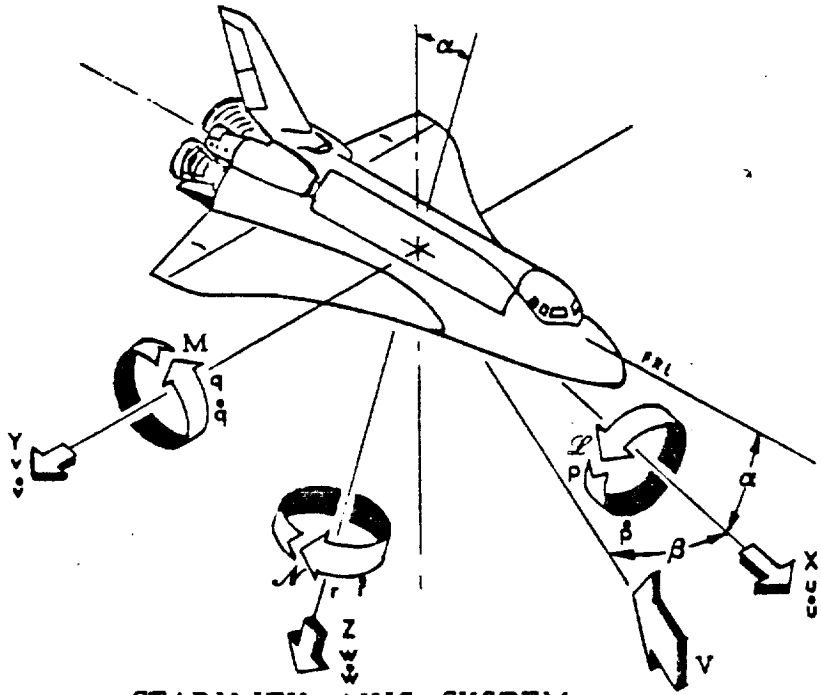
4.1.2 STABILITY-AXIS DATA. The longitudinal aerodynamic characteristics in the stability-axis system are:

4.1.2.1 LIFT COEFFICIENT

4.1.2.2 DRAG COEFFICIENT

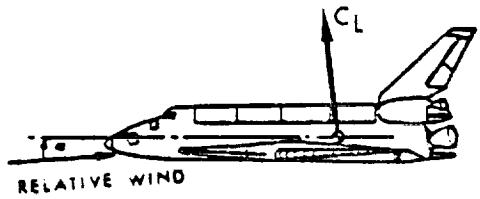
The pitching moment characteristics are identical to those for the body-axis system (see Section 4.1.1.3).

The pertinent equation for obtaining the total coefficient for any given flight condition precedes the presentation of data. Each element of the equation is defined and referenced to the appropriate figures and/or tables for obtaining the corresponding numberical values. Where additional information is considered beneficial (e.g., aeroelastic deformation, hypersonic viscous interaction, and RCS impingement), Appendices have been included for reference.



STABILITY AXIS SYSTEM

4.1.2.1 LIFT FORCE COEFFICIENT. The Orbiter Vehicle aerodynamic lift force coefficient is defined in this section. The basic aerodynamic lift force coefficient data are presented in three forms: 1) as a function of angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty^{\perp}$) from 0.005 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude; and 3) as a function of angle of attack and altitude from 300,000 feet through 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.1.2.1]. Uncertainties associated with the lift force characteristics are available in Section 6.0.



The RCS flow field interaction data are presented as a contribution to the lift force (L) rather than the coefficient (C_L) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where the RCS is used in conjunction with the aerodynamic force (cf. Section 3.6); i.e., the aerodynamic coefficient must be converted to a dimensional force *before* adding the RCS flow field interaction effect (see also Appendix B).

The total lift force is:

$$L_{TOTAL} = \bar{q}\, S\, C_{L_{\substack{TOTAL \\ AERO}}} + L_{RCS}$$

* The total aerodynamic lift force coefficient is obtained by the following equation:

$$C_{L_{TOTAL}} = C_{L_{BASIC}} + \left[\Delta C_{L_{ELEVATOR}} + \Delta C_{L_{AILERON}}\right]_{ELEVON} + \Delta C_{L_{\substack{BODY \\ FLAP}}} + \Delta C_{L_{RUDDER}} + \Delta C_{L_{\substack{SPEED \\ BRAKE}}}$$

$$+ C_{L_{\dot{\alpha}}} \frac{\dot{\alpha}\bar{c}}{2V} + C_{L_{\hat{q}}} \frac{q\bar{c}}{2V} + \Delta C_{L_{FLEX}} + \Delta C_{L_{\substack{LANDING \\ GEAR}}} + \Delta C_{L_{\substack{GROUND \\ EFFECT}}} + \Delta C_{L_{\substack{SILTS \\ POD}}}$$

where,

$C_{L_{BASIC}}$ = Basic, full-scale, freestream, rigid body lift force coefficient. (Figures 4.1.2.1-1 through -6)

NOTE: 1. All control surfaces neutral *except* $\delta_{SB} = 25°$.

* Refer to Appendix D when using digitized data.

$\Delta C_{L_{ELEVATOR}}$ = Change in lift coefficient due to elevon (elevator) deflection, δ_e, when inboard and outboard angles are equal. (Figures 4.1.2.1-7 through -35)

NOTE: 1. Partial span factor, K_L, to be used for elevon-body flap interconnect flight system where δ_e is limited to ±5° and inboard and outboard angles are not equal. (Figure 4.1.2.1-36)

$$\Delta C_{L_{e_{\delta_{e_i} \neq \delta_{e_o}}}} = K_L \, \Delta C_{L_{e_{\delta_e = \delta_{e_i}}}} + (1 - K_L) \Delta C_{L_{e_{\delta_e = \delta_{e_o}}}}$$

$\Delta C_{L_{AILERON}}$ = Change in lift coefficient due to aileron deflection, δ_a.

$$= \frac{1}{2}\left[K_{L_{(\delta_{e_L})}} \Delta C_{L e_{L_I}} + (1 - K_{L_{(\delta_{e_L})}}) \Delta C_{L e_{L_O}} + K_{L_{(\delta_{e_R})}} \Delta C_{L e_{R_I}} + (1 - K_{L_{(\delta_{e_R})}}) \Delta C_{L e_{R_O}}\right] - \Delta C_{L_{ELEVATOR}}$$

$\Delta C_{L_{BODY\ FLAP}}$ = Change in lift force coefficient due to body flap deflection, δ_{BF}. (Figures 4.1.2.1-37 through -66)

$\Delta C_{L_{RUDDER}}$ = Change in lift force coefficient due to rudder deflection, δ_r. (Assume zero)

$\Delta C_{L_{SPEED\ BRAKE}}$ = Change in lift force coefficient due to speed brake deflection, δ_{SB}. (Figures 4.1.2.1-67 through -93)

$C_{L_{\dot{\alpha}}}$ = Change in lift force coefficient with rate-of-change of angle of attack, $\dot{\alpha}$, (per radian).* (Assume zero)

C_{L_q} = Change in lift force coefficient with pitch rate, q, (per radian).* (Assume zero)

$\Delta C_{L_{FLEX}}$ = Change in lift force coefficient due to aeroelastic deformation.

$$= \Delta C^F_{L_o} - (1 - \eta_N)(C^R_L - C^R_{L_o})_{BASIC} - (1 - \eta_{L_e})\left(\Delta C^R_{L_e} + \Delta C^R_{L_{AILERON}}\right)$$

$$- (1 - \eta_{L_{BF}}) \Delta C^R_{L_{BF}} - (1 - \eta_{L_{SB}}) \Delta C^R_{L_{SB}}$$

*For rotary derivative transfer equations see NASA SP-3070, "Summary of Transformation Equations and Equations of Motion Used in Free-Flight and Wind Tunnel Data Reduction and Analysis," Gainer, T. G., and S. Hoffman, Langley Research Center, Hampton, Virginia (1972).

NOTE: 1. Detailed discussion of aeroelasticity may be obtained from Appendix A.

where the flexible (F) to rigid (R) ratios are,

η_N = basic lift (Figure 4.1.2.1-94)

η_{L_e} = elevon (Figure 4.1.2.1-95)

$\eta_{L_{BF}}$ = body flap (Figure 4.1.2.1-96)

$\eta_{L_{SB}}$ = speed brake (Assume 1.0)

$\Delta C^F_{L_o}$ = flexible intercept at $\alpha = 0$ (Figure 4.1.2.1-97)

$\Delta C_{L_{\text{LANDING GEAR}}}$ = Change in lift force coefficient due to extension of landing gear. (Figure 4.1.2.1-98)

$\Delta C_{L_{\text{GROUND EFFECT}}}$ = Change in lift force coefficient due to proximity of ground, f(h/b). (Figures 4.1.2.1-99 through -108)

NOTE: 1. See Section 3.4 for ground clearance and scrape attitude.

$\Delta C_{L_{\text{SILTS POD}}}$ = Change in lift force coefficient due to addition of SILTS pod.

$= 0.0018229 - 0.0019876M + 0.000431427M^2$

for $M \leq 6.0$

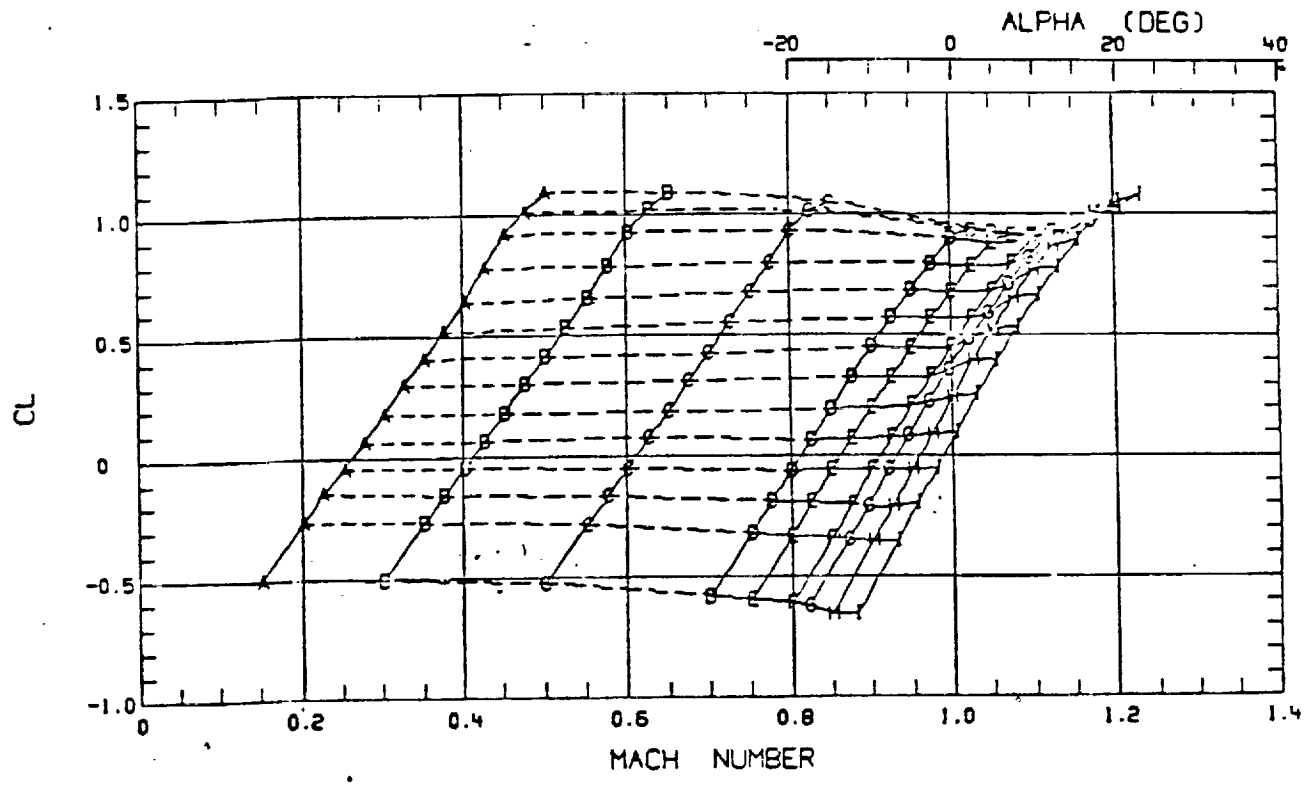
= zero for $M > 6.0$

* To obtain the RCS flow field interaction effect on the lift force use;

$$L_{RCS} = (N_{RCS} \cos \alpha - A_{RCS} \sin \alpha) \text{ - pounds}$$

where, N_{RCS} and A_{RCS} are obtained from Sections 4.1.1.1 and 4.1.1.2, respectively.

* Refer to Appendix D when using digitized data.



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

ALPHA (DEG)	MACH NUMBER 0.250 A	0.400 B	0.600 C	0.800 D	0.850 E	0.900 F	0.920 G	0.950 H	0.980 I
	LIFT COEFFICIENT								
-10.000	-0.50280	-0.51097	-0.52957	-0.58454	-0.59773	-0.61005	-0.62831	-0.65514	-0.65616
-5.000	-0.26906	-0.27397	-0.28670	-0.32761	-0.33790	-0.34601	-0.35039	-0.35897	-0.36172
-2.500	-0.15202	-0.16199	-0.17186	-0.19155	-0.19632	-0.20588	-0.21563	-0.21485	-0.19999
0.0	-0.05000	-0.05000	-0.05500	-0.06500	-0.06200	-0.06000	-0.06000	-0.06000	-0.05500
2.500	0.06214	0.06212	0.07201	0.06176	0.06652	0.07101	0.07563	0.08498	0.09414
5.000	0.17463	0.17448	0.17928	0.18859	0.19296	0.20356	0.21579	0.23947	0.24762
7.500	0.29705	0.29691	0.30657	0.31963	0.31838	0.32413	0.34997	0.38783	0.38955
10.000	0.40448	0.40924	0.41674	0.44384	0.44172	0.44572	0.47690	0.51887	0.52899
12.500	0.51599	0.52757	0.54905	0.56480	0.56566	0.56794	0.58585	0.64660	0.66026
15.000	0.63581	0.65002	0.67426	0.68162	0.67309	0.68323	0.70567	0.76535	0.77783
17.500	0.77676	0.78385	0.79709	0.79087	0.77995	0.79401	0.81577	0.86501	0.89069
20.000	0.91657	0.92529	0.92851	0.89578	0.87690	0.89485	0.91619	0.96429	0.99805
22.500	1.00634	1.01512	1.01007	0.93184	0.91266	0.92074	0.95994	1.00227	1.04837
25.000	1.08964	1.08946	1.04489	0.92289	0.90795	0.93837	0.96751	1.02232	1.07579
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

ENGINEER_____
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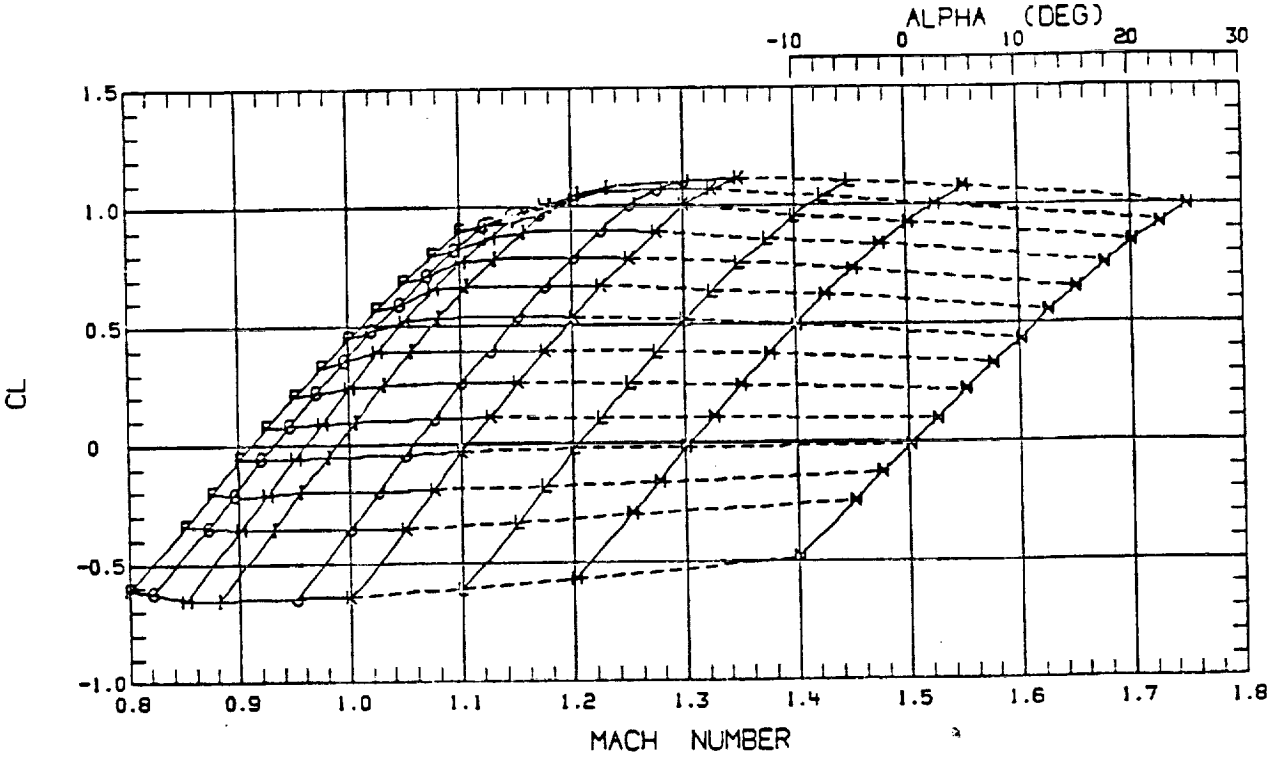
FIGURE 4.1.2.1 - 1
BASIC LIFT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER								
	0.900 F	0.920 G	0.950 H	0.980 I	1.050 J	1.100 K	1.200 L	1.300 M	1.500 N
ALPHA (DEG)	LIFT COEFFICIENT								
-10.000	-0.61005	-0.62831	-0.65514	-0.65616	-0.64808	-0.64225	-0.61158	-0.57681	-0.48844
-5.000	-0.34601	-0.35039	-0.35897	-0.36172	-0.36027	-0.35685	-0.33449	-0.30454	-0.25188
-2.500	-0.20588	-0.21553	-0.21485	-0.19888	-0.20310	-0.19292	-0.18275	-0.16776	-0.12989
0.0	-0.06000	-0.06000	-0.06000	-0.05500	-0.04700	-0.03600	-0.02500	-0.02300	-0.01500
2.500	0.07101	0.07563	0.08498	0.09414	0.10315	0.10796	0.10460	0.10295	0.09317
5.000	0.20356	0.21579	0.23947	0.24762	0.25552	0.25513	0.25014	0.24043	0.21606
7.500	0.32413	0.34997	0.38783	0.38955	0.39173	0.39121	0.38627	0.37178	0.32805
10.000	0.44572	0.47690	0.51887	0.52899	0.53602	0.53054	0.51767	0.49146	0.42874
12.500	0.56794	0.58585	0.64660	0.66026	0.66393	0.66357	0.63927	0.61835	0.54671
15.000	0.68323	0.70567	0.76535	0.77783	0.78377	0.77863	0.75952	0.72667	0.64381
17.500	0.79401	0.81577	0.86501	0.89069	0.89596	0.89086	0.85608	0.83073	0.74311
20.000	0.89485	0.91619	0.96428	0.99805	1.00286	1.00255	0.95636	0.92538	0.83834
22.500	0.92074	0.95994	1.00227	1.04837	1.06699	1.06660	1.03541	1.00114	0.91858
25.000	0.93837	0.96751	1.02232	1.07579	1.10328	1.11188	1.09985	1.07176	0.99205
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

ENGINEER_____
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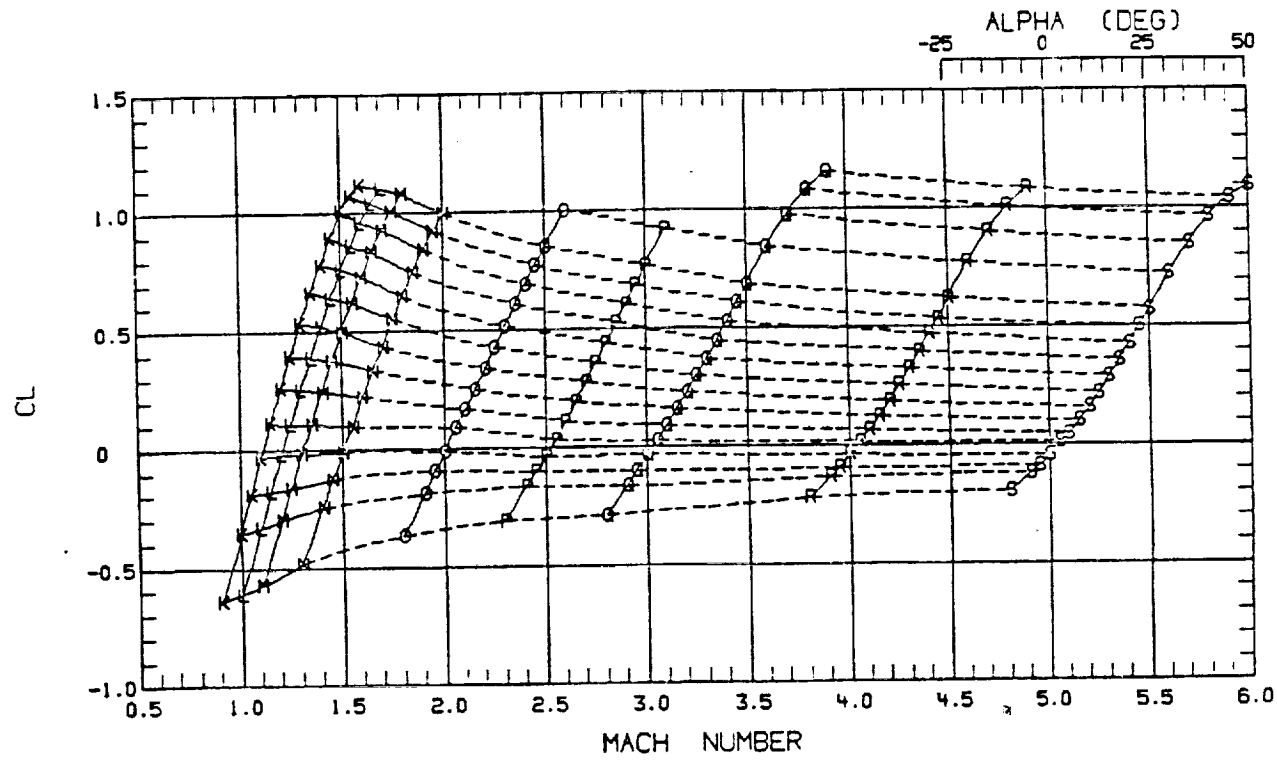
FIGURE 4.1.2.1 - 2
BASIC LIFT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	1.100 K	1.200 L	1.300 M	1.500 N	2.000 O	2.500 P	3.000 Q	4.000 R	5.000 S
ALPHA (DEG)	LIFT COEFFICIENT								
-10.000	-0.64225	-0.61158	-0.57681	-0.48844	-0.36885	-0.31514	-0.29383	-0.22874	-0.19854
-5.000	-0.35685	-0.33449	-0.30454	-0.25188	-0.19695	-0.16705	-0.16922	-0.13893	-0.12424
-2.500	-0.19292	-0.18275	-0.16776	-0.12989	-0.09888	-0.10456	-0.10504	-0.10050	-0.09081
0.0	-0.03600	-0.02500	-0.02300	-0.01500	-0.01700	-0.04290	-0.03700	-0.04430	-0.04724
2.500	0.10796	0.10460	0.10295	0.09317	0.08419	0.02995	0.02048	0.01111	0.00642
5.000	0.25513	0.25014	0.24043	0.21606	0.16125	0.10468	0.08600	0.06174	0.04301
7.500	0.39121	0.38627	0.37178	0.32805	0.24173	0.18906	0.15609	0.11881	0.09656
10.000	0.53054	0.51767	0.49146	0.42874	0.33103	0.27135	0.22528	0.18185	0.15220
12.500	0.66357	0.63927	0.61835	0.54671	0.41958	0.35229	0.29513	0.24730	0.21351
15.000	0.77863	0.75952	0.72667	0.64381	0.50777	0.43483	0.36604	0.31897	0.27892
17.500	0.89086	0.85608	0.83073	0.74311	0.60244	0.52033	0.44227	0.39229	0.35079
20.000	1.00255	0.95636	0.92538	0.83834	0.68871	0.60168	0.52215	0.46559	0.42351
22.500	1.06660	1.03541	1.00114	0.91958	0.76904	0.67886	0.60751	0.53159	0.49654
25.000	1.11188	1.09985	1.07176	0.99205	0.84561	0.76551	0.68386	0.61884	0.57019
30.000	•••••••	•••••••	•••••••	•••••••	0.99835	0.91867	0.84307	0.76946	0.72044
35.000	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	0.97219	0.89530	0.84607
40.000	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	1.07919	1.00341	0.96129
45.000	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	1.15675	1.07904	1.03683
50.000	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	1.09829

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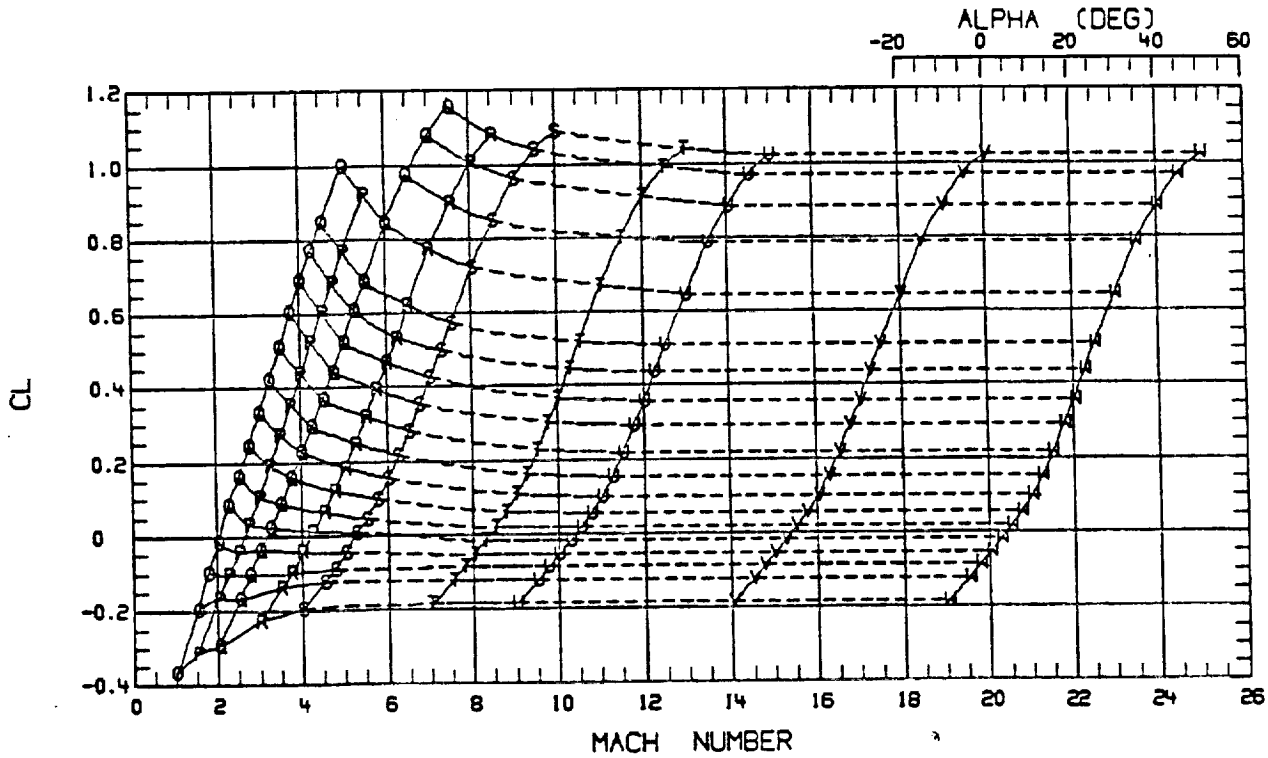
FIGURE 4.1.2.1 - 3
BASIC LIFT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	2.000 Q	2.500 P	3.000 O	4.000 R	5.000 S	8.000 T	10.000 U	15.000 V	20.000 W
ALPHA (DEG)	LIFT COEFFICIENT								
-10.000	-0.36885	-0.31514	-0.29383	-0.22874	-0.19854	-0.18641	-0.18641	-0.18641	-0.18641
-5.000	-0.19695	-0.16705	-0.16922	-0.13893	-0.12424	-0.12402	-0.12402	-0.12402	-0.12402
-2.500	-0.09888	-0.10456	-0.10504	-0.10050	-0.09081	-0.08913	-0.08913	-0.08913	-0.08913
0.0	-0.01700	-0.04290	-0.03700	-0.04430	-0.04724	-0.05540	-0.05540	-0.05540	-0.05540
2.500	0.08419	0.02995	0.02048	0.01111	0.00642	-0.02023	-0.02023	-0.02023	-0.02023
5.000	0.16125	0.10468	0.08600	0.06174	0.04301	0.01774	0.01754	0.01754	0.01754
7.500	0.24173	0.18906	0.15609	0.11881	0.09656	0.05965	0.05558	0.05558	0.05558
10.000	0.33103	0.27135	0.22528	0.18185	0.15220	0.10604	0.10002	0.10002	0.10002
12.500	0.41958	0.35229	0.29513	0.24730	0.21351	0.16115	0.15328	0.15328	0.15328
15.000	0.50777	0.43483	0.36604	0.31897	0.27892	0.22632	0.21732	0.21732	0.21732
17.500	0.60244	0.52033	0.44227	0.39229	0.35079	0.29998	0.29043	0.29043	0.29043
20.000	0.68871	0.60168	0.52215	0.46559	0.42351	0.36492	0.35587	0.35587	0.35587
22.500	0.76904	0.67886	0.60751	0.53159	0.49654	0.44356	0.43474	0.43474	0.43474
25.000	0.84561	0.76551	0.68386	0.61884	0.57019	0.51805	0.50936	0.50936	0.50936
30.000	0.99835	0.91867	0.84307	0.76946	0.72044	0.66945	0.64465	0.64465	0.64465
35.000	**********	**********	0.97219	0.89630	0.84607	0.79881	0.78382	0.78382	0.78382
40.000	**********	**********	1.07919	1.00341	0.96129	0.91017	0.88400	0.88400	0.88400
45.000	**********	**********	1.15675	1.07904	1.03683	0.98747	0.96803	0.96803	0.96803
50.000	**********	**********	**********	**********	1.08629	1.03514	1.02007	1.02007	1.02007

ENGINEER_____
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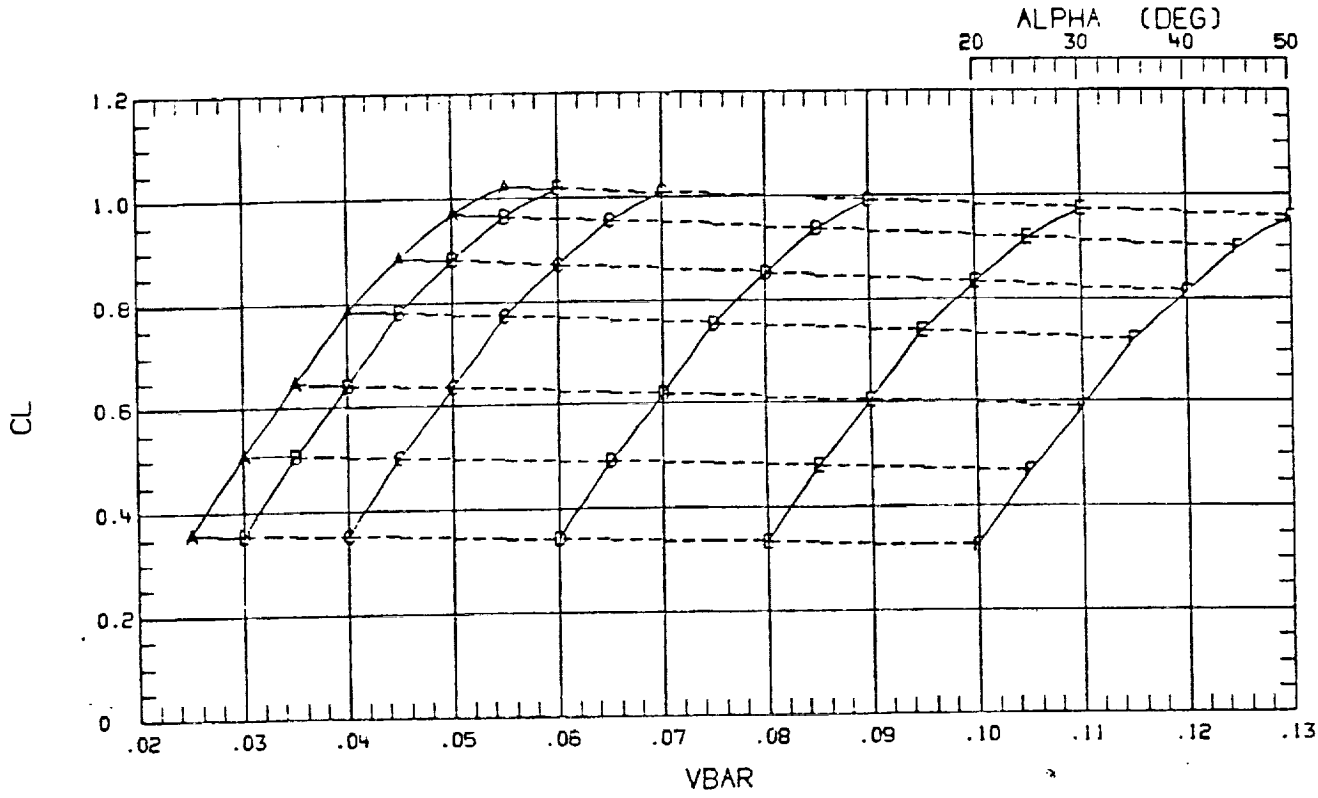
FIGURE 4.1.2.1 - 4
BASIC LIFT COEFFICIENT

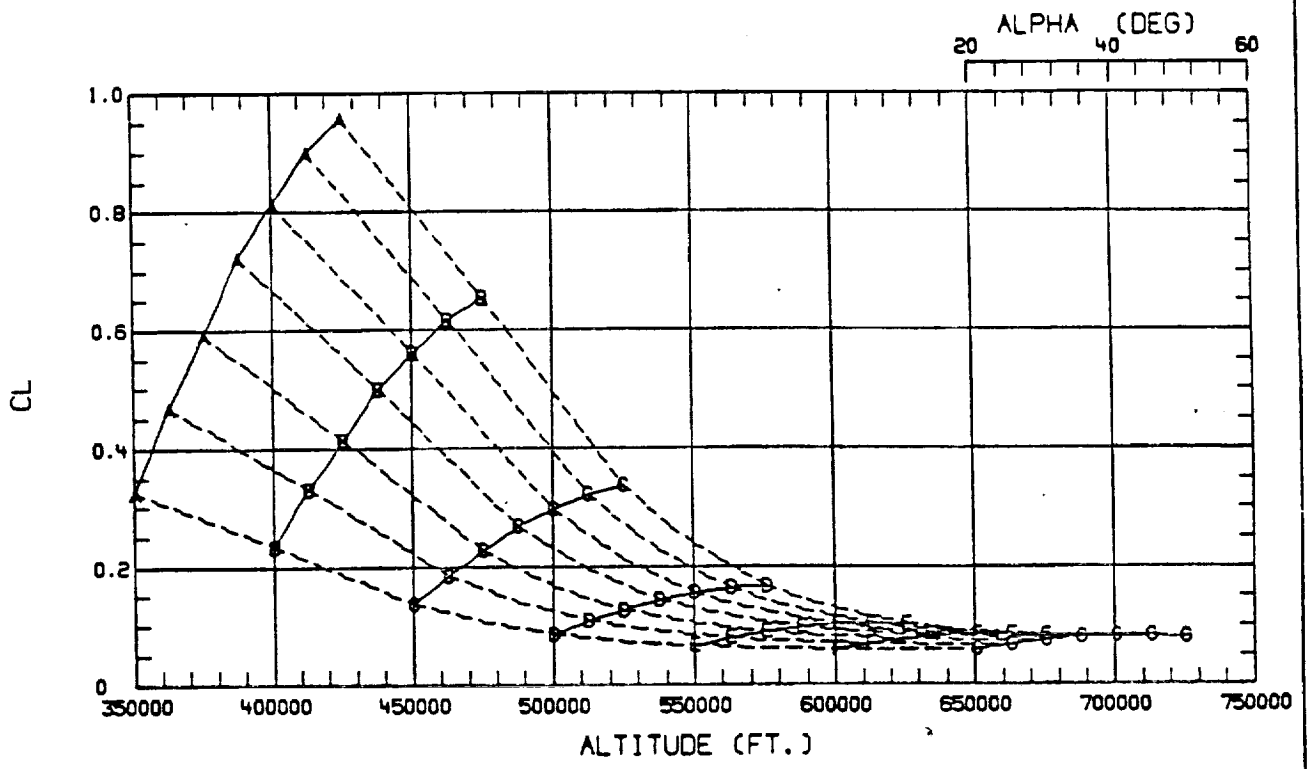


CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005	0.010	0.020	0.040	0.060	0.080
	A	B	C	D	E	F
ALPHA (DEG)	VISCOUS LIFT COEFFICIENT					
20.000	0.35587	0.35365	0.34920	0.34031	0.33141	0.32252
25.000	0.50936	0.50645	0.50057	0.48887	0.47712	0.46541
30.000	0.64465	0.64085	0.63330	0.61820	0.60310	0.58800
35.000	0.78352	0.77940	0.77074	0.75342	0.73610	0.71878
40.000	0.88400	0.87912	0.86935	0.84974	0.83020	0.81060
45.000	0.96803	0.96322	0.95367	0.93451	0.91542	0.89626
50.000	1.02007	1.01578	1.00705	0.98965	0.97234	0.95442

FIGURE 4.1.2.1-5
BASIC LIFT COEFFICIENT



CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE LIFT COEFFICIENT						
20.000	0.32252	0.23081	0.13520	0.08407	0.06477	0.05860	0.05764
25.000	0.46541	0.32742	0.18349	0.10660	0.07744	0.06827	0.06682
30.000	0.58800	0.41010	0.22462	0.12553	0.08800	0.07605	0.07427
35.000	0.71878	0.49737	0.26641	0.14300	0.09631	0.08150	0.07921
40.000	0.81060	0.55805	0.29484	0.15402	0.10082	0.08392	0.08133
45.000	0.89626	0.61384	0.31947	0.16193	0.10239	0.08351	0.08061
50.000	0.95442	0.65121	0.33515	0.16608	0.10218	0.08186	0.07873

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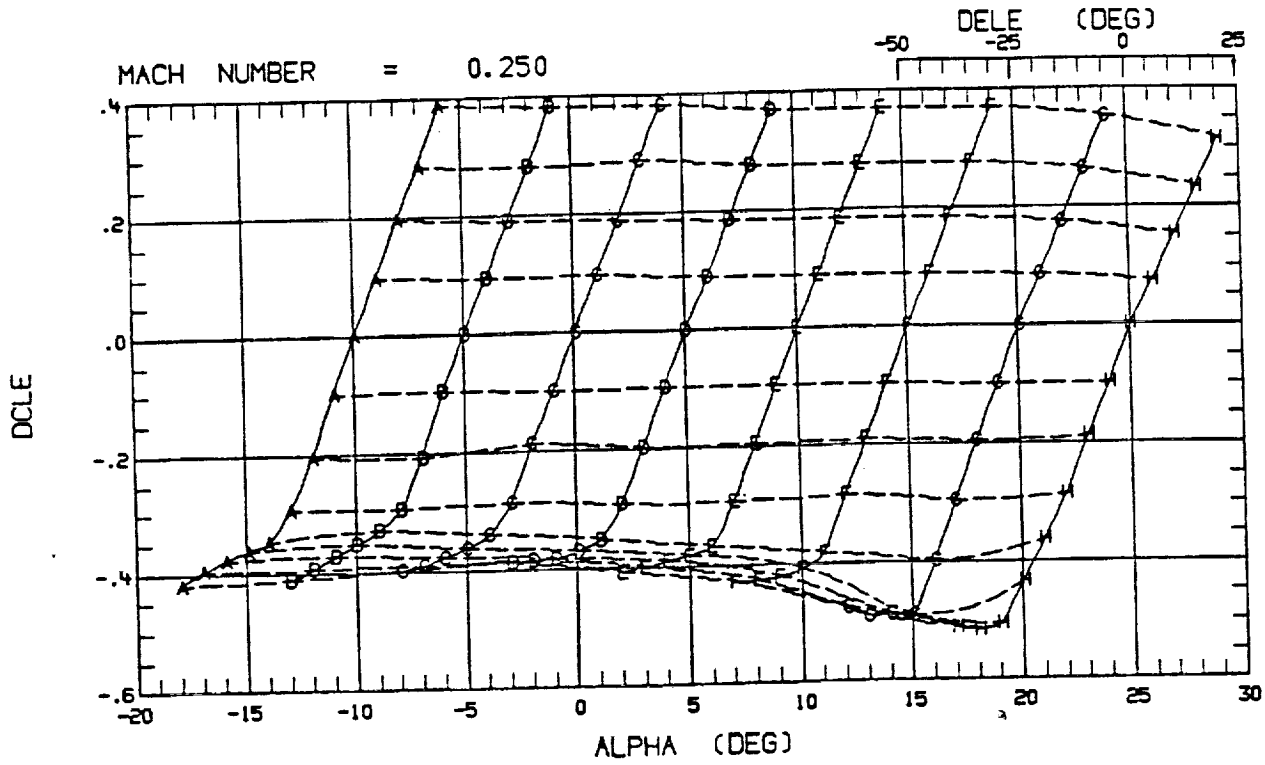
FIGURE 4.1.2.1 - 6
BASIC LIFT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.41900	-0.41300	-0.39900	-0.38900	-0.40900	-0.43000	-0.47500	-0.51000
-35.000	-0.39700	-0.39500	-0.39100	-0.38700	-0.40100	-0.42800	-0.49000	-0.51500
-30.000	-0.37800	-0.37400	-0.37800	-0.38300	-0.39200	-0.42200	-0.48800	-0.50600
-25.000	-0.36300	-0.35400	-0.36300	-0.37200	-0.38300	-0.40900	-0.49000	-0.43600
-20.000	-0.34900	-0.33100	-0.34100	-0.35300	-0.36900	-0.38400	-0.40000	-0.36300
-15.000	-0.29500	-0.29500	-0.28800	-0.29400	-0.29300	-0.28600	-0.29700	-0.28700
-10.000	-0.20700	-0.20800	-0.19000	-0.19800	-0.19700	-0.19200	-0.19700	-0.19000
-5.000	-0.10000	-0.09800	-0.10000	-0.09800	-0.09800	-0.09800	-0.10000	-0.10000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.09600	0.09300	0.09500	0.08800	0.08800	0.08800	0.08500	0.07200
10.000	0.19400	0.18900	0.18800	0.18400	0.18400	0.18400	0.17400	0.15000
15.000	0.28400	0.28000	0.28800	0.27500	0.27500	0.27500	0.26300	0.22900
20.000	0.38700	0.38200	0.38200	0.36900	0.36900	0.36900	0.35200	0.31000

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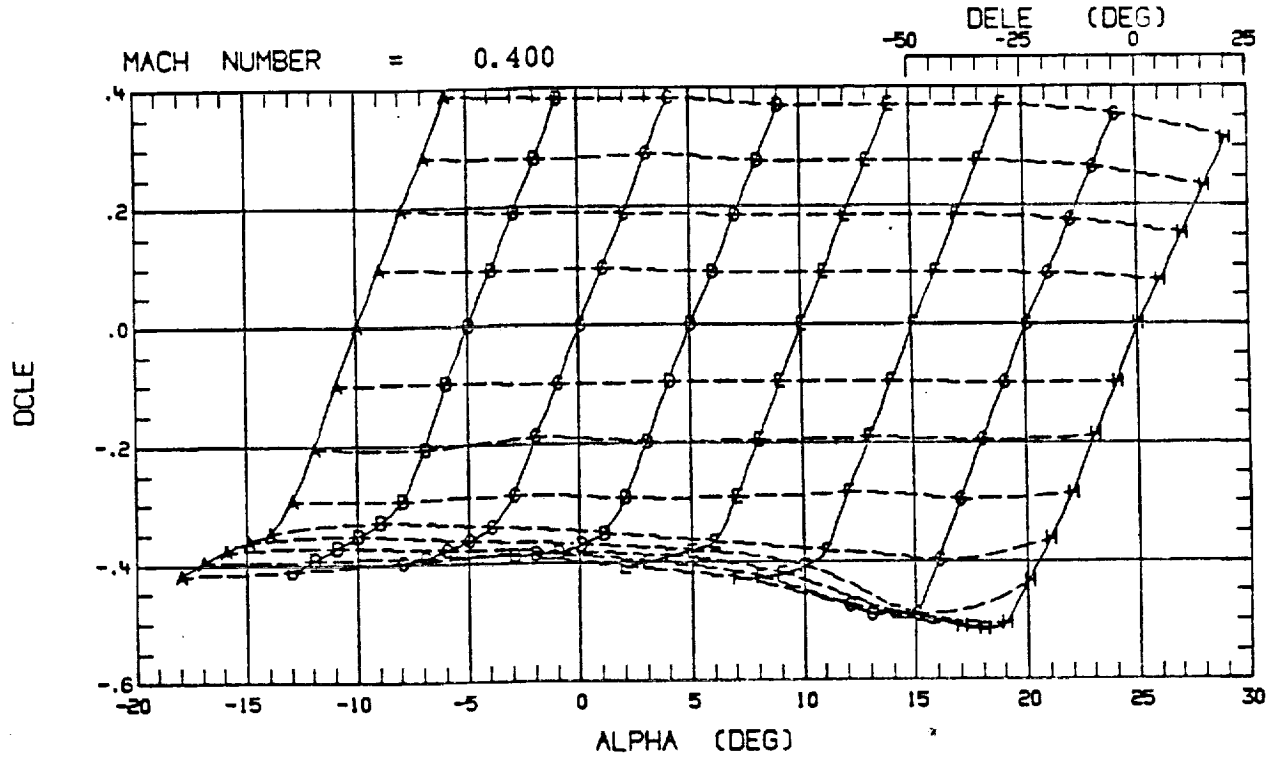
FIGURE 4.1.2.1-7
ELEVON LIFT COEFFICIENT INCREMENT

SE72-011-0000 IM



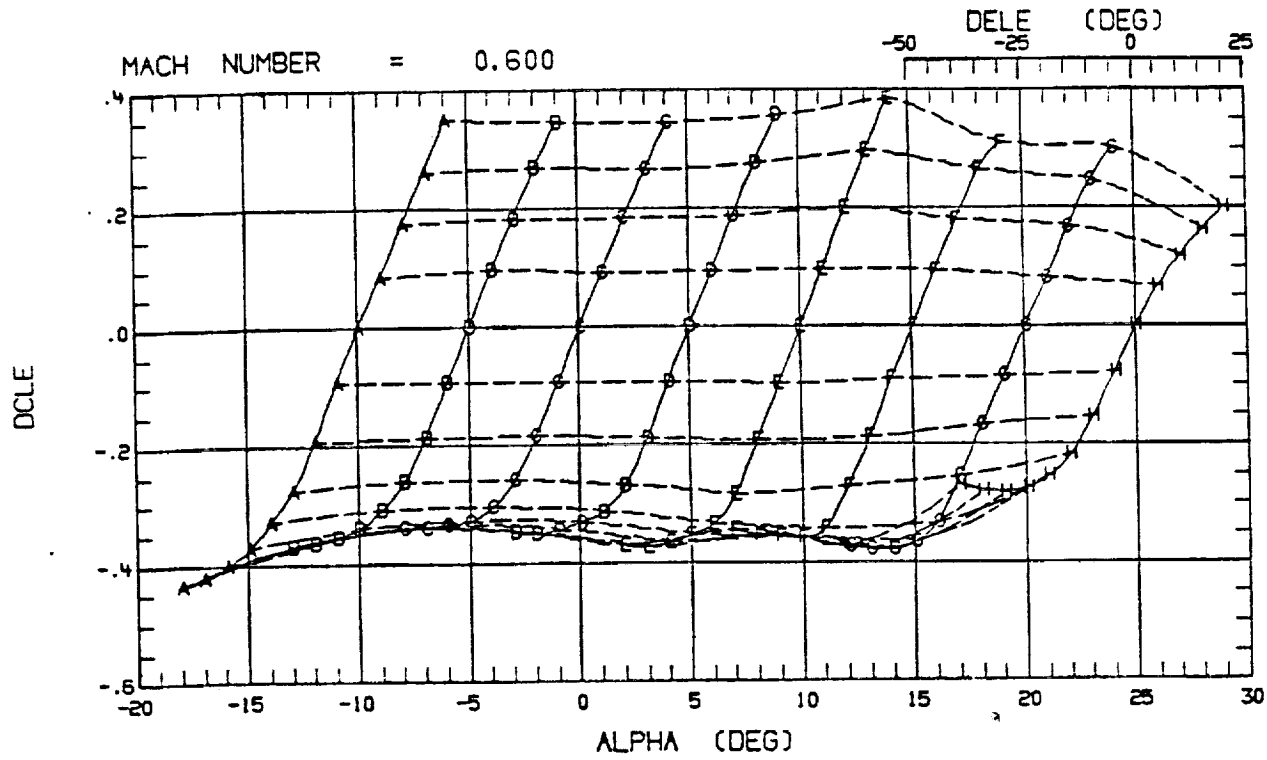
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.41900	-0.41300	-0.39900	-0.38900	-0.40900	-0.43000	-0.47500	-0.51000
-35.000	-0.39700	-0.39500	-0.39100	-0.38700	-0.40100	-0.42800	-0.49000	-0.51500
-30.000	-0.37800	-0.37400	-0.37800	-0.38300	-0.39200	-0.42200	-0.48800	-0.50600
-25.000	-0.36300	-0.35400	-0.36300	-0.37200	-0.38300	-0.40900	-0.49000	-0.43600
-20.000	-0.34900	-0.33100	-0.34100	-0.35300	-0.36900	-0.38400	-0.40000	-0.36300
-15.000	-0.29500	-0.29500	-0.28800	-0.29400	-0.29300	-0.28600	-0.29700	-0.28700
-10.000	-0.20700	-0.20800	-0.19000	-0.19800	-0.19700	-0.19200	-0.19700	-0.19000
-5.000	-0.10000	-0.09800	-0.10000	-0.09800	-0.09800	-0.09800	-0.10000	-0.10000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.09600	0.09300	0.09500	0.08800	0.08800	0.08800	0.08500	0.07200
10.000	0.19400	0.18900	0.18800	0.18400	0.18400	0.18400	0.17400	0.15000
15.000	0.28400	0.28000	0.28800	0.27500	0.27500	0.27500	0.26300	0.22900
20.000	0.38700	0.38200	0.38200	0.36900	0.36900	0.36900	0.35200	0.31000

ENGINEER 9/14/78
DATE

FIGURE 4.1.2.1-8
ELEVON LIFT COEFFICIENT INCREMENT



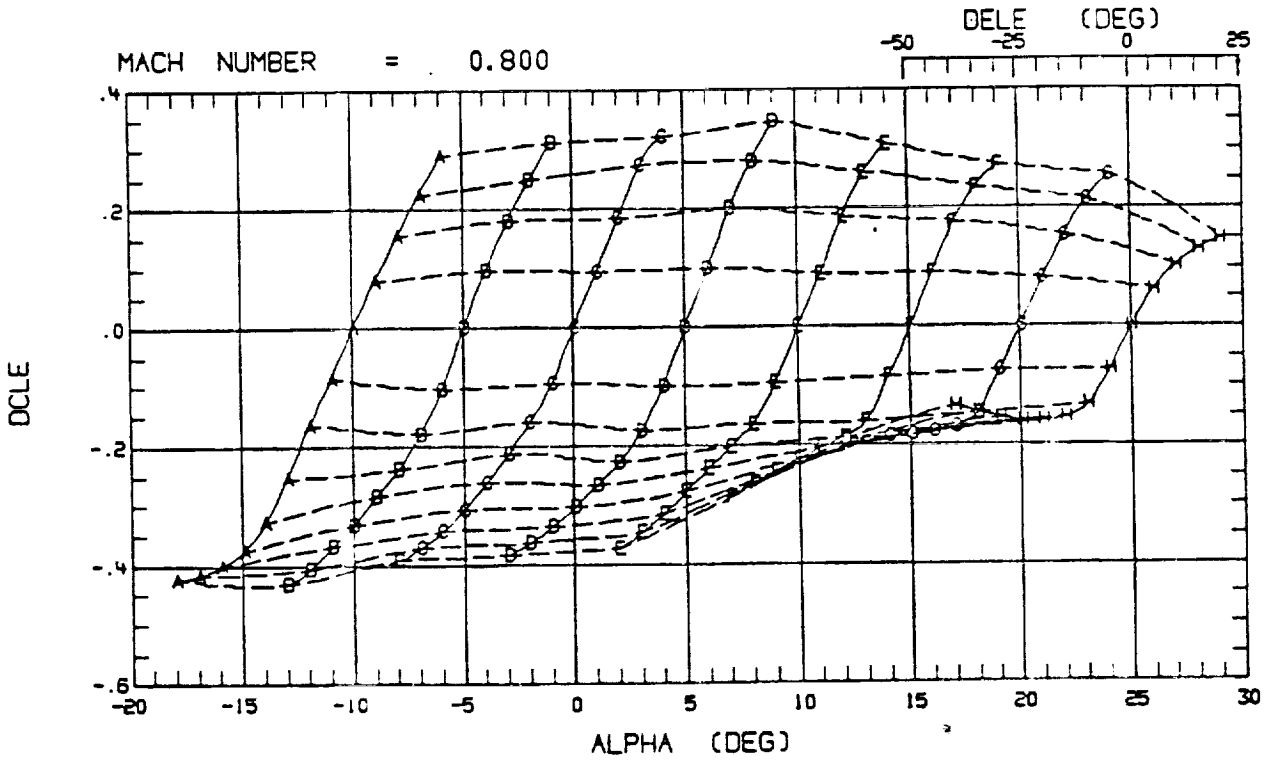
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.43500	-0.37200	-0.34200	-0.35000	-0.37200	-0.34500	-0.37300	-0.27100
-35.000	-0.42200	-0.36700	-0.34000	-0.35200	-0.37400	-0.35400	-0.37800	-0.27900
-30.000	-0.40300	-0.35600	-0.33600	-0.34500	-0.36700	-0.35700	-0.37800	-0.28200
-25.000	-0.37500	-0.34200	-0.33000	-0.33300	-0.35400	-0.36000	-0.36600	-0.27500
-20.000	-0.33100	-0.31000	-0.30600	-0.31500	-0.33500	-0.34400	-0.33300	-0.25600
-15.000	-0.27700	-0.26300	-0.26100	-0.27000	-0.28600	-0.27200	-0.25500	-0.22000
-10.000	-0.19500	-0.19000	-0.18600	-0.19100	-0.19500	-0.19000	-0.16800	-0.15600
-5.000	-0.09600	-0.09600	-0.09500	-0.09400	-0.09800	-0.09000	-0.08600	-0.07900
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.08300	0.09500	0.09000	0.09300	0.09600	0.09400	0.08000	0.06400
10.000	0.17500	0.18200	0.18300	0.18700	0.20000	0.18000	0.16700	0.11700
15.000	0.26000	0.26700	0.26500	0.27500	0.29600	0.26400	0.24400	0.16100
20.000	0.34900	0.34500	0.34400	0.35600	0.38500	0.30900	0.29900	0.19900

ENGINEER GLO
DATE 9/14/79

FIGURE 4.1.2.1-9.
ELEVON LIFT COEFFICIENT INCREMENT



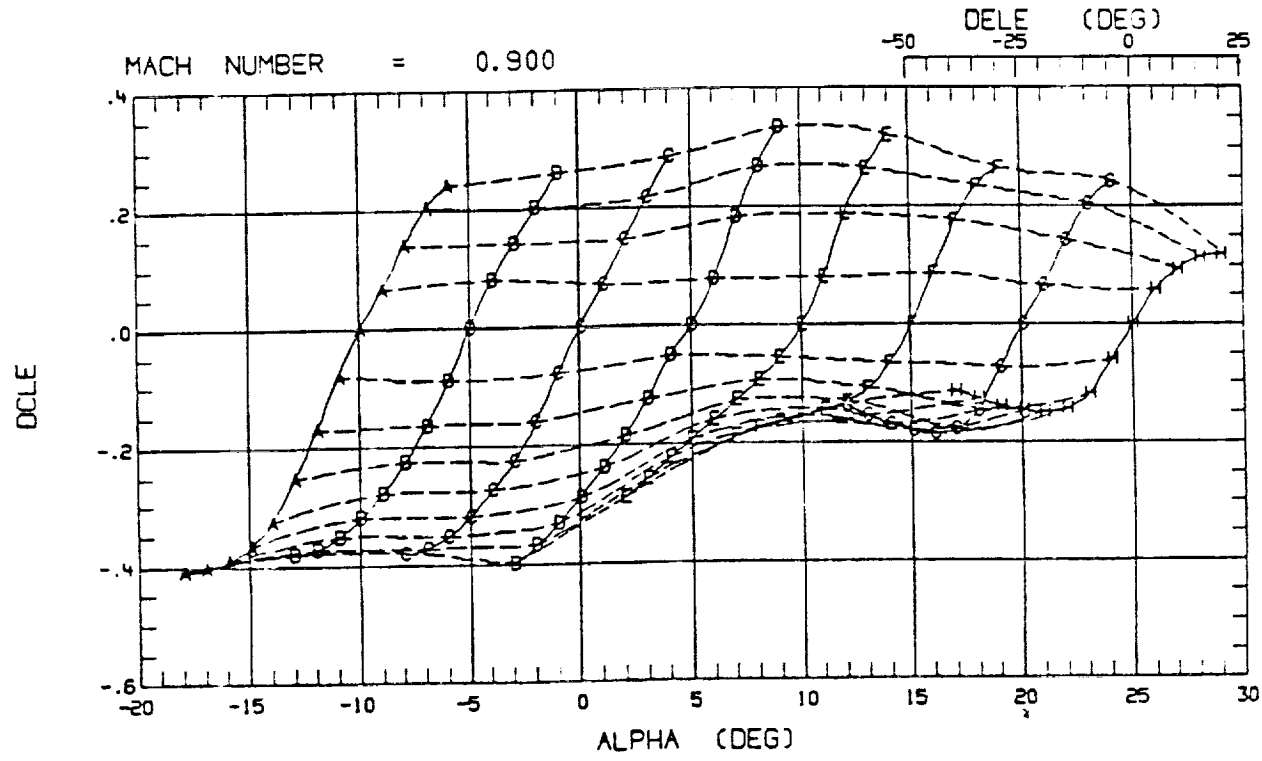
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.42600	-0.43300	-0.39300	-0.38400	-0.37400	-0.28700	-0.19300	-0.13500
-35.000	-0.41700	-0.40700	-0.37200	-0.36300	-0.34700	-0.26600	-0.19000	-0.14600
-30.000	-0.40200	-0.37000	-0.34400	-0.33700	-0.31500	-0.24500	-0.18700	-0.15500
-25.000	-0.37600	-0.33300	-0.30700	-0.30400	-0.27800	-0.22500	-0.18400	-0.16100
-20.000	-0.32900	-0.28500	-0.26300	-0.26700	-0.23900	-0.20500	-0.17900	-0.16200
-15.000	-0.25400	-0.24000	-0.21300	-0.22900	-0.20300	-0.18800	-0.17100	-0.15600
-10.000	-0.16500	-0.18000	-0.16000	-0.17500	-0.16500	-0.16200	-0.14700	-0.13400
-5.000	-0.08700	-0.10400	-0.09500	-0.10100	-0.09600	-0.08500	-0.07500	-0.07500
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.07800	0.09500	0.09400	0.09900	0.08800	0.09000	0.07900	0.06000
10.000	0.15300	0.18000	0.18400	0.20000	0.18500	0.17500	0.15200	0.10100
15.000	0.22300	0.24800	0.27400	0.27900	0.25800	0.23300	0.21100	0.12900
20.000	0.28900	0.31000	0.32200	0.34700	0.30600	0.27000	0.25200	0.14500

ENGINEER ECO
DATE 9/14/78

FIGURE 4.1.2.1-10
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

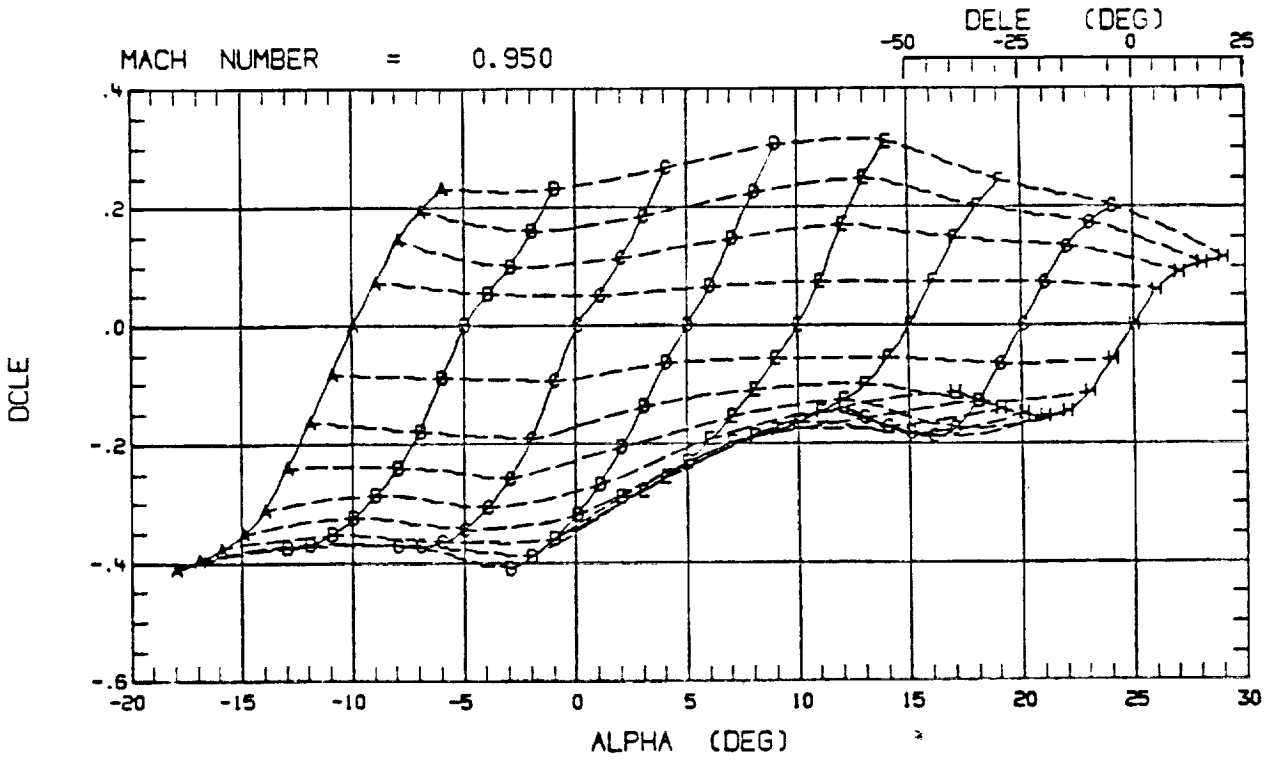
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.41000	-0.38200	-0.38200	-0.40000	-0.29000	-0.18800	-0.13700	-0.11400
-35.000	-0.40400	-0.37400	-0.37300	-0.37000	-0.25900	-0.17700	-0.15700	-0.12900
-30.000	-0.39200	-0.35400	-0.35300	-0.33400	-0.22500	-0.16600	-0.17100	-0.14000
-25.000	-0.36800	-0.32200	-0.32000	-0.29000	-0.19300	-0.15600	-0.18200	-0.14800
-20.000	-0.32800	-0.28000	-0.27600	-0.24000	-0.16000	-0.14600	-0.18600	-0.15000
-15.000	-0.25500	-0.22800	-0.22800	-0.18600	-0.12900	-0.13200	-0.17900	-0.14500
-10.000	-0.17200	-0.16500	-0.16200	-0.12500	-0.09500	-0.11100	-0.14700	-0.12100
-5.000	-0.08100	-0.09100	-0.08000	-0.05300	-0.05700	-0.06600	-0.07500	-0.06100
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.06400	0.08000	0.07000	0.07700	0.08000	0.08600	0.06400	0.05700
10.000	0.13800	0.14100	0.14500	0.18200	0.18700	0.17300	0.14000	0.09100
15.000	0.20100	0.20100	0.21700	0.26800	0.26300	0.23300	0.20200	0.11100
20.000	0.24100	0.26000	0.28500	0.33500	0.32000	0.26400	0.24100	0.11700

ENGINEER GCO
DATE 9/14/78

FIGURE 4.1.2.1-11
ELEVON LIFT COEFFICIENT INCREMENT

SL72-81-0000 IM



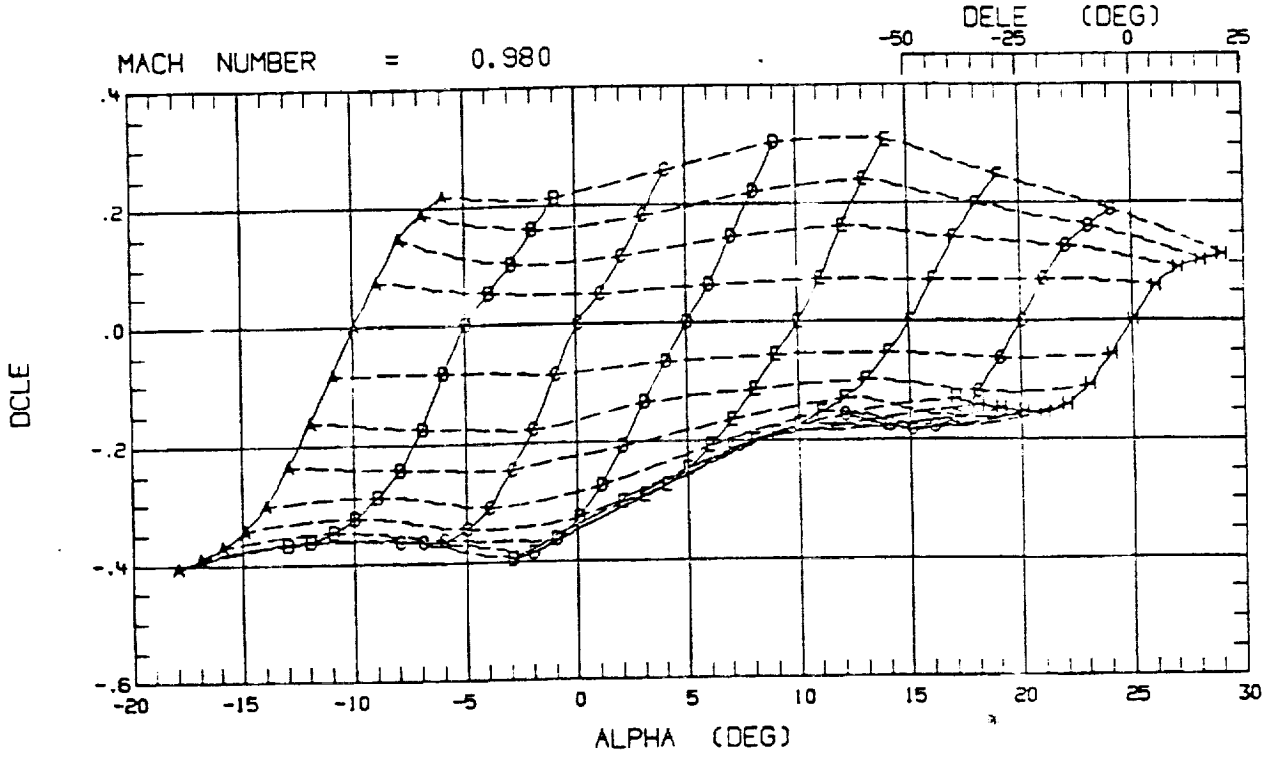
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.41100	-0.37700	-0.37300	-0.41200	-0.29100	-0.20000	-0.14000	-0.11500
-35.000	-0.39700	-0.37100	-0.37500	-0.39200	-0.28000	-0.19000	-0.15800	-0.13000
-30.000	-0.38000	-0.35500	-0.36700	-0.36100	-0.25800	-0.17900	-0.17400	-0.14200
-25.000	-0.35400	-0.32600	-0.34500	-0.32100	-0.23100	-0.16500	-0.18500	-0.15200
-20.000	-0.31300	-0.28800	-0.30900	-0.27000	-0.19500	-0.14700	-0.19000	-0.15600
-15.000	-0.24200	-0.24200	-0.26000	-0.20700	-0.15500	-0.12900	-0.17700	-0.14800
-10.000	-0.16500	-0.18200	-0.19300	-0.13900	-0.10900	-0.10200	-0.13100	-0.11600
-5.000	-0.08500	-0.09100	-0.09500	-0.06500	-0.05700	-0.05700	-0.06700	-0.05900
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.07000	0.05200	0.05000	0.06400	0.07300	0.07300	0.07100	0.05700
10.000	0.14300	0.09800	0.11300	0.14700	0.16900	0.14500	0.13100	0.08800
15.000	0.19200	0.15900	0.18400	0.22500	0.24800	0.20000	0.17100	0.10400
20.000	0.23100	0.23000	0.26500	0.30500	0.30900	0.24300	0.19900	0.11200

ENGINEER SCO
DATE 9/14/78

FIGURE 4.1.2.1-12
ELEVON LIFT COEFFICIENT INCREMENT



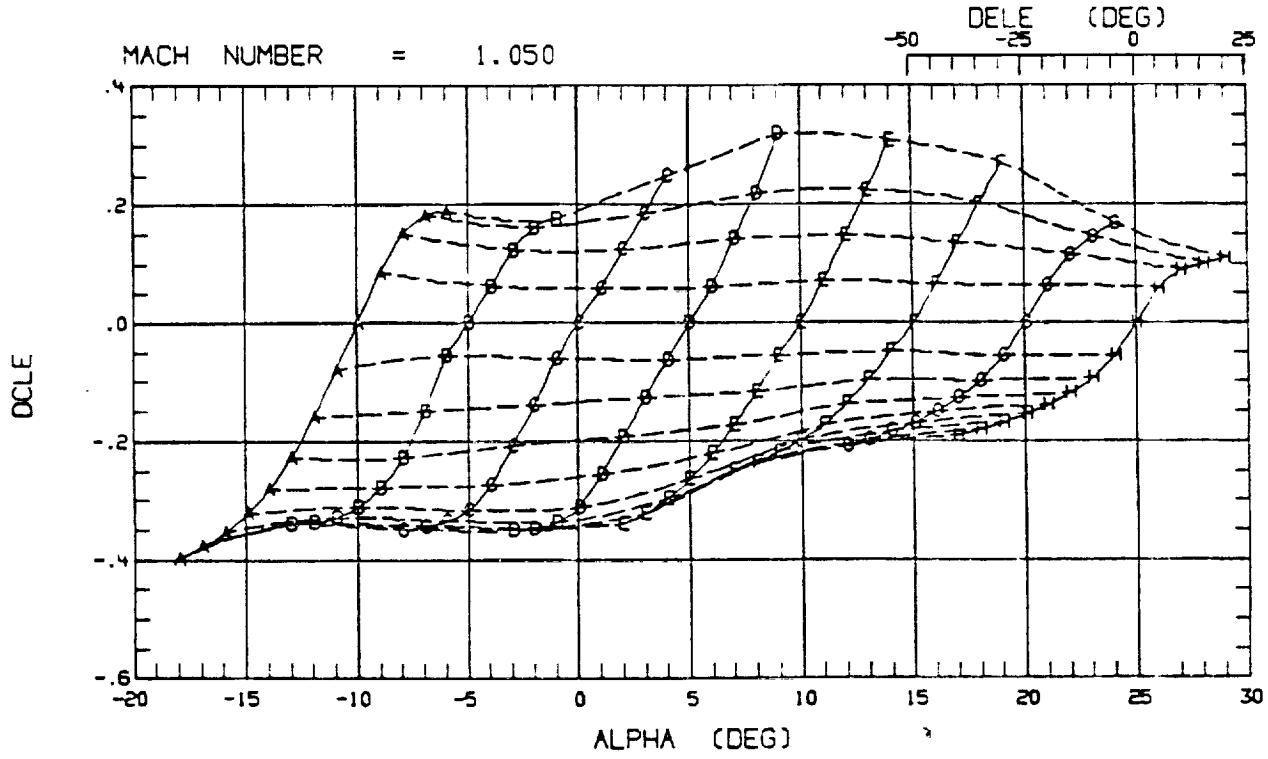
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.40829	-0.36815	-0.36669	-0.39736	-0.30243	-0.21322	-0.15719	-0.13353
-35.000	-0.39188	-0.36309	-0.36699	-0.38608	-0.29282	-0.20260	-0.16809	-0.14263
-30.000	-0.37280	-0.34889	-0.36370	-0.36495	-0.27472	-0.18996	-0.17692	-0.14880
-25.000	-0.34511	-0.32512	-0.34625	-0.32948	-0.24817	-0.17379	-0.18325	-0.15409
-20.000	-0.30422	-0.28937	-0.30991	-0.27541	-0.21000	-0.15336	-0.17905	-0.15485
-15.000	-0.23728	-0.24452	-0.24602	-0.20816	-0.16577	-0.13068	-0.16387	-0.14208
-10.000	-0.16315	-0.17531	-0.17902	-0.13601	-0.11471	-0.10016	-0.12140	-0.11114
-5.000	-0.08567	-0.08242	-0.08718	-0.06792	-0.05689	-0.05404	-0.06364	-0.05825
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.07360	0.05224	0.05050	0.06249	0.07152	0.06955	0.07106	0.05700
10.000	0.14548	0.10082	0.11294	0.14282	0.16087	0.13990	0.12538	0.08739
15.000	0.18794	0.15772	0.18128	0.21910	0.23961	0.19653	0.15927	0.10171
20.000	0.21780	0.21252	0.25848	0.30407	0.30730	0.24617	0.18618	0.11022

ENGINEER EGO
DATE 9/14/78

FIGURE 4.1.2.1-13
ELEVON LIFT COEFFICIENT INCREMENT



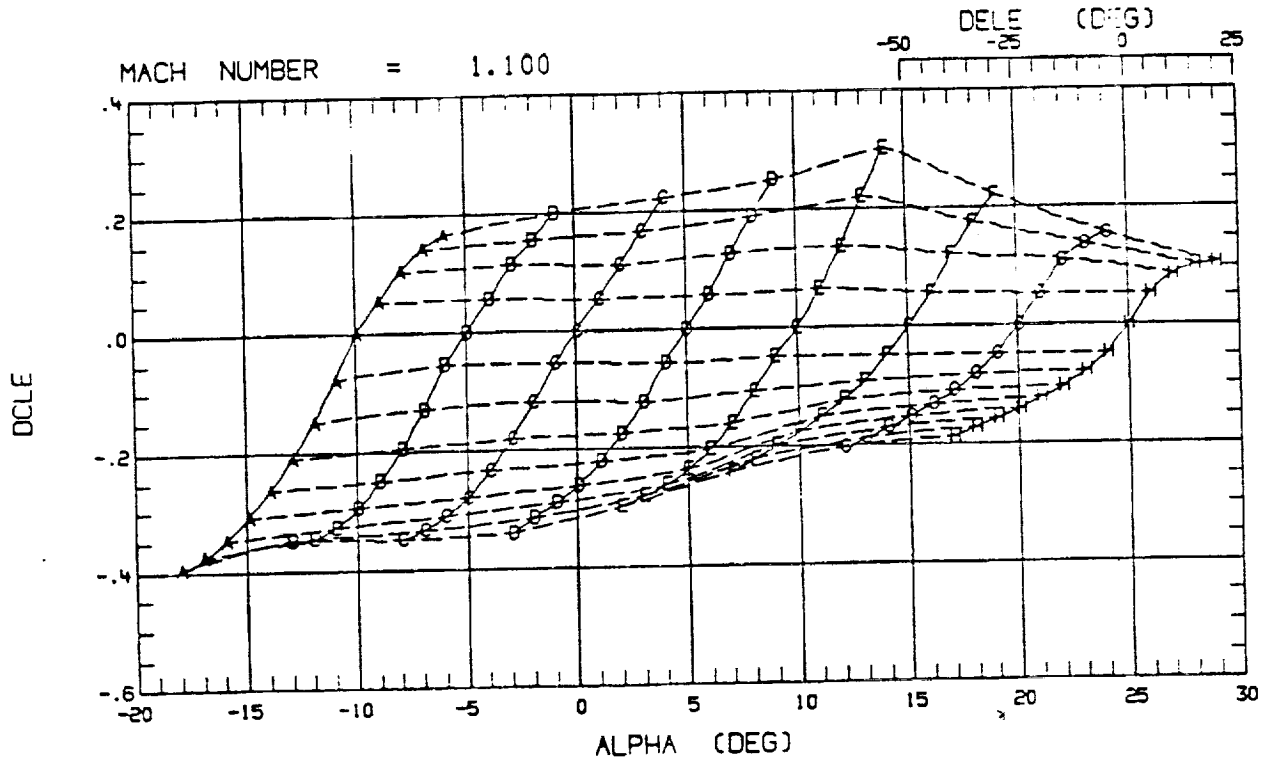
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.40000	-0.34200	-0.35100	-0.35200	-0.34000	-0.25000	-0.21000	-0.19100
-35.000	-0.37900	-0.33900	-0.34600	-0.34900	-0.32300	-0.23700	-0.20000	-0.18200
-30.000	-0.35600	-0.33000	-0.33700	-0.33900	-0.29800	-0.21900	-0.18500	-0.17000
-25.000	-0.32400	-0.31300	-0.31800	-0.31400	-0.26500	-0.19800	-0.17000	-0.15700
-20.000	-0.28400	-0.27900	-0.27600	-0.25700	-0.22300	-0.17400	-0.15100	-0.14100
-15.000	-0.22900	-0.23000	-0.20900	-0.19300	-0.17400	-0.13800	-0.12800	-0.12100
-10.000	-0.16100	-0.15000	-0.14000	-0.12700	-0.11800	-0.09800	-0.09900	-0.09500
-5.000	-0.08300	-0.05600	-0.06200	-0.06500	-0.05600	-0.05000	-0.05700	-0.05700
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.08200	0.06000	0.05700	0.06000	0.07000	0.06400	0.06300	0.05700
10.000	0.14800	0.12100	0.12300	0.14000	0.14600	0.13300	0.11200	0.08700
15.000	0.18000	0.16000	0.18500	0.21800	0.22300	0.20000	0.14300	0.09900
20.000	0.18700	0.17500	0.24800	0.31800	0.30600	0.26800	0.16600	0.10700

ENGINEER Dco
DATE 9/14/78

FIGURE 4.1.2.1-14
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

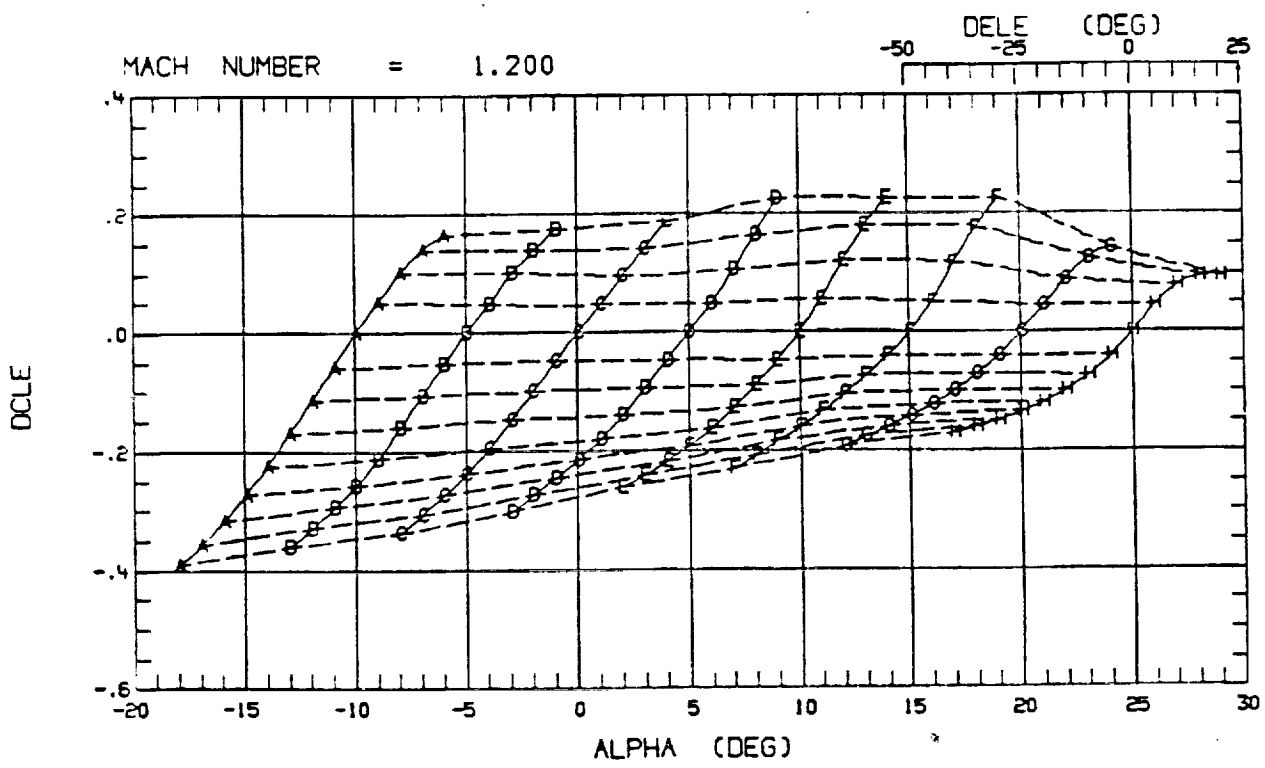
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON LIFT INCREMENT							
-40.000	-0.39800	-0.35000	-0.35000	-0.34000	-0.29800	-0.24200	-0.20500	-0.18800
-35.000	-0.37700	-0.34700	-0.33400	-0.31500	-0.28100	-0.22300	-0.19000	-0.17300
-30.000	-0.34800	-0.32800	-0.31000	-0.29100	-0.26300	-0.20000	-0.17200	-0.15800
-25.000	-0.31000	-0.29500	-0.27900	-0.26200	-0.23800	-0.17700	-0.15400	-0.14200
-20.000	-0.26400	-0.25100	-0.23400	-0.22300	-0.20400	-0.15100	-0.13400	-0.12400
-15.000	-0.21200	-0.19600	-0.18200	-0.17500	-0.16000	-0.12400	-0.11100	-0.10400
-10.000	-0.15000	-0.13000	-0.12000	-0.12300	-0.10700	-0.09200	-0.08300	-0.08000
-5.000	-0.07900	-0.05500	-0.05500	-0.05700	-0.05000	-0.04800	-0.04800	-0.04800
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.05300	0.05400	0.05300	0.05700	0.06400	0.05500	0.05300	0.05200
10.000	0.10400	0.11200	0.11100	0.12700	0.13700	0.12000	0.10900	0.08300
15.000	0.14100	0.15500	0.16700	0.18900	0.21900	0.17300	0.13600	0.09800
20.000	0.16500	0.20000	0.22300	0.25000	0.30000	0.22000	0.15400	0.10200

ENGINEER Geo
DATE 9/14/78

FIGURE 4.1.2.1-15
ELEVON LIFT COEFFICIENT INCREMENT



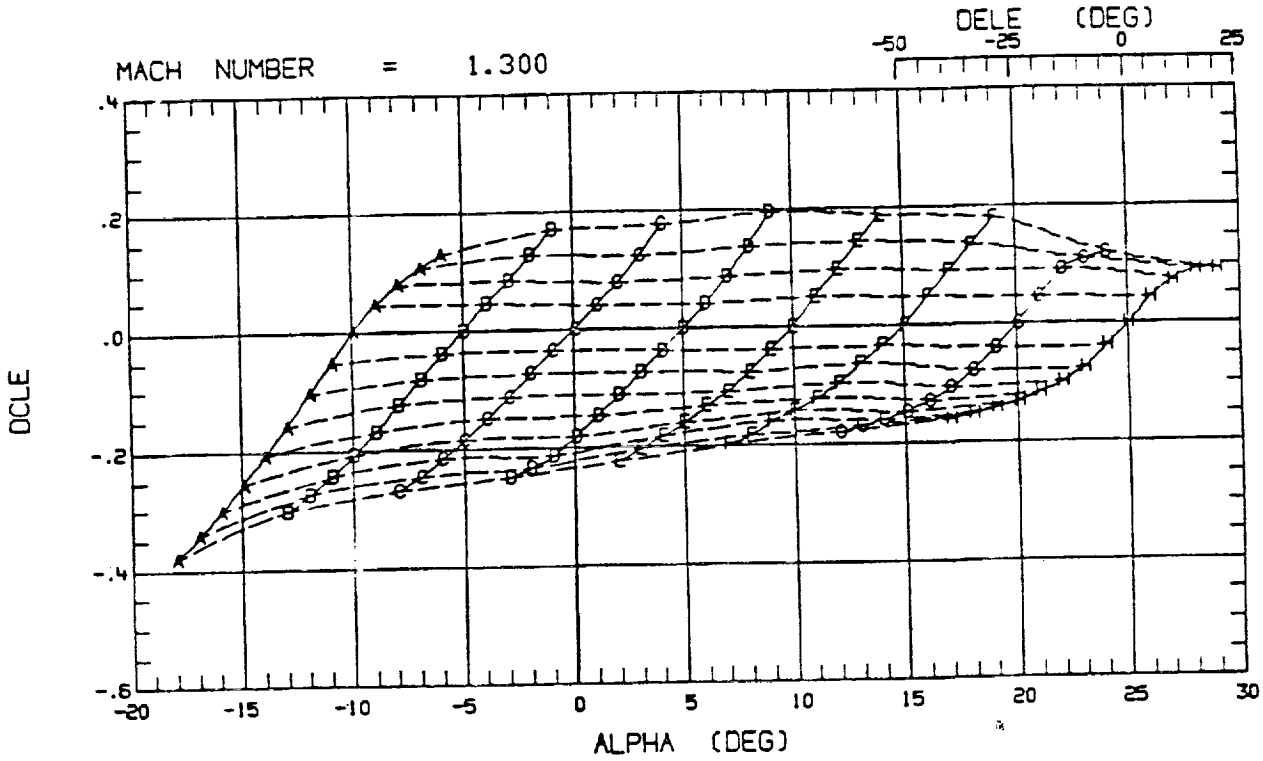
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.39100	-0.36200	-0.33800	-0.30400	-0.26300	-0.23200	-0.19400	-0.17200
-35.000	-0.35900	-0.33000	-0.30700	-0.27600	-0.24300	-0.20900	-0.17700	-0.16200
-30.000	-0.31900	-0.29600	-0.27500	-0.24600	-0.21900	-0.18500	-0.16100	-0.15000
-25.000	-0.27400	-0.25900	-0.23900	-0.21600	-0.19300	-0.16000	-0.14200	-0.13600
-20.000	-0.22600	-0.21400	-0.19700	-0.18100	-0.16300	-0.13400	-0.12300	-0.12000
-15.000	-0.17100	-0.16100	-0.14800	-0.14100	-0.12800	-0.10600	-0.10000	-0.10000
-10.000	-0.11500	-0.10700	-0.10000	-0.09500	-0.09100	-0.07400	-0.07300	-0.07400
-5.000	-0.06000	-0.05400	-0.04900	-0.04800	-0.04800	-0.04200	-0.04200	-0.04200
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.05000	0.04600	0.04600	0.04800	0.05600	0.05000	0.04400	0.04500
10.000	0.10100	0.10000	0.09500	0.10500	0.12000	0.11600	0.08800	0.07800
15.000	0.13900	0.13800	0.14200	0.16300	0.17800	0.17400	0.12400	0.09200
20.000	0.16500	0.17500	0.18700	0.22500	0.22600	0.22400	0.14200	0.09400

ENGINEER DCO
DATE 9/17/78

FIGURE 4.1.2.1-16
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

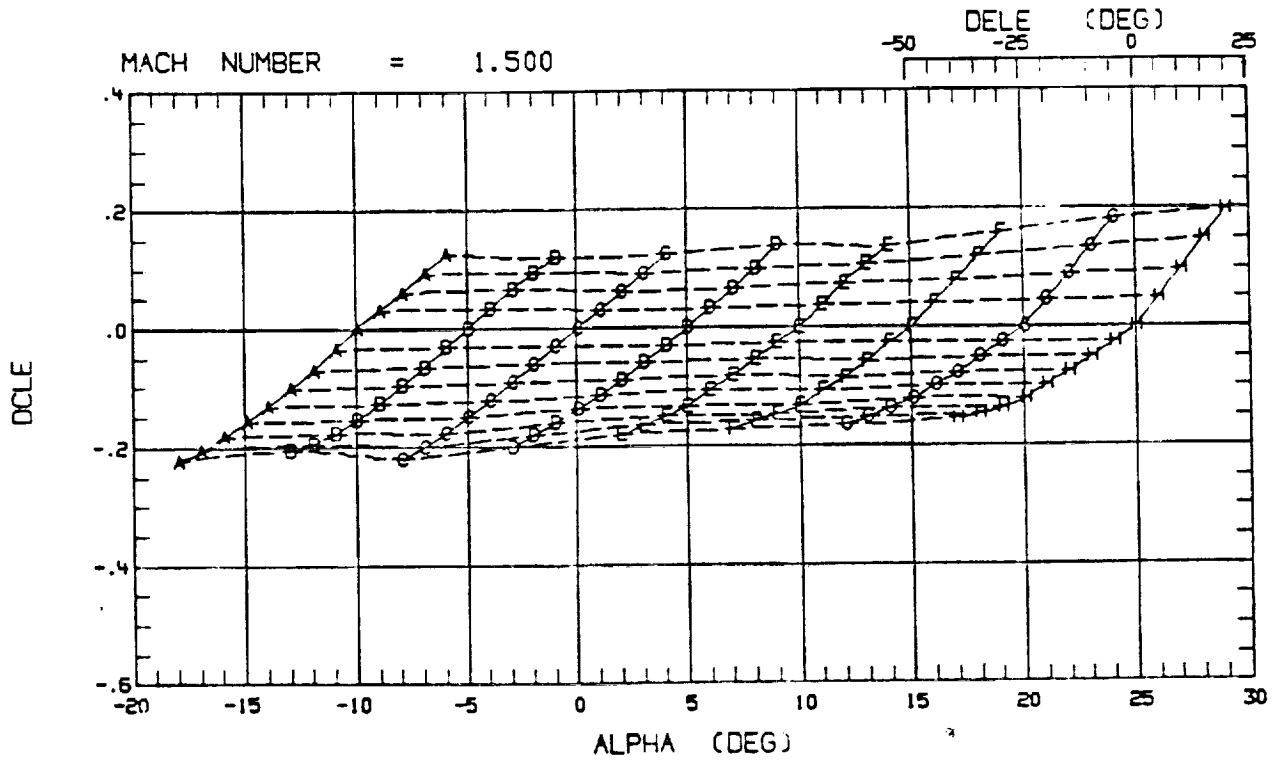
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.38100	-0.30400	-0.27000	-0.25000	-0.22500	-0.20000	-0.18000	-0.16000
-35.000	-0.34400	-0.27600	-0.24600	-0.23500	-0.20500	-0.18500	-0.17100	-0.15300
-30.000	-0.30300	-0.24500	-0.21700	-0.21500	-0.18300	-0.16000	-0.16100	-0.14400
-25.000	-0.25700	-0.20900	-0.18600	-0.18300	-0.16200	-0.14400	-0.14700	-0.13200
-20.000	-0.20900	-0.17000	-0.15100	-0.14800	-0.13400	-0.12300	-0.13000	-0.11800
-15.000	-0.16000	-0.12500	-0.11400	-0.11300	-0.10900	-0.09700	-0.10800	-0.09900
-10.000	-0.10500	-0.08300	-0.07500	-0.07500	-0.07600	-0.06500	-0.08000	-0.07600
-5.000	-0.05500	-0.03800	-0.03600	-0.03800	-0.03800	-0.03500	-0.04100	-0.04000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.04400	0.04400	0.04000	0.04000	0.05000	0.04600	0.04500	0.04100
10.000	0.07700	0.08200	0.07800	0.08500	0.09500	0.09000	0.09100	0.07100
15.000	0.10500	0.12600	0.12300	0.13600	0.14300	0.13400	0.10800	0.08800
20.000	0.12800	0.16800	0.17600	0.19500	0.18800	0.17900	0.11800	0.08900

ENGINEER GCO
DATE 9/14/78

FIGURE 4.1.2.1-17
ELEVON LIFT COEFFICIENT INCREMENT



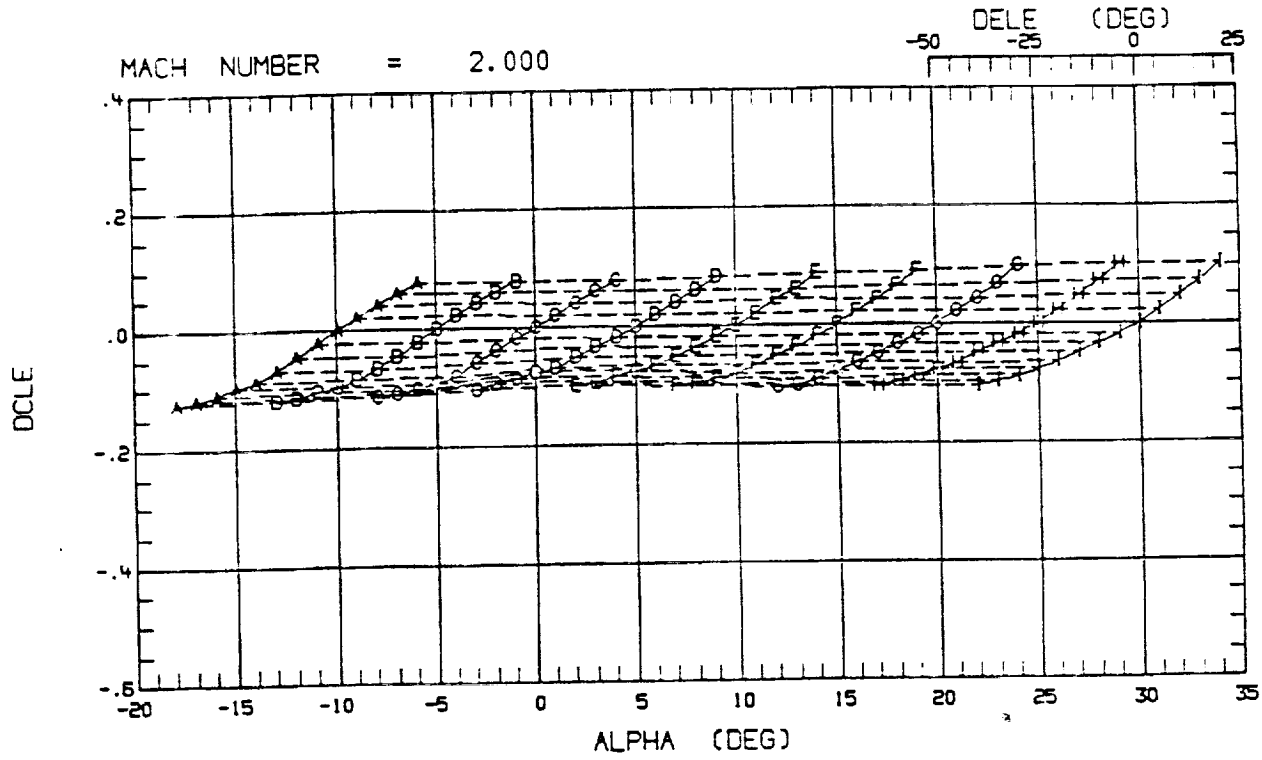
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.22412	-0.20786	-0.22071	-0.20126	-0.18229	-0.17347	-0.16724	-0.15611
-35.000	-0.20612	-0.19579	-0.20103	-0.18214	-0.16637	-0.15911	-0.15398	-0.14908
-30.000	-0.18422	-0.17763	-0.17821	-0.16213	-0.15153	-0.14892	-0.13781	-0.13888
-25.000	-0.15880	-0.15522	-0.15060	-0.13804	-0.13445	-0.13266	-0.12228	-0.12375
-20.000	-0.13254	-0.12874	-0.12363	-0.11561	-0.10678	-0.10852	-0.10055	-0.09902
-15.000	-0.10206	-0.09831	-0.09235	-0.08915	-0.08217	-0.08614	-0.07858	-0.07773
-10.000	-0.07174	-0.06636	-0.06076	-0.05997	-0.05485	-0.05839	-0.05275	-0.05240
-5.000	-0.03630	-0.03256	-0.03029	-0.03213	-0.02675	-0.02730	-0.02638	-0.02665
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.03035	0.03189	0.03005	0.03109	0.03608	0.03976	0.04369	0.04748
10.000	0.05833	0.06577	0.06064	0.06420	0.07350	0.07889	0.08717	0.09579
15.000	0.09110	0.09415	0.08980	0.09890	0.10487	0.11829	0.13471	0.14783
20.000	0.12382	0.11766	0.12316	0.13760	0.13502	0.16007	0.18199	0.19600

ENGINEER DCO
DATE 9/14/78

FIGURE 4.1.2.1-18
ELEVON LIFT COEFFICIENT INCREMENT



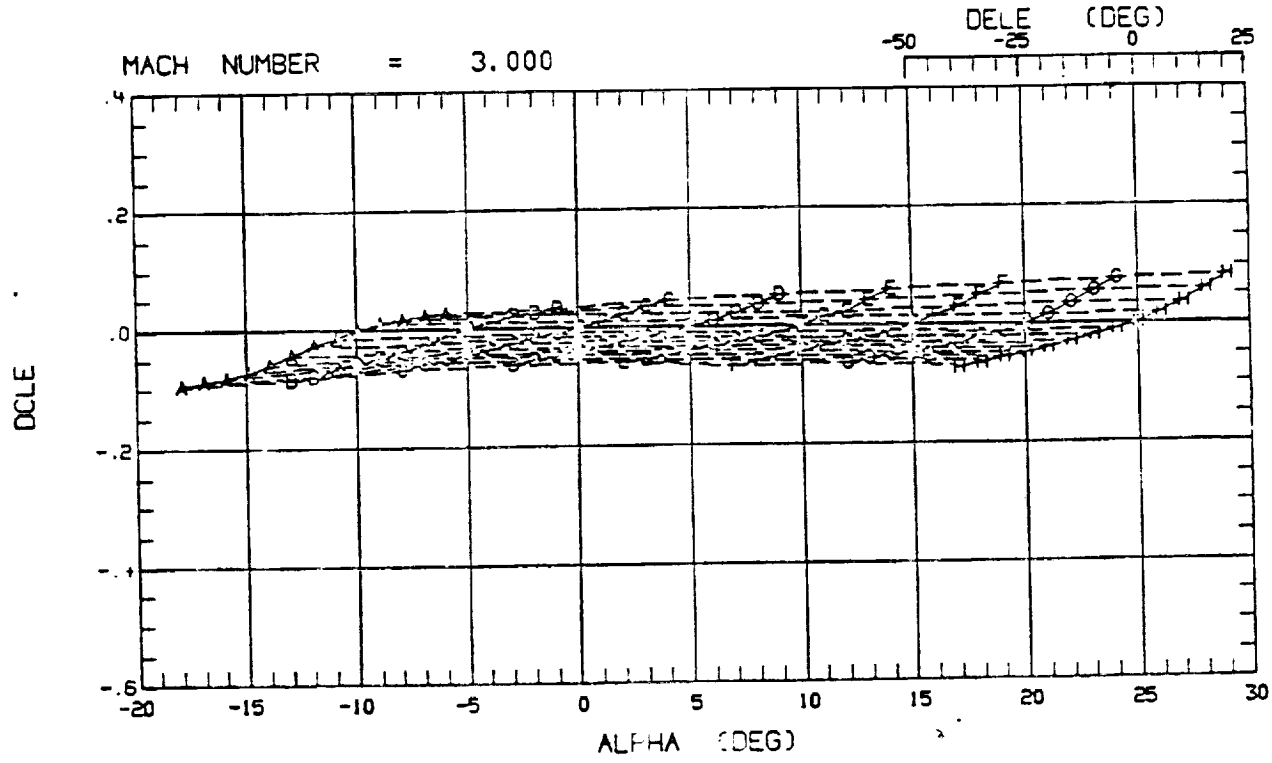
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	ELEVON LIFT INCREMENT								
-40.000	-0.12500	-0.12000	-0.11500	-0.10500	-0.10000	-0.10200	-0.10500	-0.10500	-0.10500
-35.000	-0.12000	-0.11500	-0.11000	-0.09500	-0.09400	-0.09800	-0.10300	-0.09800	-0.09800
-30.000	-0.11000	-0.10600	-0.10300	-0.08700	-0.08500	-0.09000	-0.09300	-0.08700	-0.08900
-25.000	-0.09700	-0.09700	-0.09300	-0.07700	-0.07600	-0.08300	-0.07900	-0.07700	-0.07900
-20.000	-0.08700	-0.08500	-0.08100	-0.07000	-0.06700	-0.06800	-0.06500	-0.06600	-0.06500
-15.000	-0.06900	-0.06800	-0.06000	-0.05300	-0.05200	-0.05200	-0.05000	-0.05000	-0.05000
-10.000	-0.04700	-0.04700	-0.04000	-0.03500	-0.03700	-0.03700	-0.03500	-0.03500	-0.03500
-5.000	-0.02400	-0.02400	-0.02000	-0.02000	-0.01900	-0.02000	-0.01900	-0.01900	-0.01900
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01900	0.02100	0.01900	0.01900	0.02000	0.02200	0.02200	0.02200	0.02200
10.000	0.03900	0.04200	0.03900	0.03900	0.04400	0.04200	0.04300	0.04700	0.04700
15.000	0.05900	0.06100	0.05900	0.05900	0.06100	0.06500	0.06700	0.07200	0.07200
20.000	0.07800	0.07800	0.07800	0.08200	0.08700	0.09000	0.09800	0.10000	0.10000

ENGINEER SCO
DATE 5/4/73

FIGURE 4.1.2.1-19
ELEVON LIFT COEFFICIENT INCREMENT



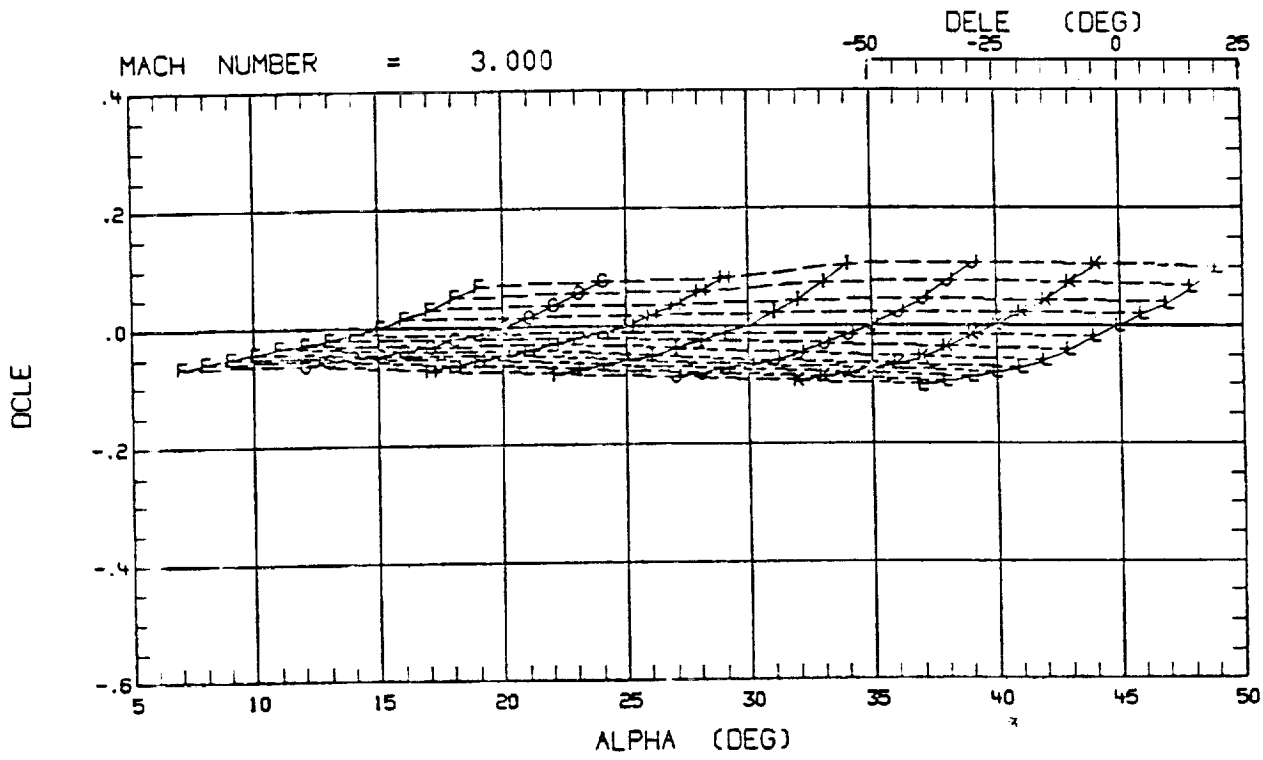
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON LIFT INCREMENT							
-40.000	-0.09500	-0.08500	-0.07000	-0.06300	-0.06000	-0.06800	-0.06500	-0.07400
-35.000	-0.08800	-0.08000	-0.06000	-0.05500	-0.05500	-0.06000	-0.05800	-0.06600
-30.000	-0.08200	-0.06700	-0.05200	-0.04800	-0.04800	-0.05100	-0.05300	-0.05800
-25.000	-0.07200	-0.05900	-0.04500	-0.04200	-0.04000	-0.04300	-0.04800	-0.05000
-20.000	-0.05900	-0.05000	-0.03700	-0.03500	-0.03500	-0.03400	-0.04100	-0.04200
-15.000	-0.04400	-0.04000	-0.02700	-0.02500	-0.02700	-0.02900	-0.03300	-0.03200
-10.000	-0.02700	-0.02700	-0.01700	-0.01700	-0.02000	-0.02100	-0.02200	-0.02100
-5.000	-0.01500	-0.01400	-0.01000	-0.01000	-0.01100	-0.01200	-0.01300	-0.01100
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00900	0.00900	0.00900	0.01000	0.01400	0.01500	0.01500	0.01800
10.000	0.01500	0.02000	0.02200	0.02200	0.02300	0.02900	0.03500	0.03500
15.000	0.02200	0.02500	0.03400	0.03600	0.04200	0.04900	0.05500	0.05800
20.000	0.02500	0.03200	0.04500	0.05200	0.06000	0.06800	0.07500	0.08000

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.2.1-20
ELEVON LIFT COEFFICIENT INCREMENT



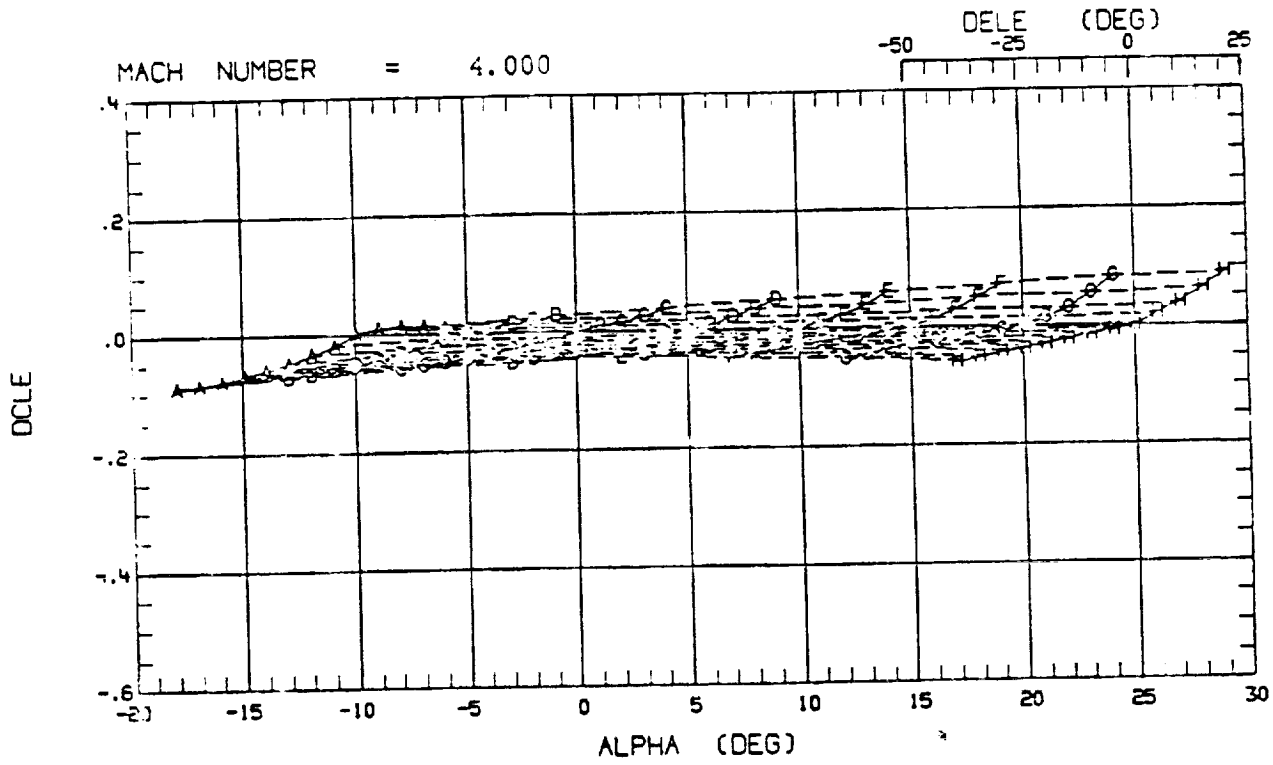
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON LIFT INCREMENT						
-40.000	-0.06800	-0.06500	-0.07400	-0.08200	-0.08850	-0.09500	-0.10225
-35.000	-0.06000	-0.05800	-0.06600	-0.07500	-0.08150	-0.08800	-0.09600
-30.000	-0.05100	-0.05300	-0.05800	-0.06700	-0.07400	-0.08100	-0.08837
-25.000	-0.04300	-0.04800	-0.05000	-0.06000	-0.06722	-0.07400	-0.08062
-20.000	-0.03400	-0.04100	-0.04200	-0.05200	-0.06029	-0.06700	-0.07225
-15.000	-0.02900	-0.03300	-0.03200	-0.03900	-0.04700	-0.05500	-0.05962
-10.000	-0.02100	-0.02200	-0.02100	-0.02600	-0.03150	-0.03700	-0.04137
-5.000	-0.01200	-0.01300	-0.01100	-0.01300	-0.01500	-0.01700	-0.01900
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01500	0.01500	0.01800	0.02100	0.02177	0.02100	0.01912
10.000	0.02900	0.03500	0.03500	0.04200	0.04383	0.04200	0.03750
15.000	0.04900	0.05500	0.05800	0.07200	0.07492	0.07200	0.06563
20.000	0.06800	0.07500	0.08000	0.10300	0.10601	0.10300	0.09737

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.2.1-21
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

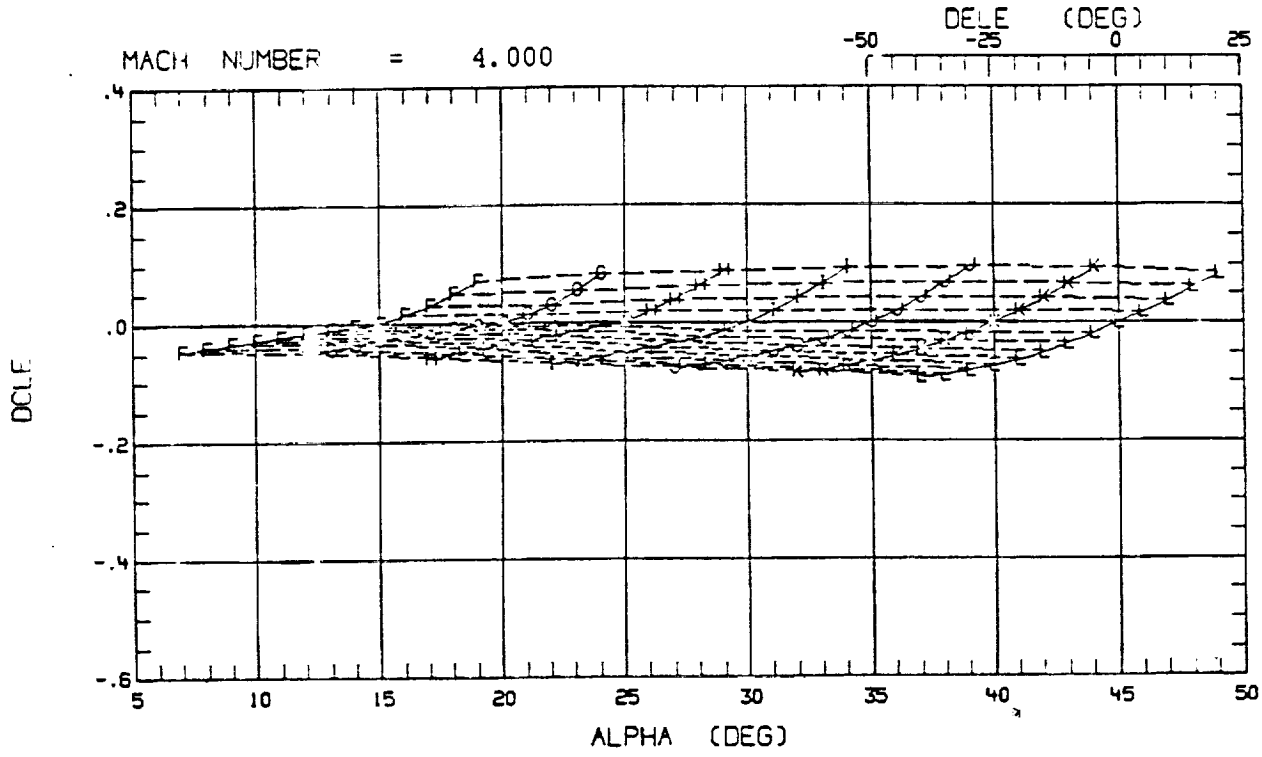
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.08900	-0.07300	-0.06000	-0.05100	-0.04300	-0.04700	-0.05100	-0.06000
-35.000	-0.08500	-0.06600	-0.05500	-0.04500	-0.03900	-0.04100	-0.04500	-0.05300
-30.000	-0.07900	-0.05900	-0.05000	-0.04000	-0.03400	-0.03500	-0.03600	-0.04500
-25.000	-0.07000	-0.05200	-0.04300	-0.03400	-0.02900	-0.02900	-0.02900	-0.03800
-20.000	-0.06000	-0.04500	-0.03600	-0.02900	-0.02600	-0.02300	-0.02400	-0.03100
-15.000	-0.04900	-0.03400	-0.02800	-0.02100	-0.02000	-0.01700	-0.01700	-0.02300
-10.000	-0.03500	-0.02300	-0.02000	-0.01400	-0.01500	-0.01200	-0.01100	-0.01500
-5.000	-0.02000	-0.01100	-0.01200	-0.00700	-0.00800	-0.00600	-0.00500	-0.00800
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00800	0.00700	0.00800	0.01000	0.01200	0.01400	0.01400	0.01900
10.000	0.01100	0.01400	0.01500	0.02100	0.02200	0.02900	0.03000	0.03800
15.000	0.01100	0.02000	0.02400	0.03500	0.03900	0.05000	0.05400	0.06200
20.000	0.01000	0.02600	0.03800	0.05000	0.05900	0.07100	0.08200	0.08700

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.2.1-22
ELEVON LIFT COEFFICIENT INCREMENT



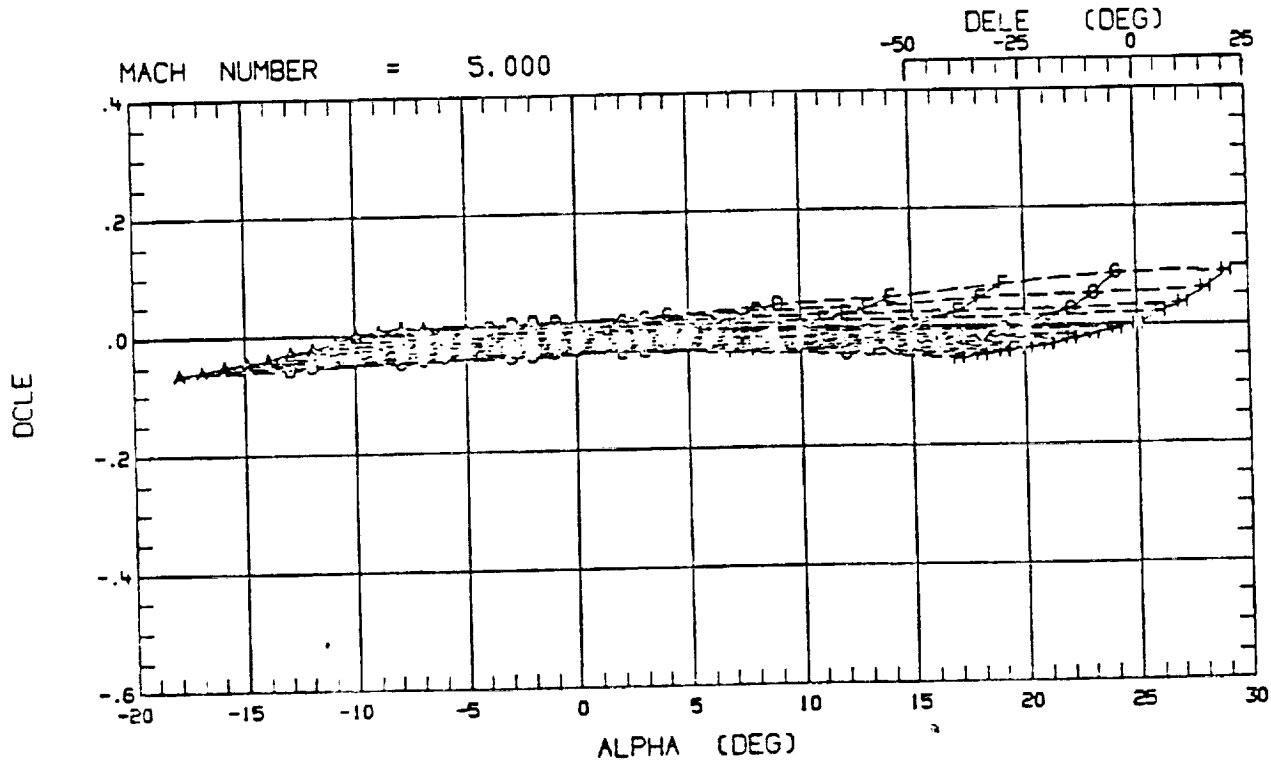
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON LIFT INCREMENT						
-40.000	-0.04700	-0.05100	-0.06000	-0.07000	-0.07700	-0.08400	-0.09212
-35.000	-0.04100	-0.04500	-0.05300	-0.06500	-0.07300	-0.08100	-0.08937
-30.000	-0.03500	-0.03600	-0.04500	-0.05900	-0.06650	-0.07400	-0.08187
-25.000	-0.02900	-0.02900	-0.03800	-0.05100	-0.05850	-0.06600	-0.07387
-20.000	-0.02300	-0.02400	-0.03100	-0.04300	-0.05000	-0.05700	-0.06400
-15.000	-0.01700	-0.01700	-0.02300	-0.03500	-0.04050	-0.04600	-0.05187
-10.000	-0.01200	-0.01100	-0.01500	-0.02600	-0.02900	-0.03200	-0.03650
-5.000	-0.00600	-0.00500	-0.00800	-0.01500	-0.01650	-0.01800	-0.01950
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01400	0.01400	0.01900	0.01900	0.01900	0.01900	0.01712
10.000	0.02900	0.03000	0.03800	0.04100	0.04216	0.04100	0.03688
15.000	0.05000	0.05400	0.06200	0.06600	0.06767	0.06600	0.05925
20.000	0.07100	0.08200	0.08700	0.09200	0.09426	0.09200	0.08150

ENGINEER GCO
DATE 9/13/78

FIGURE 4.1.2.1-23
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

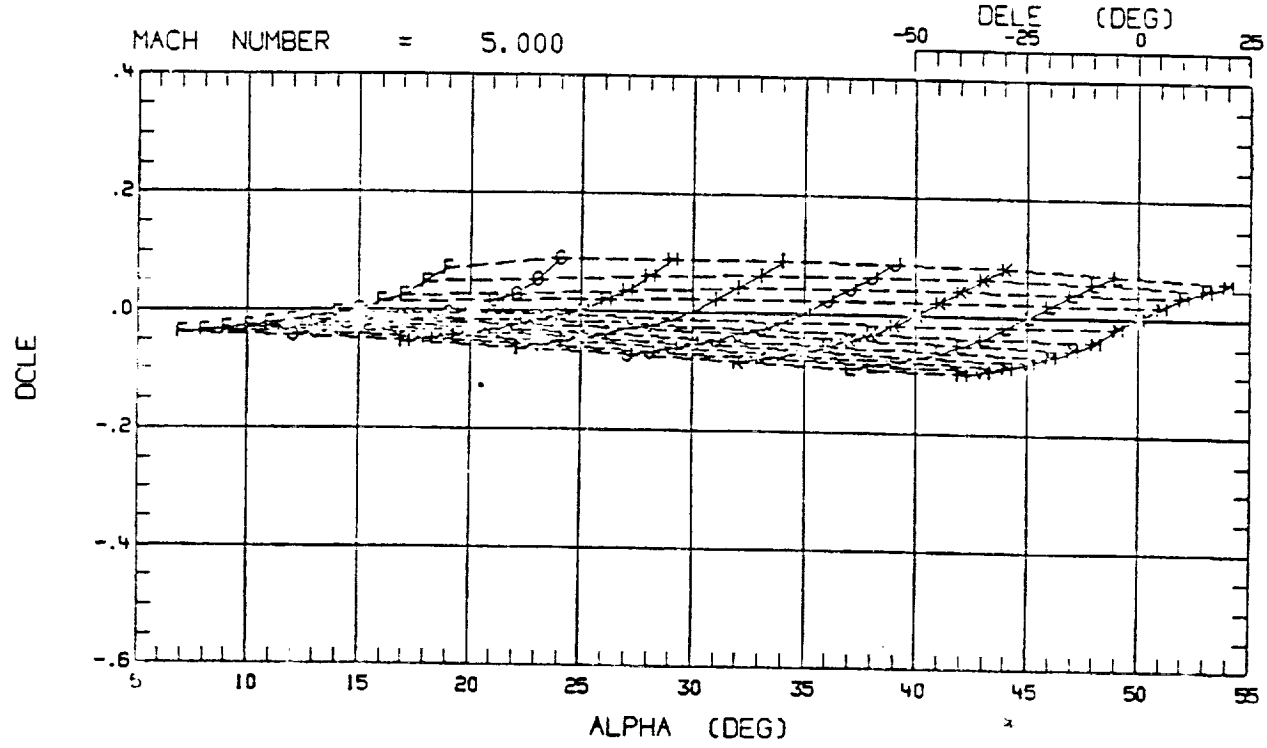
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.06500	-0.05700	-0.04800	-0.04200	-0.03600	-0.04000	-0.04500	-0.05500
-35.000	-0.05900	-0.05100	-0.04500	-0.03800	-0.03400	-0.03600	-0.04000	-0.04900
-30.000	-0.05200	-0.04500	-0.03800	-0.03400	-0.02900	-0.03200	-0.03500	-0.04400
-25.000	-0.04600	-0.04000	-0.03300	-0.02900	-0.02600	-0.02800	-0.03000	-0.03800
-20.000	-0.04000	-0.03400	-0.02800	-0.02500	-0.02200	-0.02400	-0.02500	-0.03300
-15.000	-0.03000	-0.02600	-0.02100	-0.01900	-0.01700	-0.01800	-0.01900	-0.02500
-10.000	-0.02400	-0.01700	-0.01400	-0.01300	-0.01600	-0.01200	-0.01700	-0.01600
-5.000	-0.01300	-0.00900	-0.00700	-0.00600	-0.00600	-0.00600	-0.00600	-0.00800
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00500	0.00600	0.00700	0.00900	0.01100	0.01300	0.01700	0.01950
10.000	0.00900	0.01200	0.01400	0.01800	0.02200	0.02500	0.02800	0.03460
15.000	0.00700	0.01300	0.01900	0.02900	0.03300	0.04800	0.05300	0.05900
20.000	0.00200	0.01400	0.02400	0.03900	0.05100	0.07000	0.08700	0.08700

ENGINEER Geo
DATE 9/13/78

FIGURE 4.1.2.1-24
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

REFERENCE DIMENSIONS

DELE (DEG)	ALPHA (DEG) 15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
	ELEVON LIFT INCREMENT							
-40.000	-0.04000	-0.04500	-0.05500	-0.06500	-0.07500	-0.08500	-0.09312	-0.10000
-35.000	-0.03600	-0.04000	-0.04900	-0.05900	-0.06870	-0.07800	-0.08675	-0.09500
-30.000	-0.03200	-0.03500	-0.04400	-0.05300	-0.06250	-0.07200	-0.08038	-0.08800
-25.000	-0.02900	-0.03000	-0.03800	-0.04600	-0.05550	-0.06500	-0.07300	-0.08000
-20.000	-0.02400	-0.02500	-0.03300	-0.04000	-0.04850	-0.05700	-0.06400	-0.07000
-15.000	-0.01800	-0.01900	-0.02500	-0.03000	-0.03700	-0.04400	-0.05100	-0.05800
-10.000	-0.01200	-0.01700	-0.01600	-0.02400	-0.03002	-0.03500	-0.03937	-0.04300
-5.000	-0.00600	-0.00600	-0.00800	-0.01300	-0.01621	-0.01800	-0.01862	-0.01800
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01300	0.01700	0.01950	0.02200	0.02282	0.02200	0.02050	0.01800
10.000	0.02500	0.02800	0.03460	0.04120	0.04235	0.04120	0.03887	0.03500
15.000	0.04800	0.05300	0.05900	0.06200	0.06330	0.06200	0.05637	0.04700
20.000	0.07000	0.08700	0.08700	0.08700	0.08494	0.08000	0.07087	0.05800

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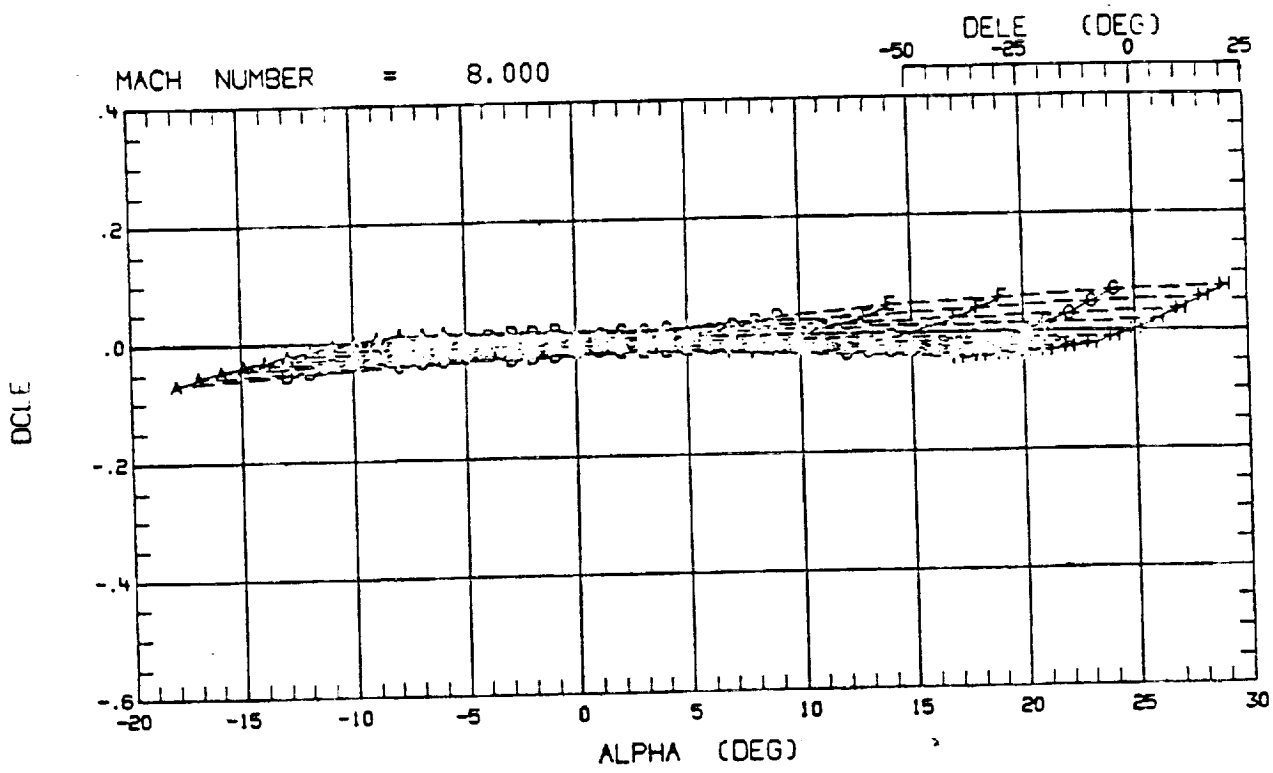
DATE 9/13/78

FIGURE 4.1.2.1-25
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.06900	-0.05500	-0.04200	-0.03300	-0.02500	-0.03000	-0.03400	-0.04400
-35.000	-0.05800	-0.04800	-0.03700	-0.03100	-0.02400	-0.02800	-0.03200	-0.04200
-30.000	-0.04700	-0.04000	-0.03300	-0.02800	-0.02400	-0.02700	-0.03100	-0.03900
-25.000	-0.03900	-0.03300	-0.02800	-0.02500	-0.02200	-0.02500	-0.02800	-0.03600
-20.000	-0.03100	-0.02700	-0.02300	-0.02200	-0.02000	-0.02300	-0.02500	-0.03300
-15.000	-0.02300	-0.02100	-0.01900	-0.01800	-0.01800	-0.02000	-0.02200	-0.02800
-10.000	-0.01500	-0.01400	-0.01200	-0.01500	-0.01500	-0.01700	-0.01800	-0.02300
-5.000	-0.00700	-0.00700	-0.00700	-0.00700	-0.01000	-0.00800	-0.01200	-0.01200
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00500	0.00500	0.00500	0.00700	0.00900	0.01200	0.01400	0.01700
10.000	0.01000	0.01000	0.01000	0.01400	0.01700	0.02400	0.02800	0.03500
15.000	0.01000	0.01000	0.01000	0.02200	0.02800	0.04000	0.04800	0.05400
20.000	0.01100	0.01100	0.01100	0.02900	0.04600	0.05700	0.06700	0.07300

ENGINEER DCO
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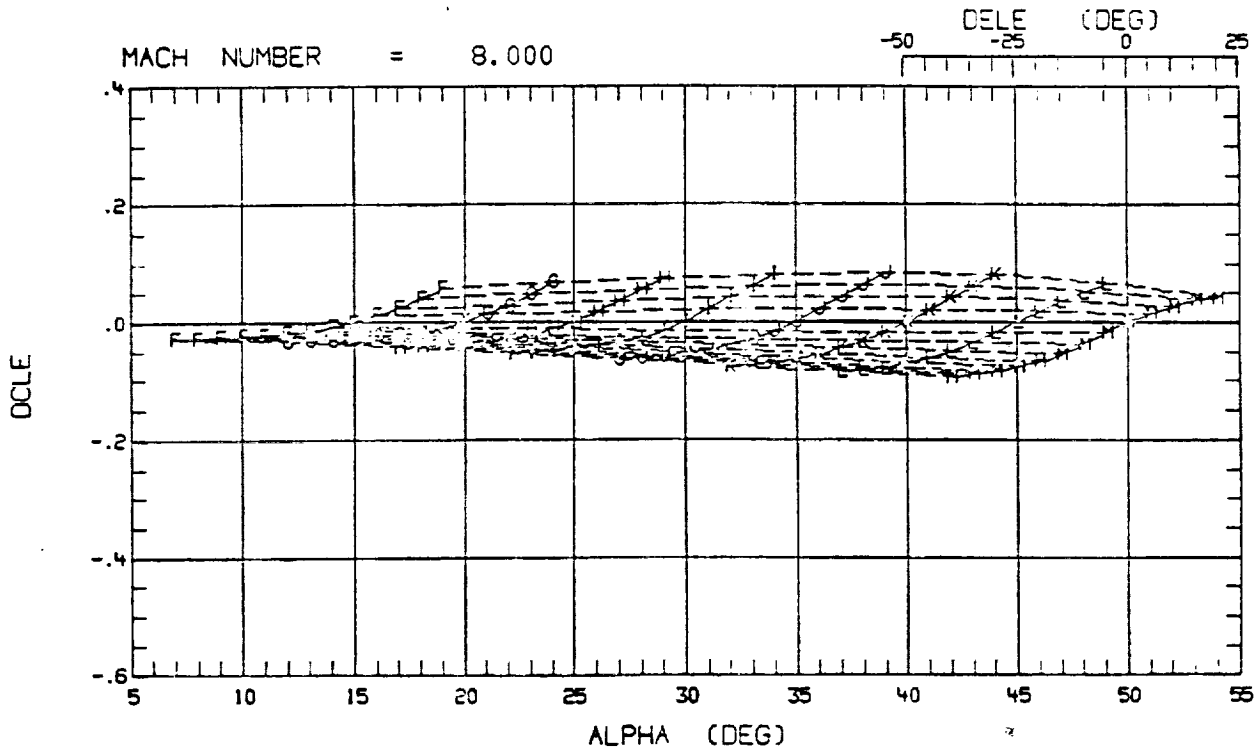
FIGURE 4.1.2.1- 26
ELEVON LIFT COEFFICIENT INCREMENT



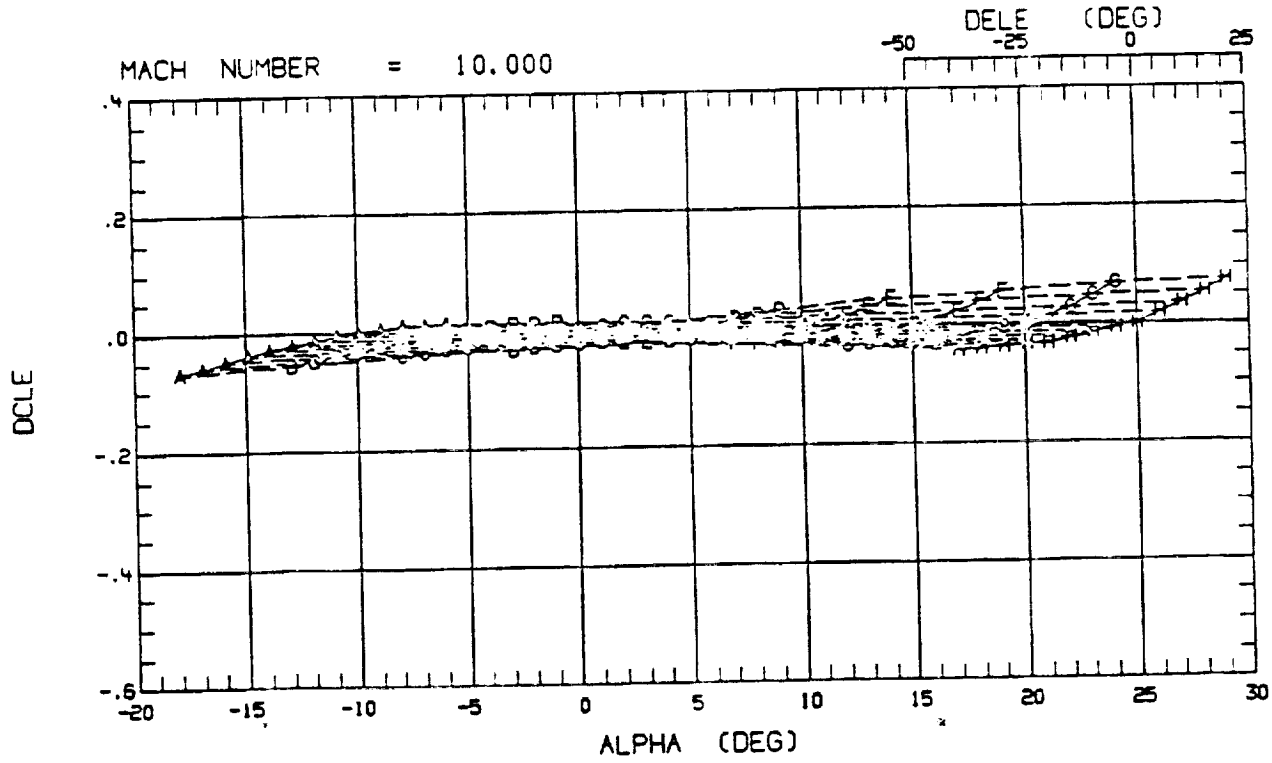
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.03000	-0.03400	-0.04400	-0.05400	-0.06500	-0.07600	-0.08587	-0.09500
-35.000	-0.02800	-0.03200	-0.04200	-0.05100	-0.06200	-0.07300	-0.08212	-0.09000
-30.000	-0.02700	-0.03100	-0.03900	-0.04800	-0.05900	-0.07000	-0.07875	-0.08600
-25.000	-0.02500	-0.02800	-0.03600	-0.04400	-0.05350	-0.06300	-0.07063	-0.07700
-20.000	-0.02300	-0.02500	-0.03300	-0.04000	-0.04800	-0.05600	-0.06287	-0.06900
-15.000	-0.02000	-0.02200	-0.02800	-0.03400	-0.03950	-0.04500	-0.05088	-0.05700
-10.000	-0.01700	-0.01800	-0.02300	-0.02800	-0.03050	-0.03300	-0.03587	-0.03900
-5.000	-0.00800	-0.01200	-0.01200	-0.01700	-0.01750	-0.01800	-0.01850	-0.01900
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01200	0.01400	0.01700	0.02100	0.02150	0.02000	0.01725	0.01300
10.000	0.02400	0.02800	0.03500	0.04100	0.04300	0.04100	0.03500	0.02500
15.000	0.04000	0.04800	0.05400	0.06000	0.06240	0.06000	0.05100	0.03600
20.000	0.05700	0.06700	0.07300	0.07900	0.08186	0.07900	0.06400	0.03900

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.2.1-27
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

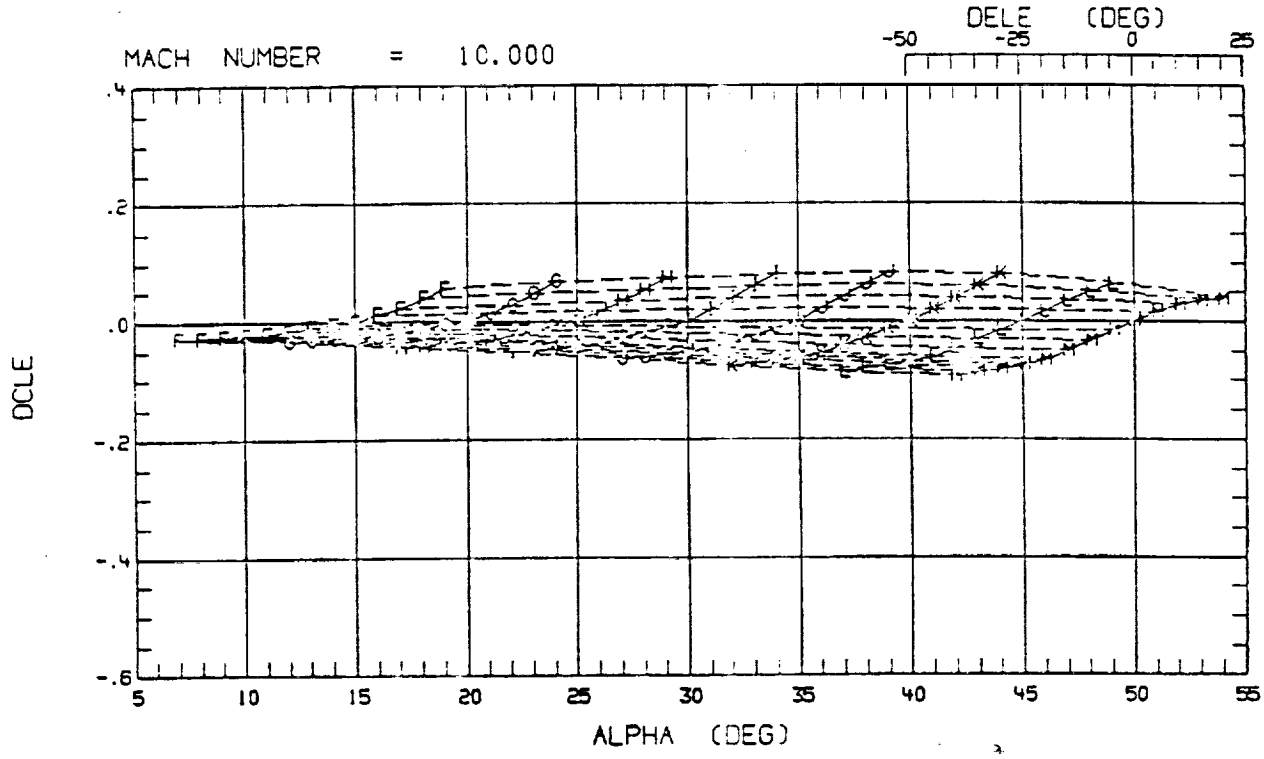
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.07000	-0.05600	-0.04200	-0.03300	-0.02500	-0.03000	-0.03400	-0.04400
-35.000	-0.05900	-0.04800	-0.03700	-0.03000	-0.02400	-0.02800	-0.03200	-0.04100
-30.000	-0.04900	-0.04100	-0.03200	-0.02700	-0.02200	-0.02600	-0.03000	-0.03800
-25.000	-0.03900	-0.03300	-0.02800	-0.02400	-0.02000	-0.02400	-0.02800	-0.03500
-20.000	-0.02900	-0.02600	-0.02300	-0.02100	-0.01800	-0.02200	-0.02600	-0.03300
-15.000	-0.02200	-0.01900	-0.01700	-0.01500	-0.01400	-0.01600	-0.01900	-0.02500
-10.000	-0.01400	-0.01300	-0.01100	-0.01000	-0.00900	-0.01100	-0.01300	-0.01600
-5.000	-0.00700	-0.00600	-0.00600	-0.00500	-0.00500	-0.00500	-0.00600	-0.00800
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00400	0.00400	0.00400	0.00700	0.00800	0.01100	0.01400	0.01700
10.000	0.00900	0.00900	0.00900	0.01300	0.01700	0.02200	0.02900	0.03400
15.000	0.01000	0.01000	0.01000	0.02000	0.03100	0.03900	0.04800	0.05300
20.000	0.01100	0.01100	0.01000	0.02800	0.04500	0.05600	0.06700	0.07300

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.2.1-28
ELEVON LIFT COEFFICIENT INCREMENT



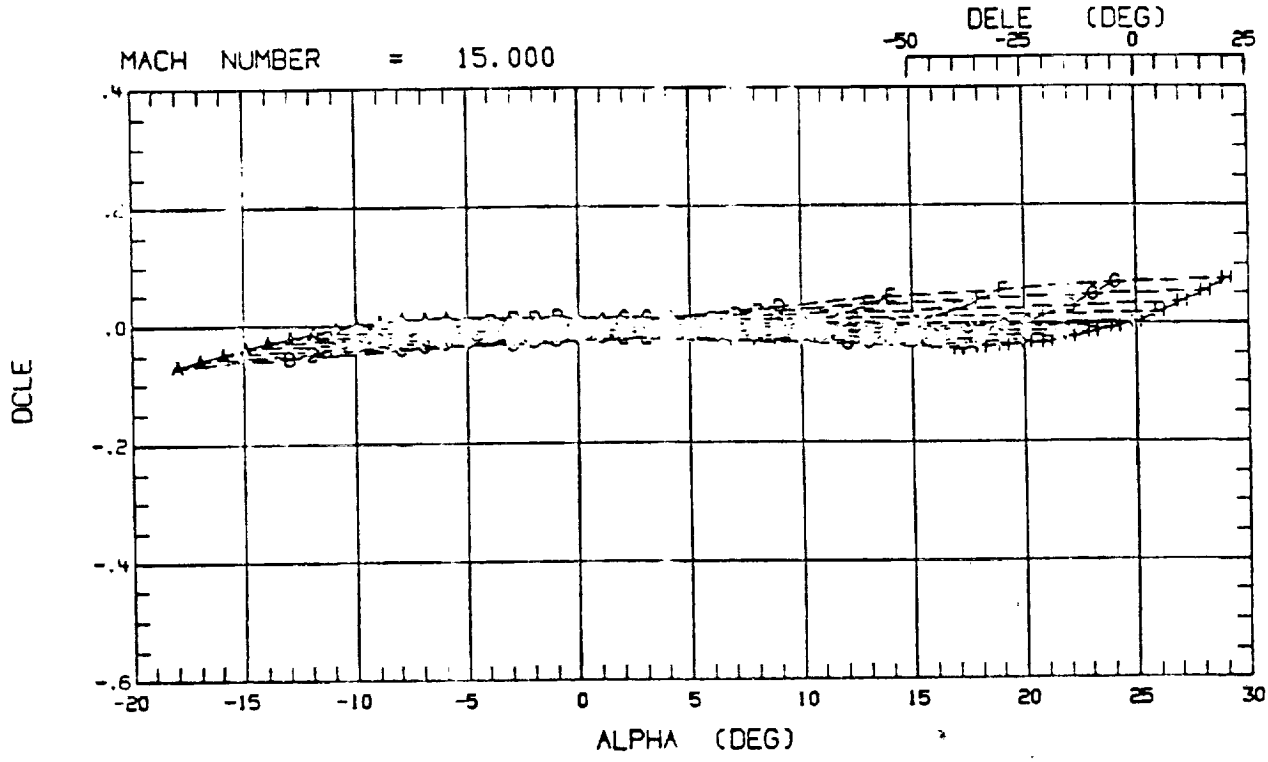
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.03000	-0.03400	-0.04400	-0.05300	-0.06500	-0.07700	-0.08675	-0.09500
-35.000	-0.02800	-0.03200	-0.04100	-0.05000	-0.06100	-0.07200	-0.08075	-0.08800
-30.000	-0.02600	-0.03000	-0.03800	-0.04600	-0.05600	-0.06600	-0.07450	-0.08200
-25.000	-0.02400	-0.02800	-0.03500	-0.04300	-0.05200	-0.06100	-0.06850	-0.07500
-20.000	-0.02200	-0.02600	-0.03300	-0.04000	-0.04750	-0.05500	-0.06175	-0.06800
-15.000	-0.01600	-0.01900	-0.02500	-0.03000	-0.03600	-0.04200	-0.04687	-0.05100
-10.000	-0.01100	-0.01300	-0.01600	-0.02000	-0.02400	-0.02800	-0.03125	-0.03400
-5.000	-0.00500	-0.00600	-0.00800	-0.01000	-0.01200	-0.01400	-0.01562	-0.01700
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01100	0.01400	0.01700	0.02000	0.02086	0.02000	0.01775	0.01400
10.000	0.02200	0.02800	0.03400	0.04000	0.04171	0.04000	0.03550	0.02800
15.000	0.03900	0.04800	0.05300	0.05900	0.06140	0.05900	0.05000	0.03500
20.000	0.05600	0.06700	0.07300	0.07900	0.08188	0.07900	0.06362	0.03900

ENGINEER ECO
DATE 9/13/78

FIGURE 4.1.2.1-29
ELEVON LIFT COEFFICIENT INCREMENT



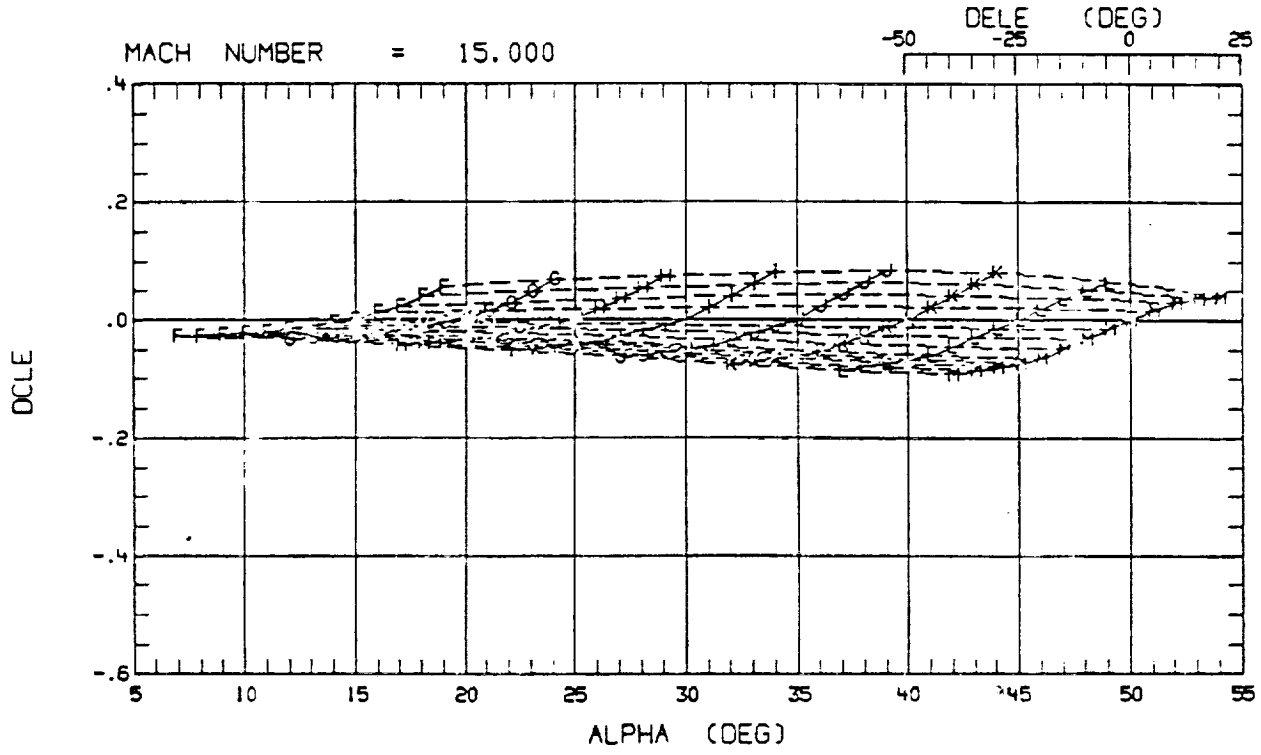
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.07000	-0.05600	-0.04200	-0.03300	-0.02500	-0.03000	-0.03400	-0.04400
-35.000	-0.05800	-0.04800	-0.03700	-0.03000	-0.02400	-0.02800	-0.03200	-0.04100
-30.000	-0.04900	-0.04100	-0.03200	-0.02700	-0.02200	-0.02600	-0.03000	-0.03800
-25.000	-0.03900	-0.03300	-0.02800	-0.02400	-0.02000	-0.02400	-0.02800	-0.03500
-20.000	-0.02900	-0.02600	-0.02300	-0.02100	-0.01800	-0.02200	-0.02600	-0.03300
-15.000	-0.02200	-0.01900	-0.01700	-0.01500	-0.01400	-0.01600	-0.01900	-0.02500
-10.000	-0.01400	-0.01300	-0.01100	-0.01000	-0.00900	-0.01100	-0.01300	-0.01600
-5.000	-0.00700	-0.00600	-0.00600	-0.00500	-0.00500	-0.00500	-0.00600	-0.00800
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00400	0.00400	0.00400	0.00700	0.00800	0.01100	0.01400	0.01700
10.000	0.00900	0.00900	0.00900	0.01300	0.01700	0.02200	0.02800	0.03400
15.000	0.01000	0.01000	0.01000	0.02000	0.03100	0.03900	0.04800	0.05300
20.000	0.01100	0.01100	0.01000	0.02800	0.04500	0.05600	0.06700	0.07300

ENGINEER ECO
DATE 9/13/78

FIGURE 4.1.2.1-30
ELEVON LIFT COEFFICIENT INCREMENT



CONFIGURATION

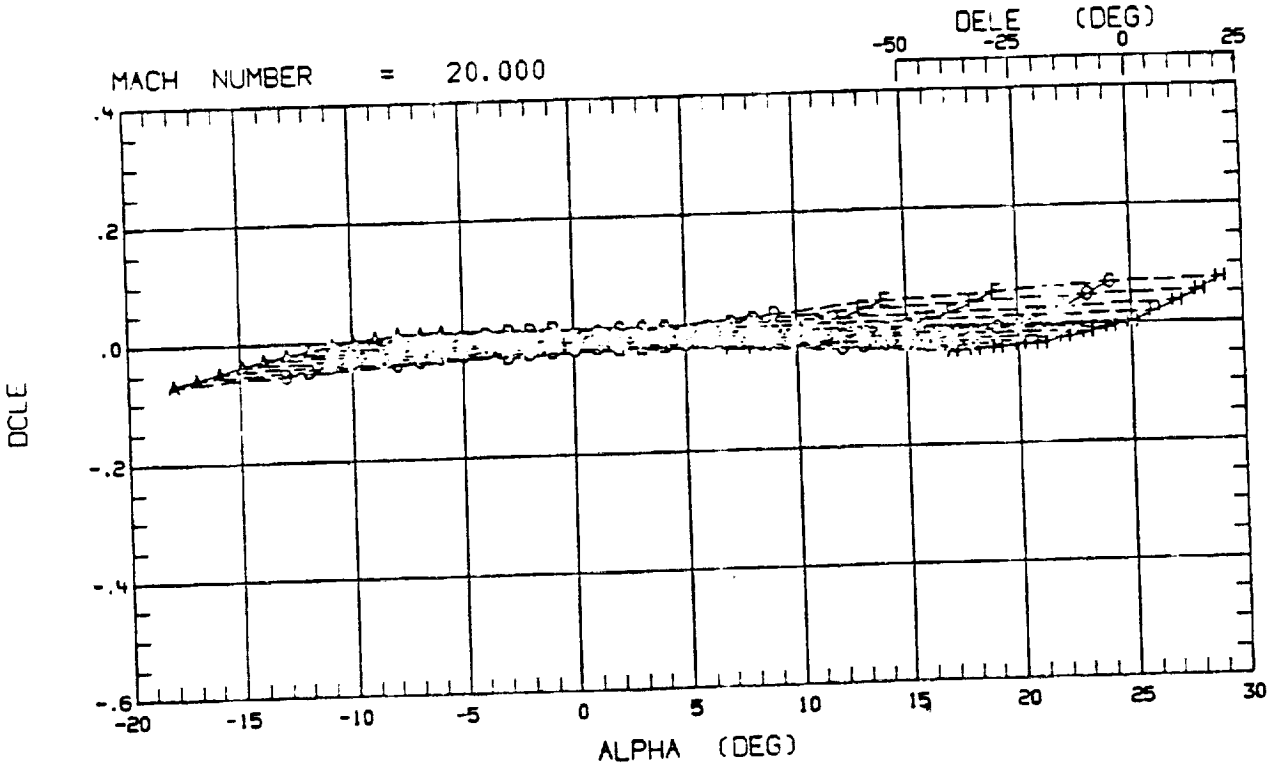
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.03000	-0.03400	-0.04400	-0.05300	-0.06500	-0.07700	-0.08675	-0.09500
-35.000	-0.02800	-0.03200	-0.04100	-0.05000	-0.06100	-0.07200	-0.08075	-0.08800
-30.000	-0.02600	-0.03000	-0.03800	-0.04600	-0.05600	-0.06600	-0.07450	-0.08200
-25.000	-0.02400	-0.02800	-0.03500	-0.04300	-0.05200	-0.06100	-0.06850	-0.07500
-20.000	-0.02200	-0.02600	-0.03300	-0.04000	-0.04750	-0.05500	-0.06175	-0.06800
-15.000	-0.01600	-0.01900	-0.02500	-0.03000	-0.03600	-0.04200	-0.04687	-0.05100
-10.000	-0.01100	-0.01300	-0.01600	-0.02000	-0.02400	-0.02800	-0.03125	-0.03400
-5.000	-0.00500	-0.00600	-0.00800	-0.01000	-0.01200	-0.01400	-0.01562	-0.01700
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01100	0.01400	0.01700	0.02000	0.02086	0.02000	0.01775	0.01400
10.000	0.02200	0.02800	0.03400	0.04000	0.04171	0.04000	0.03550	0.02800
15.000	0.03900	0.04800	0.05300	0.05900	0.06140	0.05900	0.05000	0.03500
20.000	0.05600	0.06700	0.07300	0.07900	0.08188	0.07900	0.06362	0.03800

ENGINEER CCO
DATE 9/13/78

FIGURE 4.1.2.1-31
ELEVON LIFT COEFFICIENT INCREMENT

ST 78-SM-0011 IM



CONFIGURATION

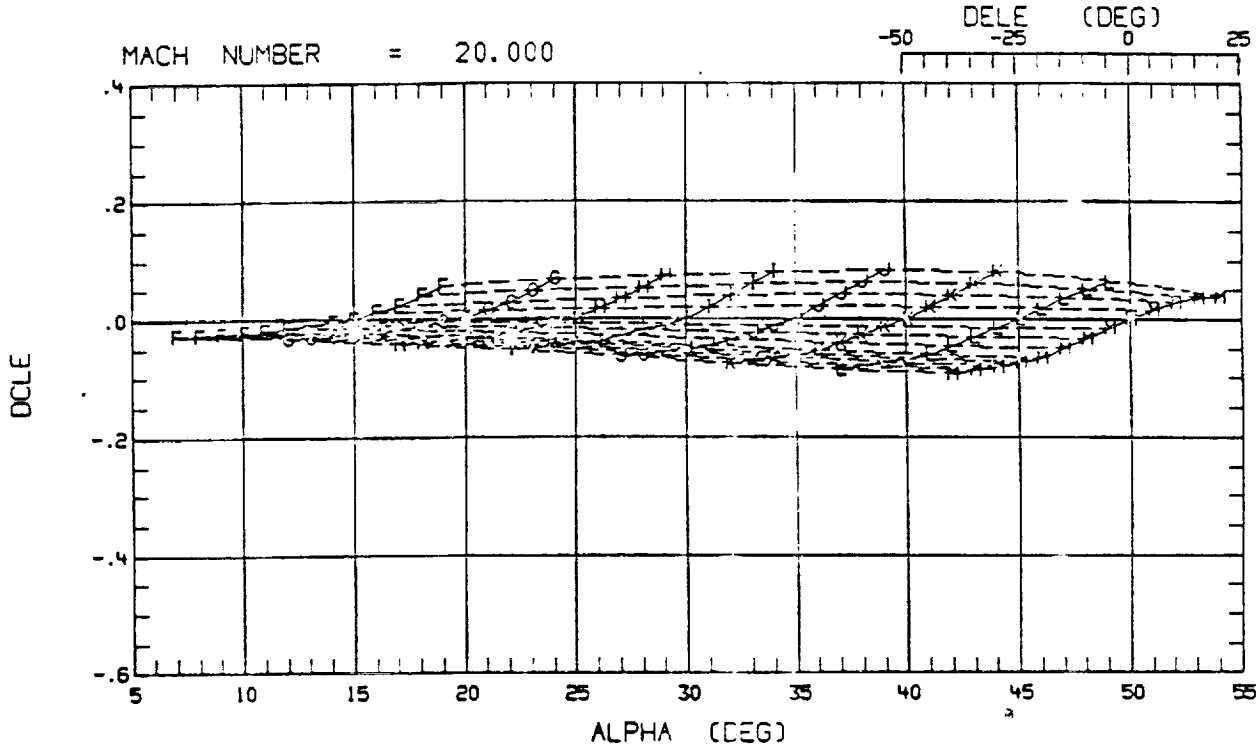
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS
WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.07000	-0.05600	-0.04200	-0.03300	-0.02500	-0.03000	-0.03400	-0.04400
-35.000	-0.05900	-0.04800	-0.03700	-0.03000	-0.02400	-0.02800	-0.03200	-0.04100
-30.000	-0.04900	-0.04100	-0.03200	-0.02700	-0.02200	-0.02600	-0.03000	-0.03800
-25.000	-0.03900	-0.03300	-0.02800	-0.02400	-0.02000	-0.02400	-0.02800	-0.03500
-20.000	-0.02900	-0.02600	-0.02300	-0.02100	-0.01800	-0.02200	-0.02600	-0.03300
-15.000	-0.02200	-0.01900	-0.01700	-0.01500	-0.01400	-0.01600	-0.01900	-0.02500
-10.000	-0.01400	-0.01300	-0.01100	-0.01000	-0.00900	-0.01100	-0.01300	-0.01600
-5.000	-0.00700	-0.00600	-0.00600	-0.00500	-0.00500	-0.00500	-0.00600	-0.00800
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00400	0.00400	0.00400	0.00700	0.00300	0.01100	0.01400	0.01700
10.000	0.00900	0.00900	0.00900	0.01300	0.01700	0.02200	0.02800	0.03400
15.000	0.01000	0.01000	0.01000	0.02000	0.03100	0.03900	0.04800	0.05300
20.000	0.01100	0.01100	0.01100	0.02800	0.04500	0.05600	0.06700	0.07300

ENGINEER DCO
DATE 9/13/72

FIGURE 4.1.2.1-32
ELEVON LIFT COEFFICIENT INCREMENT



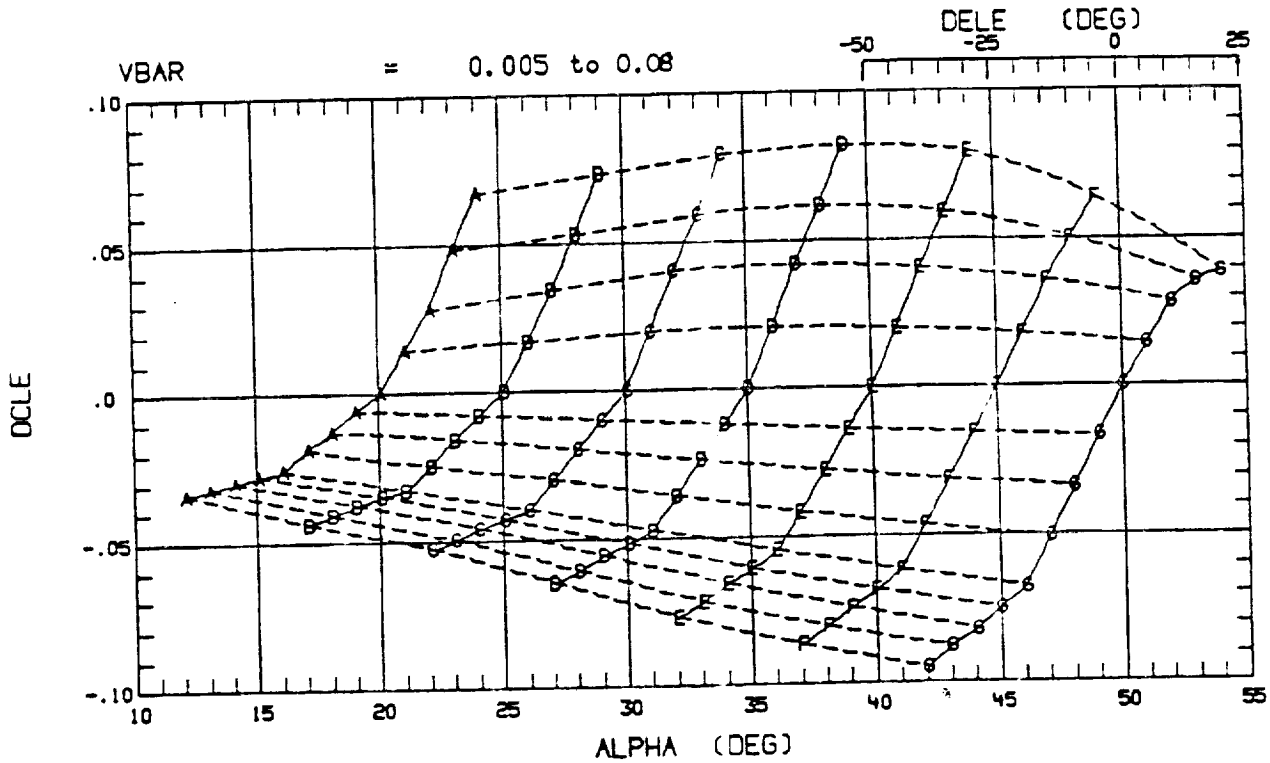
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON LIFT INCREMENT							
-40.000	-0.03000	-0.03400	-0.04400	-0.05300	-0.06500	-0.07700	-0.08675	-0.09500
-35.000	-0.02800	-0.03200	-0.04100	-0.05000	-0.06100	-0.07200	-0.08075	-0.08800
-30.000	-0.02600	-0.03000	-0.03800	-0.04600	-0.05600	-0.06600	-0.07450	-0.08200
-25.000	-0.02400	-0.02800	-0.03500	-0.04300	-0.05200	-0.06100	-0.06850	-0.07500
-20.000	-0.02200	-0.02600	-0.03300	-0.04000	-0.04750	-0.05500	-0.06175	-0.06800
-15.000	-0.01600	-0.01900	-0.02500	-0.03000	-0.03600	-0.04200	-0.04687	-0.05100
-10.000	-0.01100	-0.01300	-0.01600	-0.02000	-0.02400	-0.02800	-0.03125	-0.03400
-5.000	-0.00500	-0.00600	-0.00800	-0.01000	-0.01200	-0.01400	-0.01562	-0.01700
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01100	0.01400	0.01700	0.02000	0.02086	0.02000	0.01775	0.01400
10.000	0.02200	0.02800	0.03400	0.04000	0.04171	0.04000	0.03550	0.02800
15.000	0.03900	0.04800	0.05300	0.05900	0.06140	0.05900	0.05000	0.03500
20.000	0.05600	0.06700	0.07300	0.07900	0.08103	0.07900	0.06362	0.03800

ENGINEER [illegible]
DATE 9/13/78

FIGURE 4.1.2.1-33
ELEVON LIFT COEFFICIENT INCREMENT



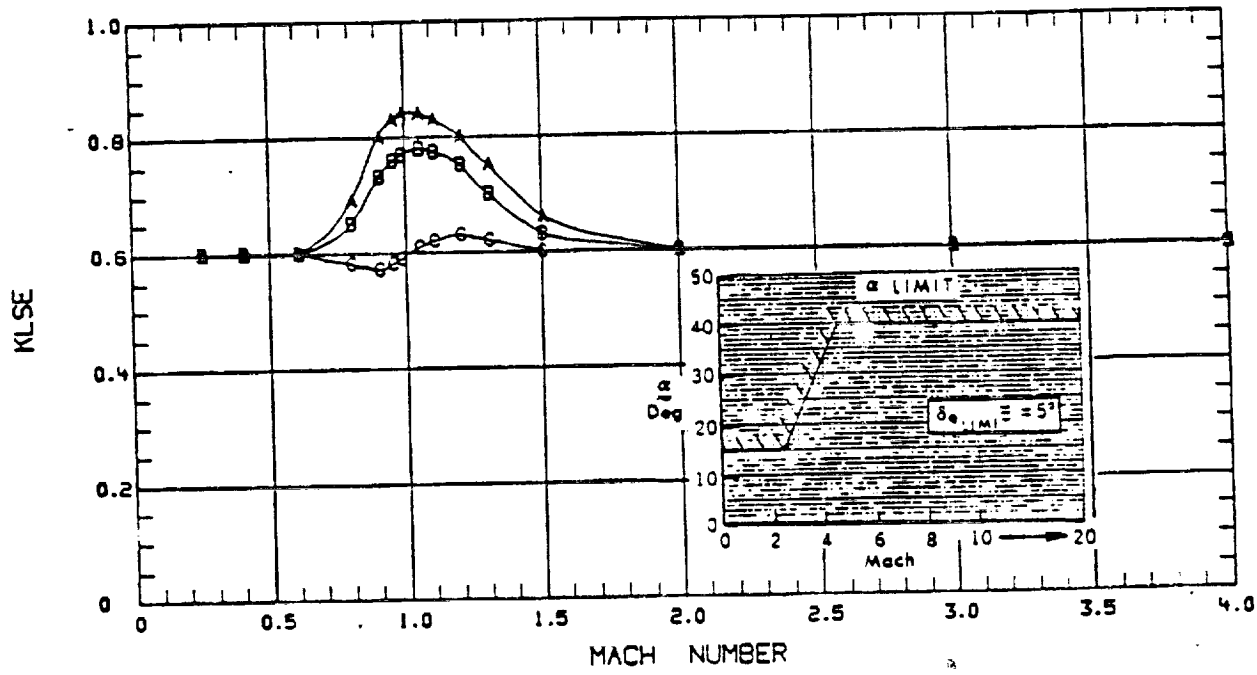
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON LIFT INCREMENT						
-40.000	-0.03400	-0.04400	-0.05300	-0.06500	-0.07700	-0.08675	-0.09500
-35.000	-0.03200	-0.04100	-0.05000	-0.06100	-0.07200	-0.08075	-0.08800
-30.000	-0.03000	-0.03800	-0.04600	-0.05600	-0.06600	-0.07450	-0.08200
-25.000	-0.02800	-0.03500	-0.04300	-0.05200	-0.06100	-0.06850	-0.07500
-20.000	-0.02600	-0.03300	-0.04000	-0.04750	-0.05500	-0.06175	-0.06800
-15.000	-0.01900	-0.02500	-0.03000	-0.03600	-0.04200	-0.04687	-0.05100
-10.000	-0.01300	-0.01600	-0.02000	-0.02400	-0.02800	-0.03125	-0.03400
-5.000	-0.00600	-0.00800	-0.01000	-0.01200	-0.01400	-0.01562	-0.01700
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01400	0.01700	0.02000	0.02086	0.02000	0.01775	0.01400
10.000	0.02800	0.03400	0.04000	0.04171	0.04000	0.03550	0.02800
15.000	0.04800	0.05300	0.05900	0.06140	0.05900	0.05000	0.03500
20.000	0.06700	0.07300	0.07900	0.08198	0.07900	0.06362	0.03800

ENGINEER NASA
DATE

FIGURE 4.1.2.1-34
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

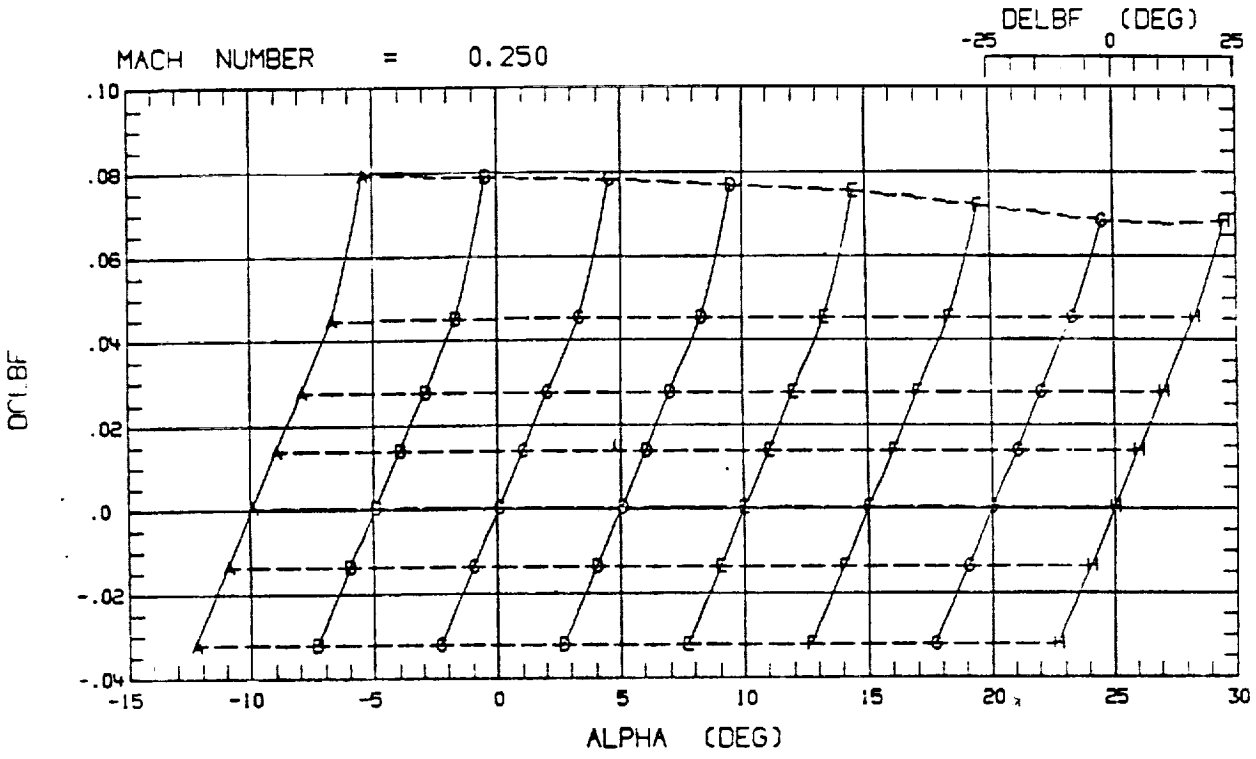
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

	DELE (DEG)		
	-5.000	0.0	5.000
	A	B	C
MACH NUMBER	LIFT PARTIAL SPAN FACTOR		
0.250	0.60000	0.60000	0.60000
0.400	0.60000	0.60000	0.60000
0.600	0.60000	0.60000	0.60000
0.800	0.69000	0.65000	0.58000
0.900	0.80000	0.73000	0.57000
0.950	0.83000	0.76000	0.58000
0.980	0.84000	0.77000	0.59000
1.050	0.84000	0.78000	0.61000
1.100	0.83000	0.77500	0.62000
1.200	0.80000	0.75000	0.63000
1.300	0.75000	0.70000	0.62000
1.500	0.66000	0.63000	0.60000
2.000	0.60000	0.60000	0.60000
3.000	0.60000	0.60000	0.60000
4.000	0.60000	0.60000	0.60000
5.000	0.60000	0.60000	0.60000
8.000	0.60000	0.60000	0.60000
10.000	0.60000	0.60000	0.60000
15.000	0.60000	0.60000	0.60000
20.000	0.60000	0.60000	0.60000

NOTE: In the event partial span factors are required which exceed the given limits, the Aero Data Unit at Rockwell International should be contacted before extrapolation of the given data.

ENGINEER DCO WMZ
DATE 9/13/78 REV 1-26-79

FIGURE 4.1.2.1-36
ELEVON PARTIAL SPAN FACTOR

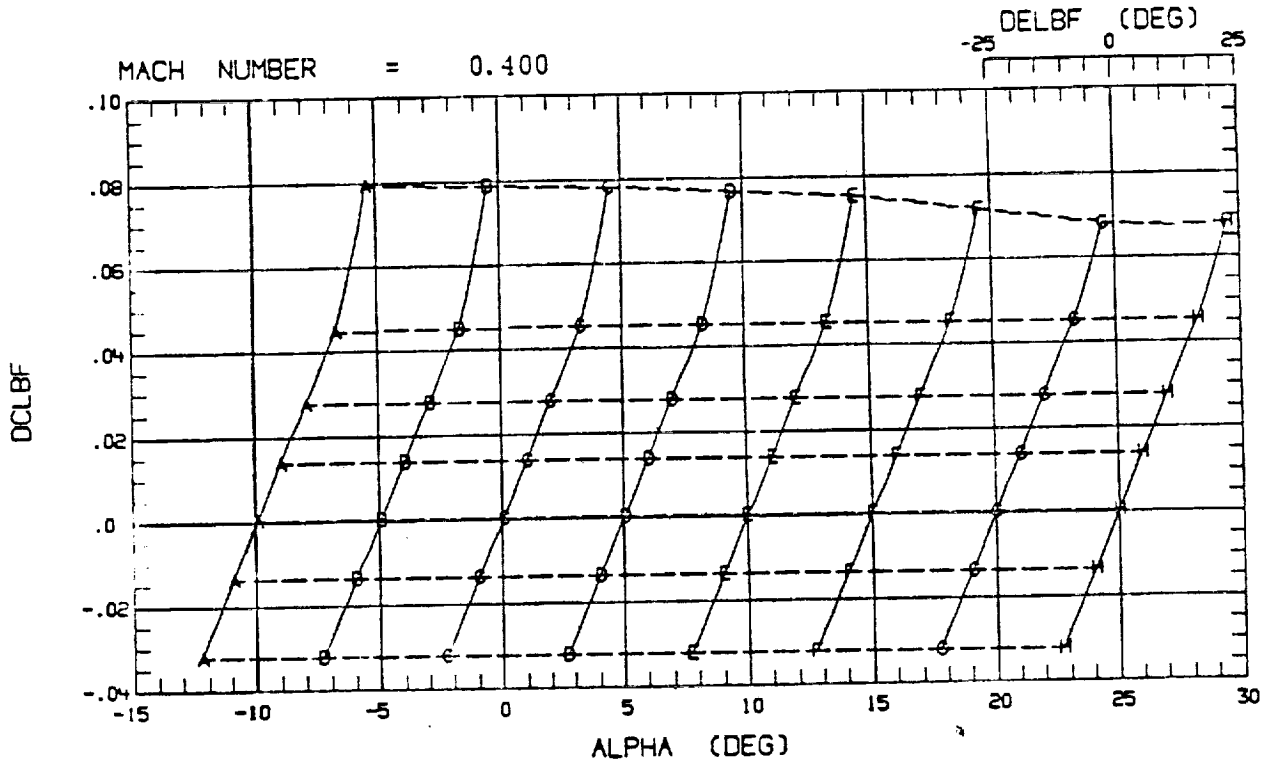


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.03220	-0.03220	-0.03220	-0.03220	-0.03220	-0.03220	-0.03220	-0.03220
-5.000	-0.01374	-0.01377	-0.01379	-0.01379	-0.01379	-0.01379	-0.01379	-0.01379
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01370	0.01377	0.01380	0.01380	0.01380	0.01380	0.01380	0.01380
10.000	0.02734	0.02755	0.02761	0.02761	0.02761	0.02761	0.02761	0.02761
16.300	0.04460	0.04497	0.04520	0.04520	0.04520	0.04520	0.04520	0.04520
22.500	0.07900	0.07860	0.07780	0.07669	0.07500	0.07145	0.06790	0.06790

ENGINEER WMZ
DATE 7-20-78

FIGURE 4.1.2.1-37
EFFECT OF BODY FLAP



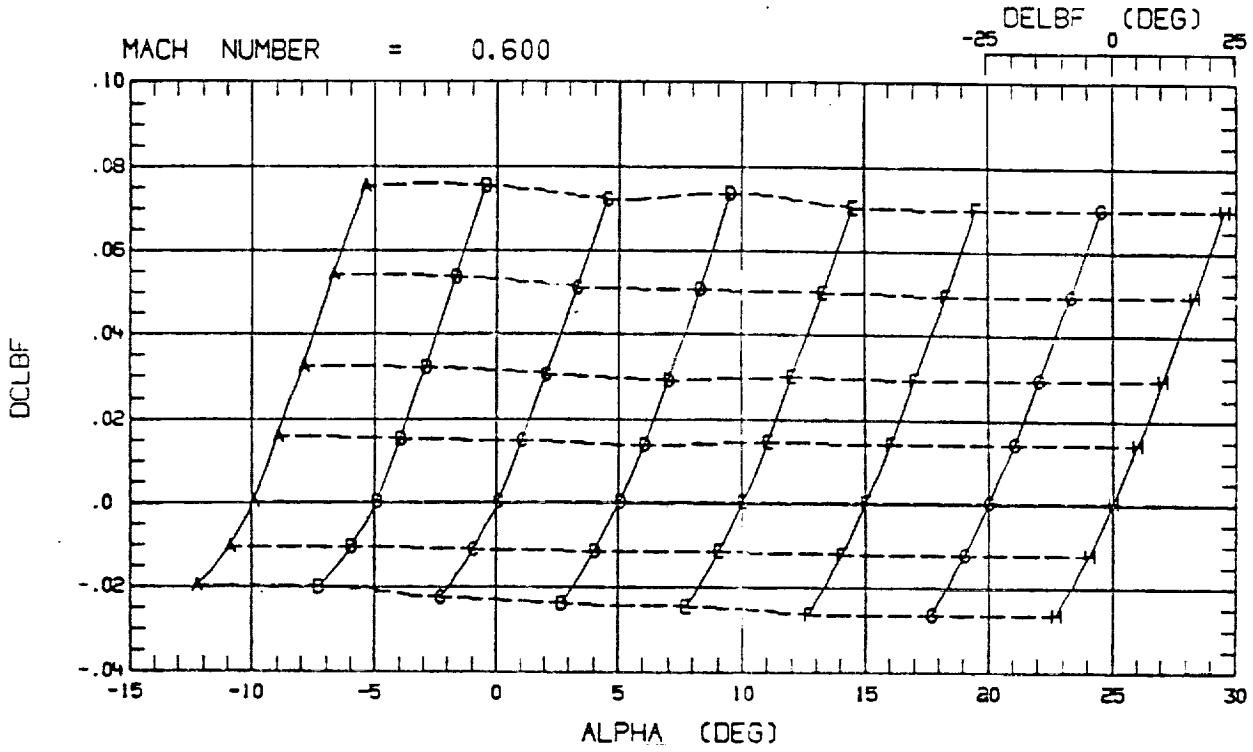
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.03220	-0.03220	-0.03220	-0.03220	-0.03220	-0.03220	-0.03220	-0.03220
-5.000	-0.01374	-0.01377	-0.01379	-0.01379	-0.01379	-0.01379	-0.01379	-0.01379
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01370	0.01377	0.01380	0.01380	0.01380	0.01380	0.01380	0.01380
10.000	0.02734	0.02755	0.02761	0.02761	0.02761	0.02761	0.02761	0.02761
16.300	0.04450	0.04497	0.04520	0.04520	0.04520	0.04520	0.04520	0.04520
22.500	0.07900	0.07860	0.07780	0.07669	0.07500	0.07145	0.06790	0.06790

ENGINEER WJM 2
DATE 9-20-78

FIGURE 4.1.2.1-38
EFFECT OF BODY FLAP

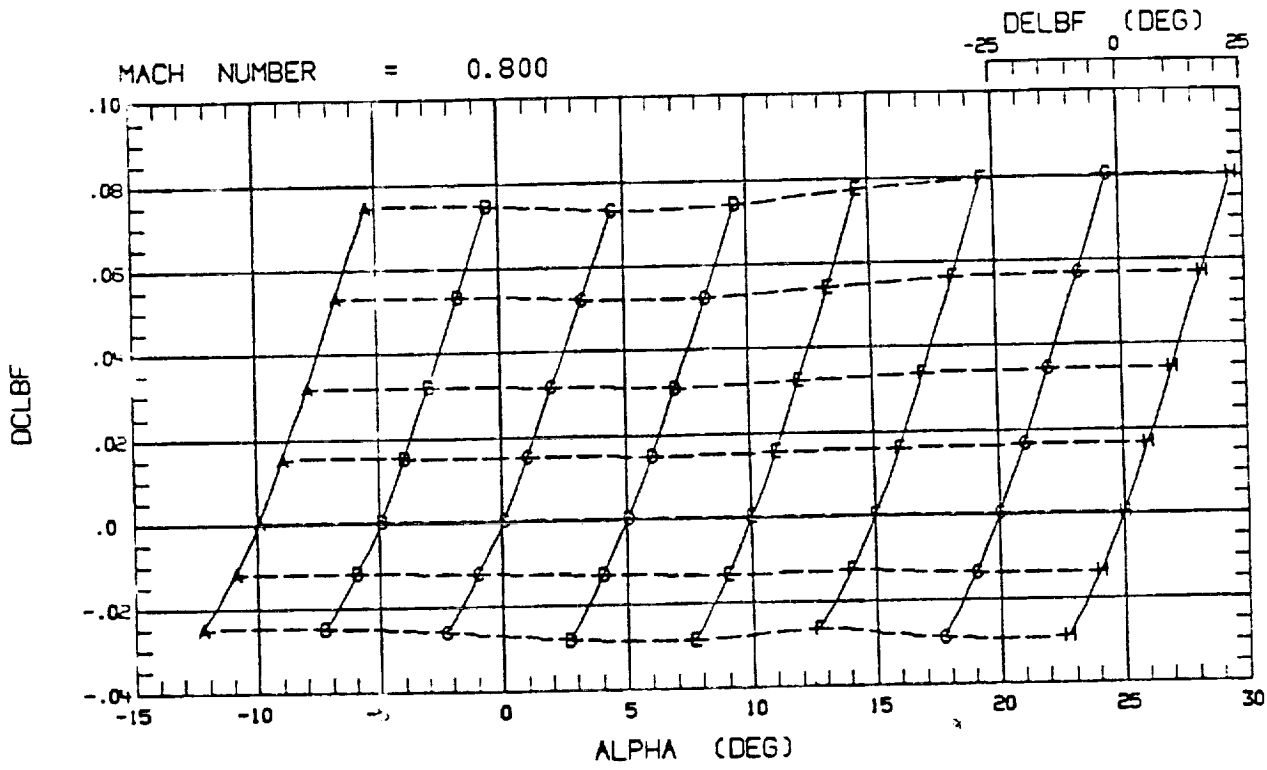


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.01990	-0.01994	-0.02267	-0.02400	-0.02476	-0.02635	-0.02635	-0.02635
-5.000	-0.01043	-0.01042	-0.01112	-0.01150	-0.01172	-0.01218	-0.01218	-0.01218
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01574	0.01520	0.01455	0.01358	0.01433	0.01393	0.01393	0.01393
10.000	0.03260	0.03202	0.03053	0.02902	0.02992	0.02913	0.02913	0.02913
16.300	0.05400	0.05359	0.05111	0.05044	0.05003	0.04917	0.04917	0.04917
22.500	0.07530	0.07525	0.07182	0.07345	0.07028	0.06970	0.06970	0.06970

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.1-39
EFFECT OF BODY FLAP



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

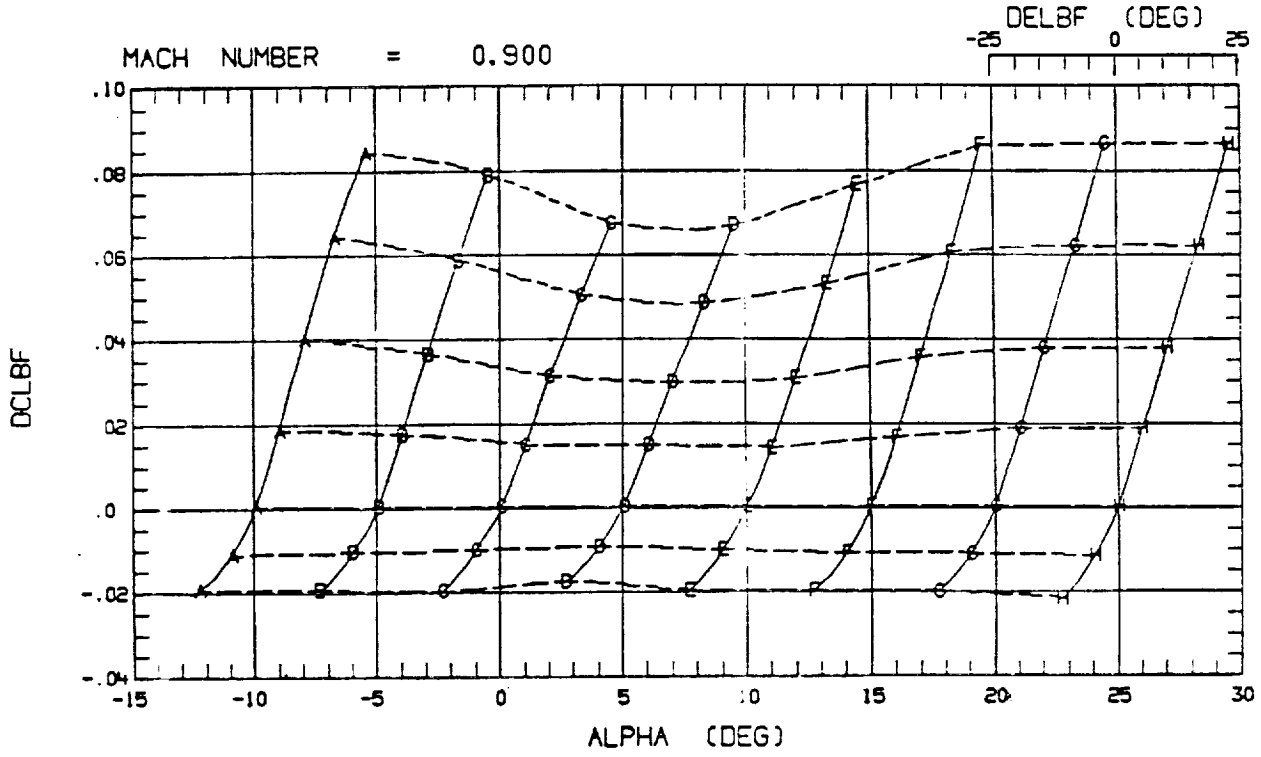
WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.02498	-0.02498	-0.02630	-0.02840	-0.02856	-0.02650	-0.02900	-0.02900
-5.000	-0.01202	-0.01202	-0.01238	-0.01306	-0.01327	-0.01275	-0.01361	-0.01361
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01525	0.01525	0.01515	0.01473	0.01526	0.01596	0.01639	0.01639
10.000	0.03183	0.03183	0.03139	0.03081	0.03203	0.03355	0.03413	0.03413
16.300	0.05312	0.05312	0.05215	0.05215	0.05426	0.05634	0.05700	0.05700
22.500	0.07449	0.07449	0.07291	0.07418	0.07717	0.07939	0.08000	0.08000

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.1-40
EFFECT OF BODY FLAP

SD72-SH-0000 IM

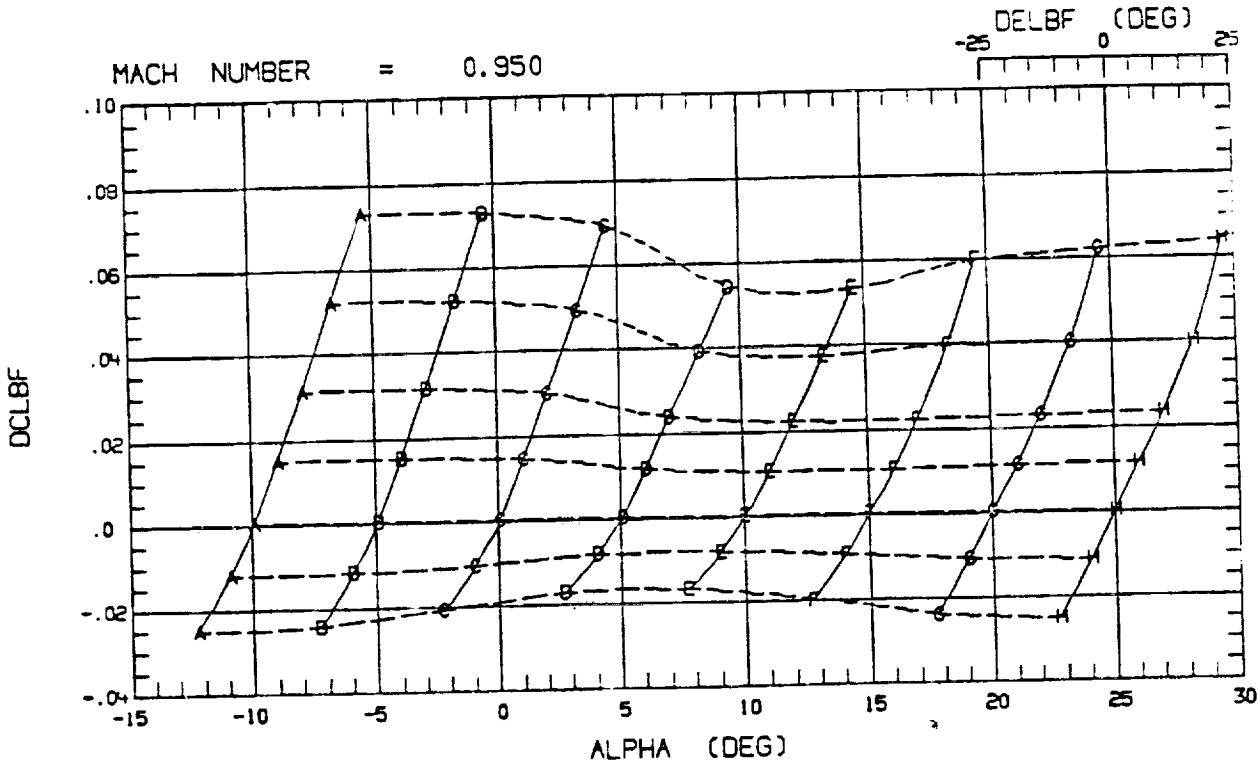


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.01955	-0.01955	-0.01973	-0.01775	-0.01960	-0.01971	-0.02000	-0.02200
-5.000	-0.01105	-0.01065	-0.01009	-0.00932	-0.01027	-0.01085	-0.01105	-0.01170
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01845	0.01727	0.01478	0.01462	0.01413	0.01667	0.01851	0.01852
10.000	0.03985	0.03623	0.03100	0.02952	0.03077	0.03577	0.03774	0.03774
16.300	0.06400	0.05857	0.05010	0.04830	0.05313	0.06057	0.06200	0.06200
22.500	0.08400	0.07883	0.06731	0.06683	0.07644	0.08575	0.08600	0.08600

ENGINEER [illegible]
DATE 9-10-78

FIGURE 4.1.2.1-41
EFFECT OF BODY FLAP



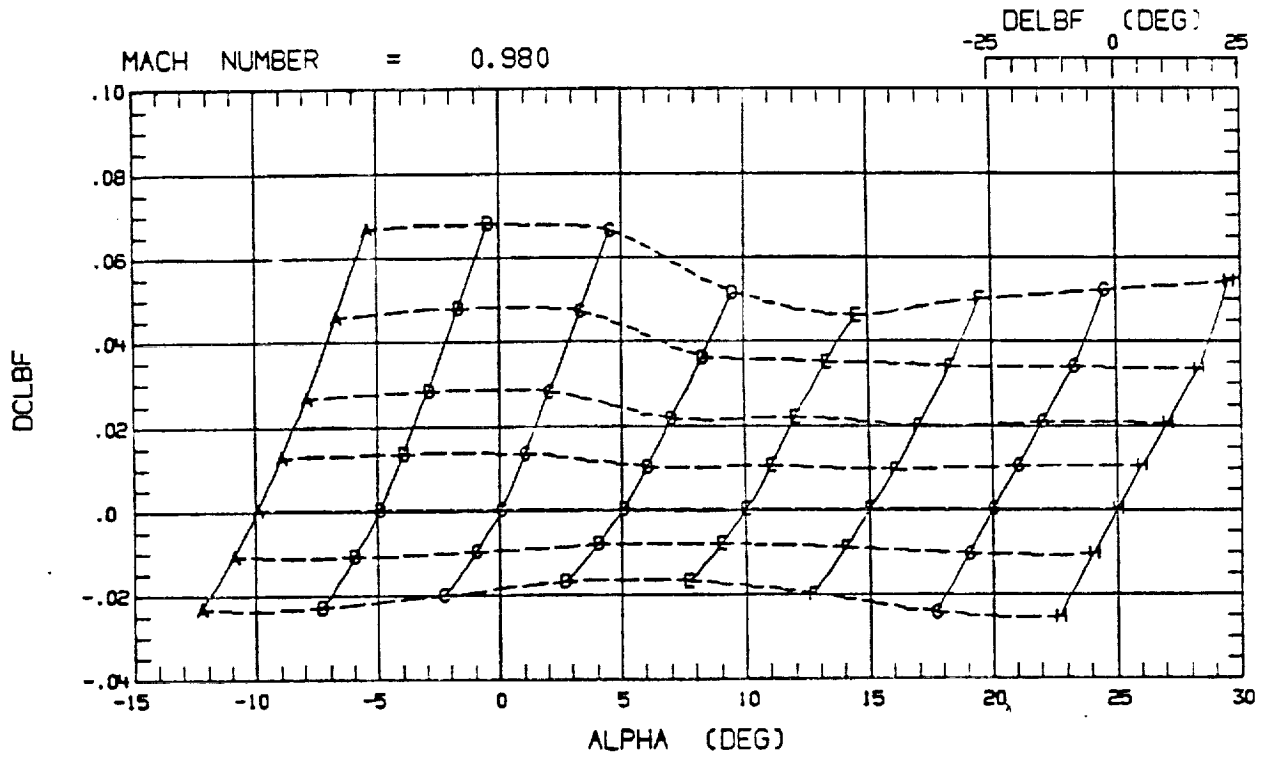
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.02500	-0.02430	-0.02072	-0.01711	-0.01704	-0.01993	-0.02400	-0.02500
-5.000	-0.01194	-0.01171	-0.01036	-0.00841	-0.00829	-0.00938	-0.01074	-0.01106
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01489	0.01515	0.01420	0.01137	0.01036	0.01051	0.01123	0.01141
10.000	0.03112	0.03134	0.02963	0.02344	0.02203	0.02222	0.02294	0.02310
16.300	0.05200	0.05195	0.04934	0.03876	0.03745	0.03949	0.04000	0.04000
22.500	0.07300	0.07249	0.06906	0.05399	0.05328	0.05975	0.06200	0.06400

ENGINEER Wmz
DATE 9-30-78

FIGURE 4.1.2.1-42
EFFECT OF BODY FLAP



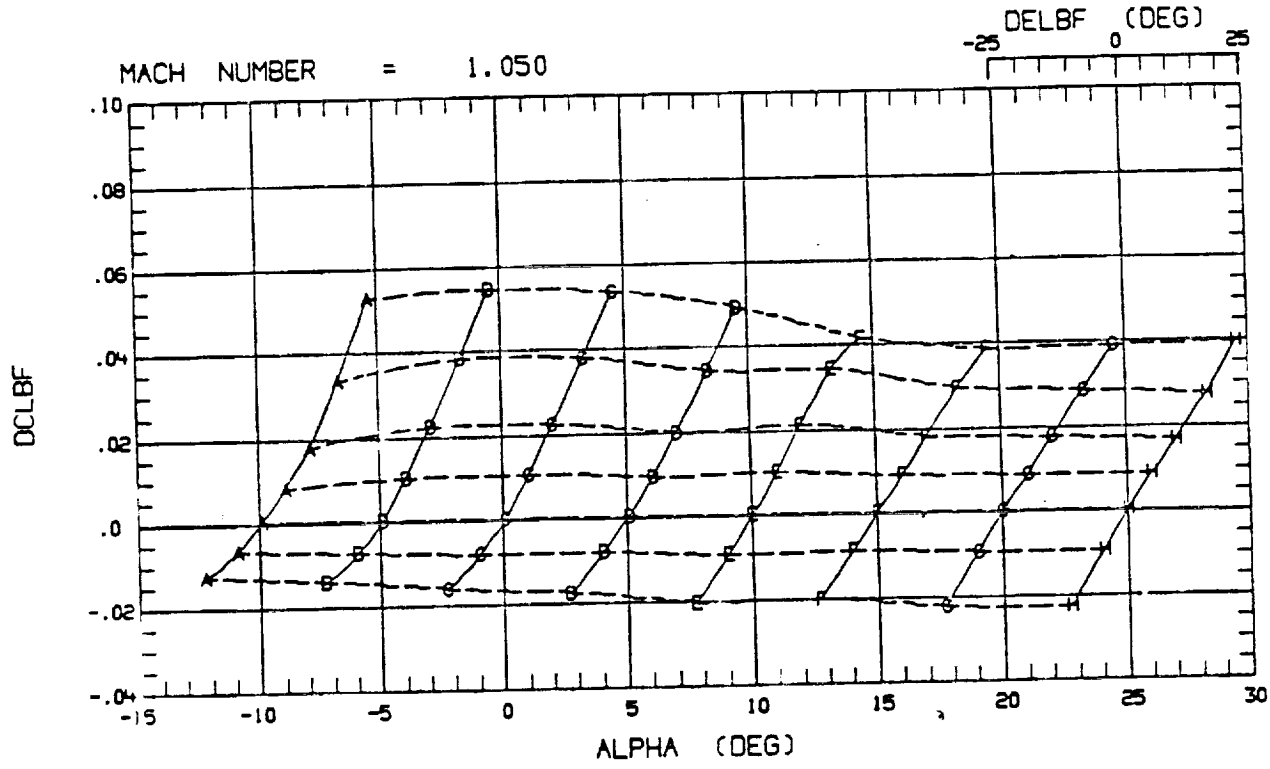
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.02346	-0.02301	-0.01998	-0.01700	-0.01696	-0.02000	-0.02450	-0.02533
-5.000	-0.01098	-0.01100	-0.00994	-0.00818	-0.00809	-0.00899	-0.01045	-0.01068
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01242	0.01341	0.01316	0.01006	0.01029	0.00955	0.01039	0.01035
10.000	0.02627	0.02832	0.02787	0.02131	0.02183	0.01970	0.02072	0.02028
16.300	0.04562	0.04789	0.04698	0.03614	0.03513	0.03391	0.03381	0.03329
22.500	0.06569	0.06787	0.06635	0.05134	0.04607	0.04990	0.05205	0.05413

ENGINEER WMZ
DATE 4-20-78

FIGURE 4.1.2.1-43
EFFECT OF BODY FLAP



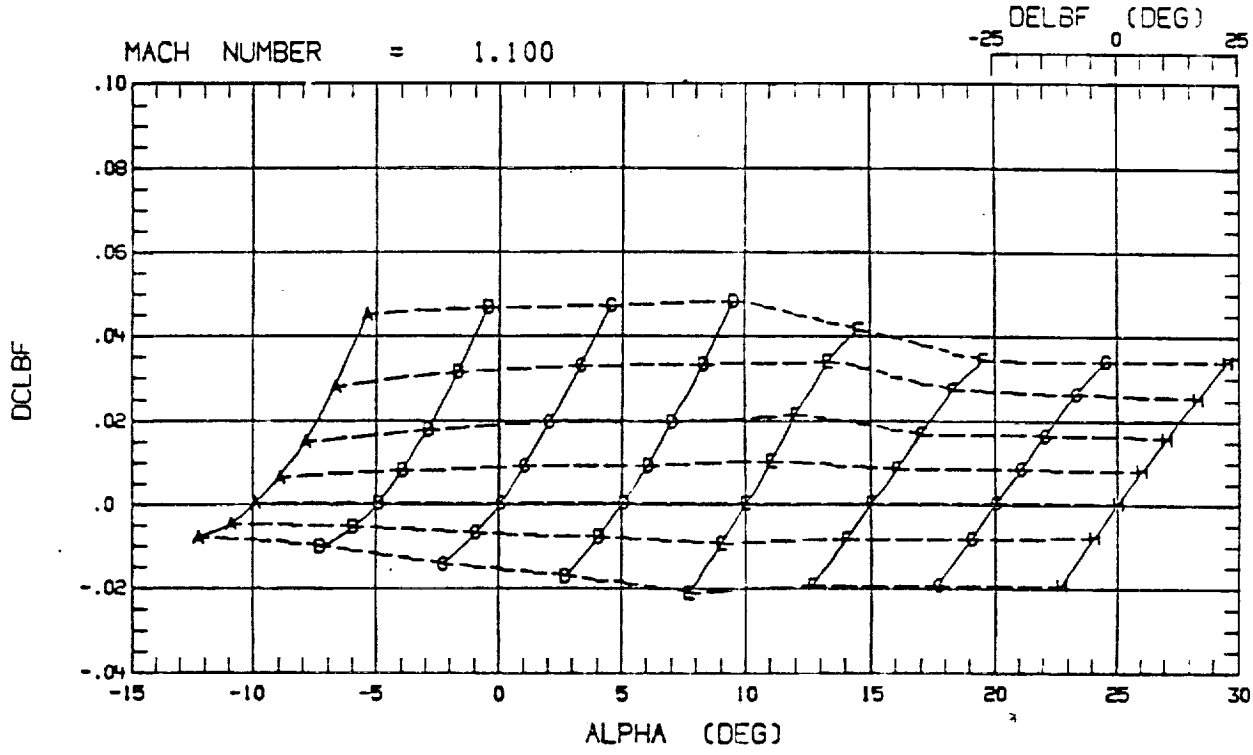
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.01273	-0.01407	-0.01613	-0.01747	-0.02043	-0.02008	-0.02216	-0.02274
-5.000	-0.00657	-0.00737	-0.00802	-0.00818	-0.00915	-0.00867	-0.00929	-0.00940
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00806	0.01021	0.01054	0.00937	0.01014	0.00889	0.00883	0.00861
10.000	0.01770	0.02215	0.02236	0.01981	0.02129	0.01801	0.01750	0.01659
16.300	0.03316	0.03807	0.03776	0.03409	0.03419	0.02923	0.02839	0.02732
22.500	0.05267	0.05455	0.05340	0.04926	0.04144	0.03849	0.03906	0.03967

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.1-44
EFFECT OF BODY FLAP

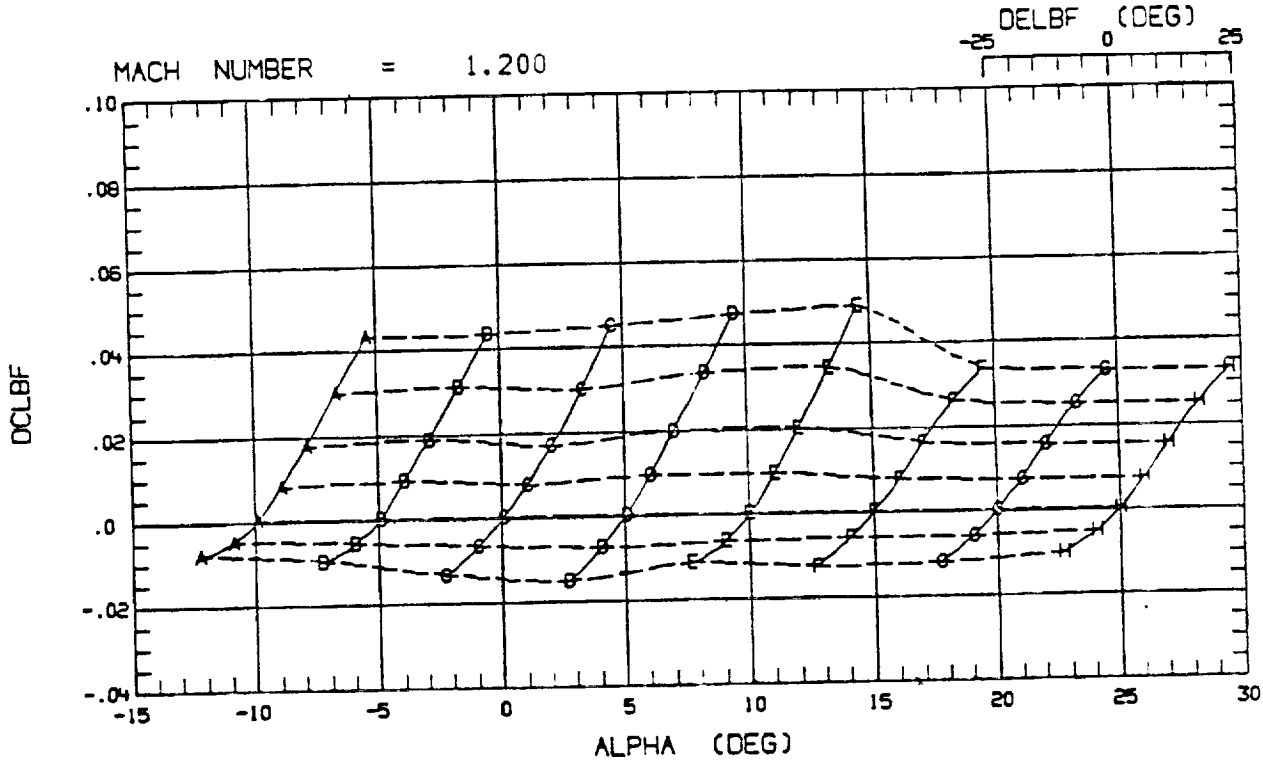


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00800	-0.01010	-0.01427	-0.01742	-0.02100	-0.01951	-0.01950	-0.01950
-5.000	-0.00466	-0.00558	-0.00705	-0.00811	-0.00931	-0.00833	-0.00825	-0.00817
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00637	0.00780	0.00894	0.00918	0.01009	0.00833	0.00817	0.00791
10.000	0.01455	0.01746	0.01918	0.01935	0.02101	0.01666	0.01627	0.01559
16.300	0.02800	0.03131	0.03286	0.03330	0.03382	0.02711	0.02600	0.02500
22.500	0.04500	0.04654	0.04705	0.04817	0.04146	0.03409	0.03400	0.03400

ENGINEER WJMZ
DATE 4-26-78

FIGURE 4.1.2.1 -45
EFFECT OF BODY FLAP



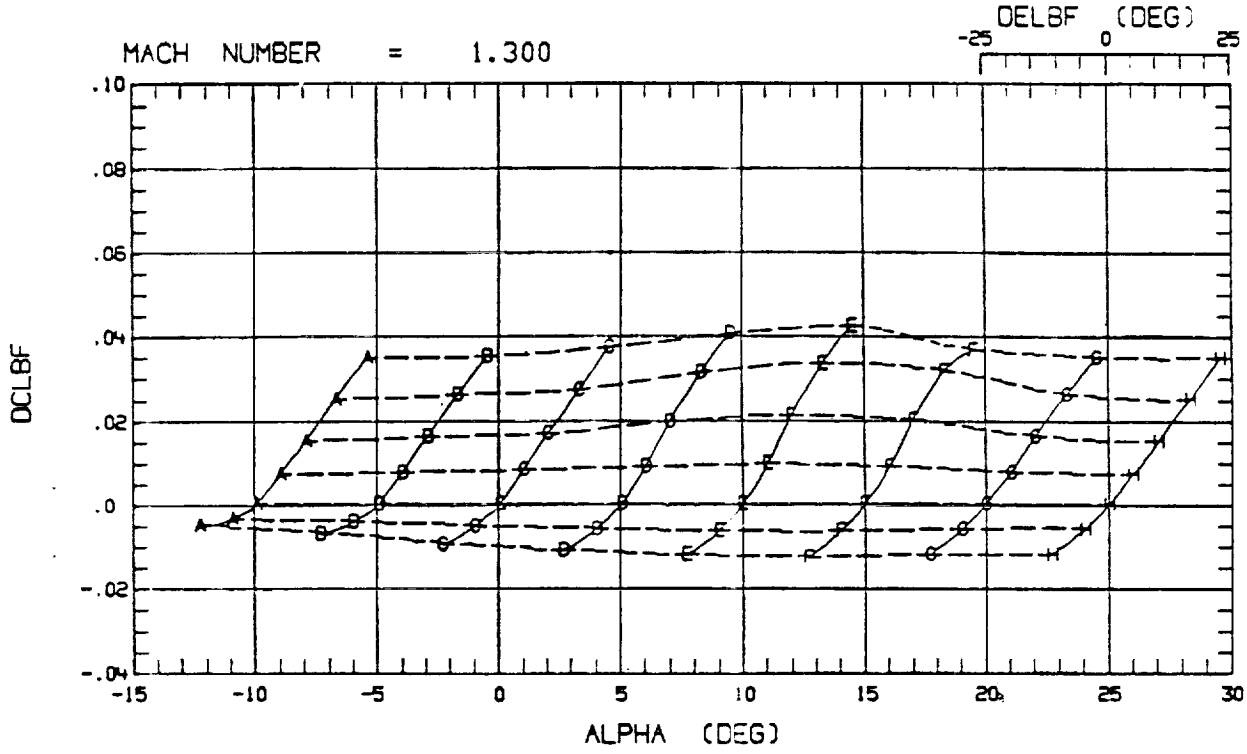
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00800	-0.00978	-0.01352	-0.01510	-0.01138	-0.01249	-0.01200	-0.01000
-5.000	-0.00480	-0.00545	-0.00659	-0.00736	-0.00622	-0.00598	-0.00574	-0.00509
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00791	0.00886	0.00775	0.00937	0.00929	0.00760	0.00734	0.00729
10.000	0.01741	0.01859	0.01669	0.01962	0.02011	0.01629	0.01552	0.01553
16.300	0.03000	0.03099	0.02986	0.03343	0.03432	0.02511	0.02500	0.02500
22.500	0.04300	0.04339	0.04500	0.04726	0.04887	0.03347	0.03300	0.03300

ENGINEER WAAZ
DATE 9-26-75

FIGURE 4.1.2.1-46
EFFECT OF BODY FLAP

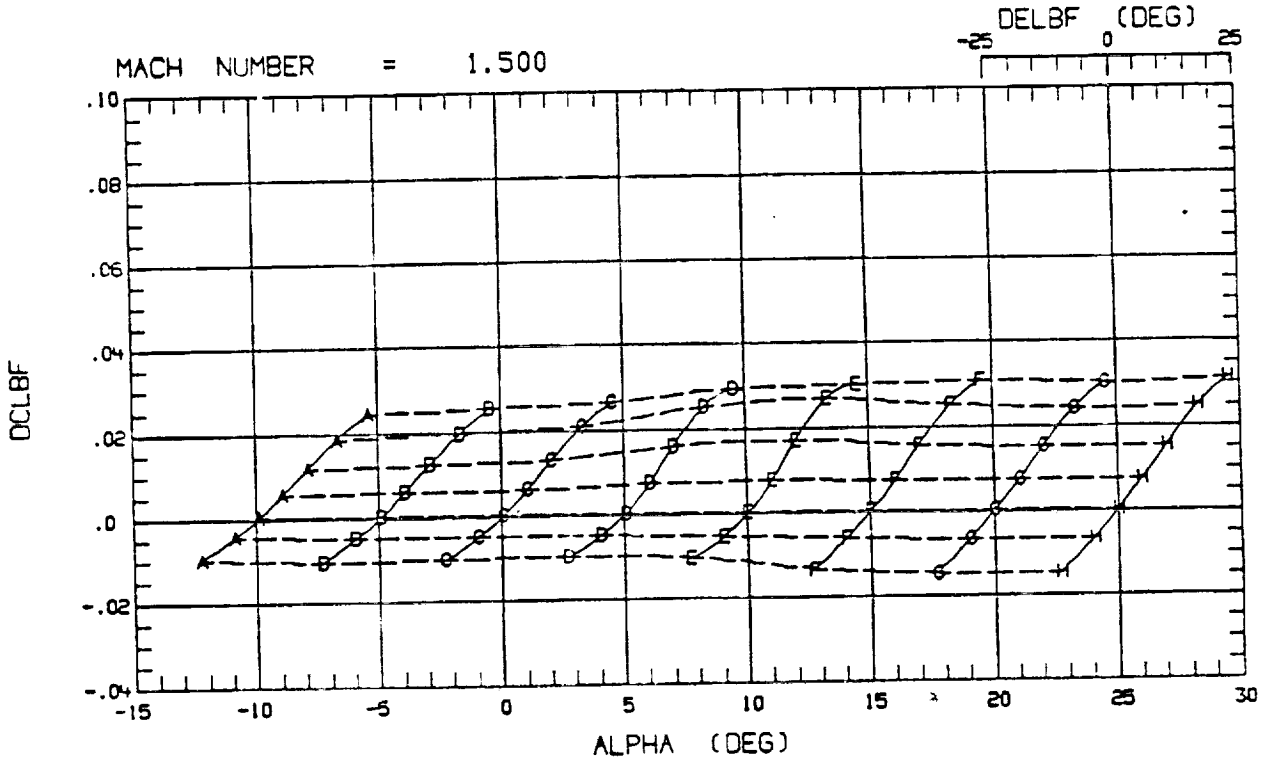


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00500	-0.00680	-0.00941	-0.01103	-0.01195	-0.01254	-0.01200	-0.01200
-5.000	-0.00346	-0.00412	-0.00505	-0.00589	-0.00636	-0.00640	-0.00581	-0.00574
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00713	0.00770	0.00828	0.00902	0.00958	0.00894	0.00771	0.00722
10.000	0.01500	0.01607	0.01669	0.01960	0.02113	0.01998	0.01608	0.01502
16.300	0.02500	0.02501	0.02718	0.03140	0.03369	0.03163	0.02500	0.02500
22.500	0.03500	0.03518	0.03740	0.04064	0.04236	0.03679	0.03500	0.03500

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.1-47
EFFECT OF BODY FLAP



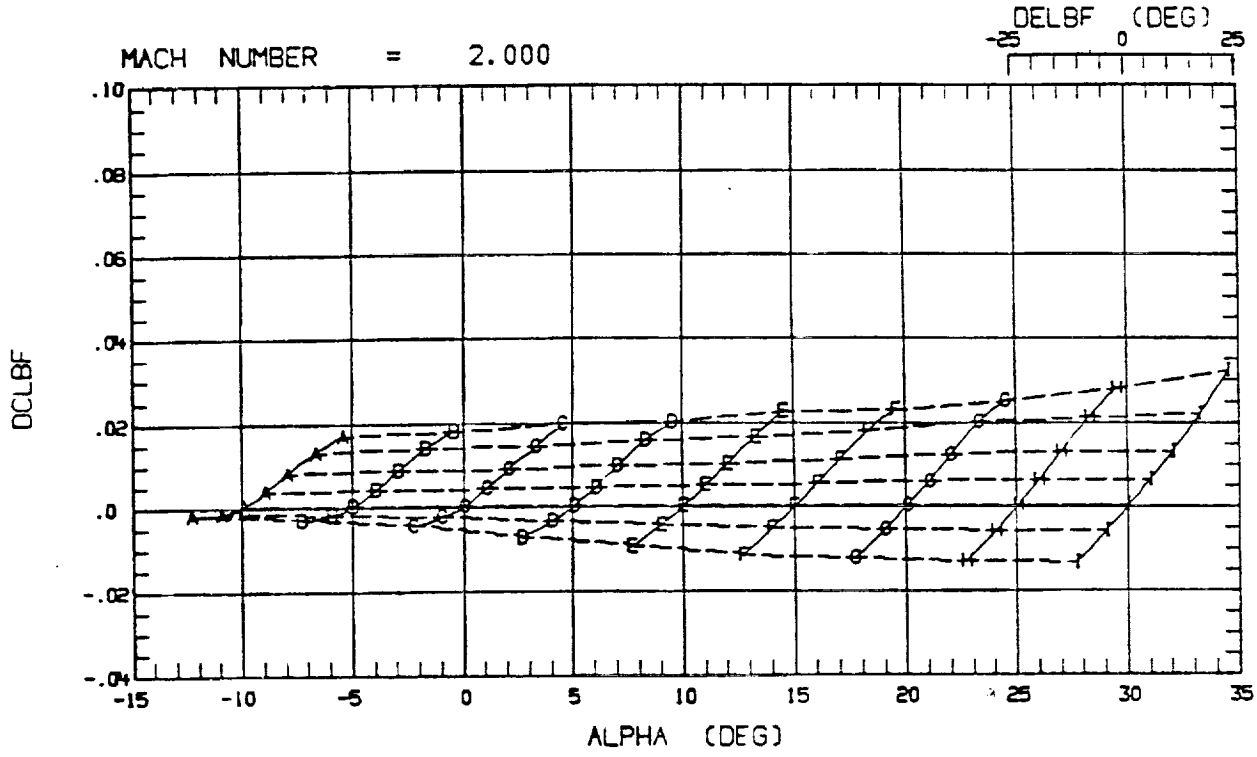
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00972	-0.01057	-0.01019	-0.00965	-0.01058	-0.01354	-0.01470	-0.01468
-5.000	-0.00451	-0.00487	-0.00484	-0.00498	-0.00541	-0.00623	-0.00654	-0.00657
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00544	0.00574	0.00604	0.00709	0.00756	0.00730	0.00716	0.00728
10.000	0.01141	0.01211	0.01297	0.01587	0.01702	0.01554	0.01494	0.01523
16.300	0.01840	0.01949	0.02077	0.02513	0.02687	0.02489	0.02405	0.02451
22.500	0.02438	0.02532	0.02633	0.02944	0.03006	0.03088	0.03006	0.03094

ENGINEER WMZ
DATE 4-30-78

FIGURE 4.1.2.1-48
EFFECT OF BODY FLAP



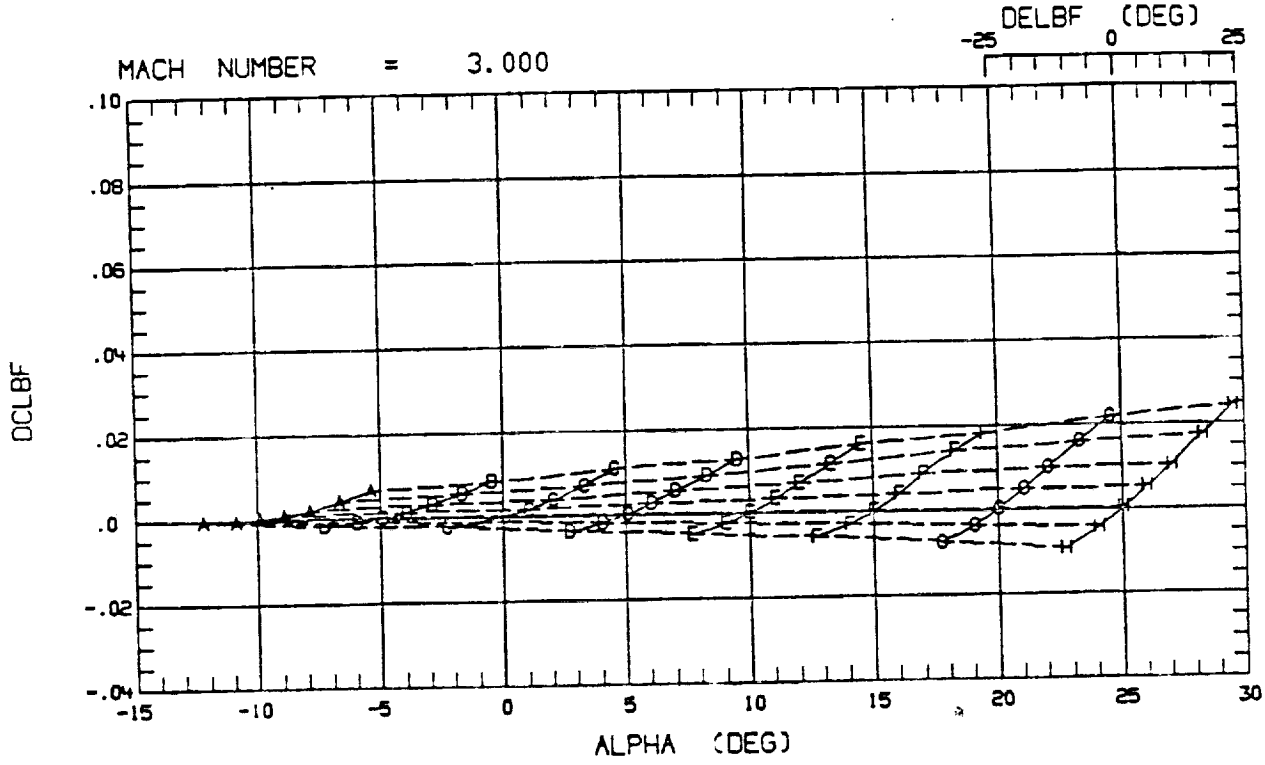
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT								
-11.700	-0.00200	-0.00300	-0.00439	-0.00715	-0.00944	-0.01142	-0.01246	-0.01300	-0.01319
-5.000	-0.00160	-0.00200	-0.00249	-0.00348	-0.00429	-0.00503	-0.00552	-0.00577	-0.00590
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00370	0.00396	0.00429	0.00455	0.00498	0.00540	0.00597	0.00630	0.00625
10.000	0.00811	0.00876	0.00891	0.00978	0.01025	0.01115	0.01241	0.01298	0.01287
16.300	0.01300	0.01400	0.01444	0.01568	0.01662	0.01800	0.02000	0.02100	0.02200
22.500	0.01700	0.01800	0.01958	0.02015	0.02250	0.02291	0.02500	0.02800	0.03200

ENGINEER WM L
DATE 9-30-78

FIGURE 4.1.2.1-49
EFFECT OF BODY FLAP

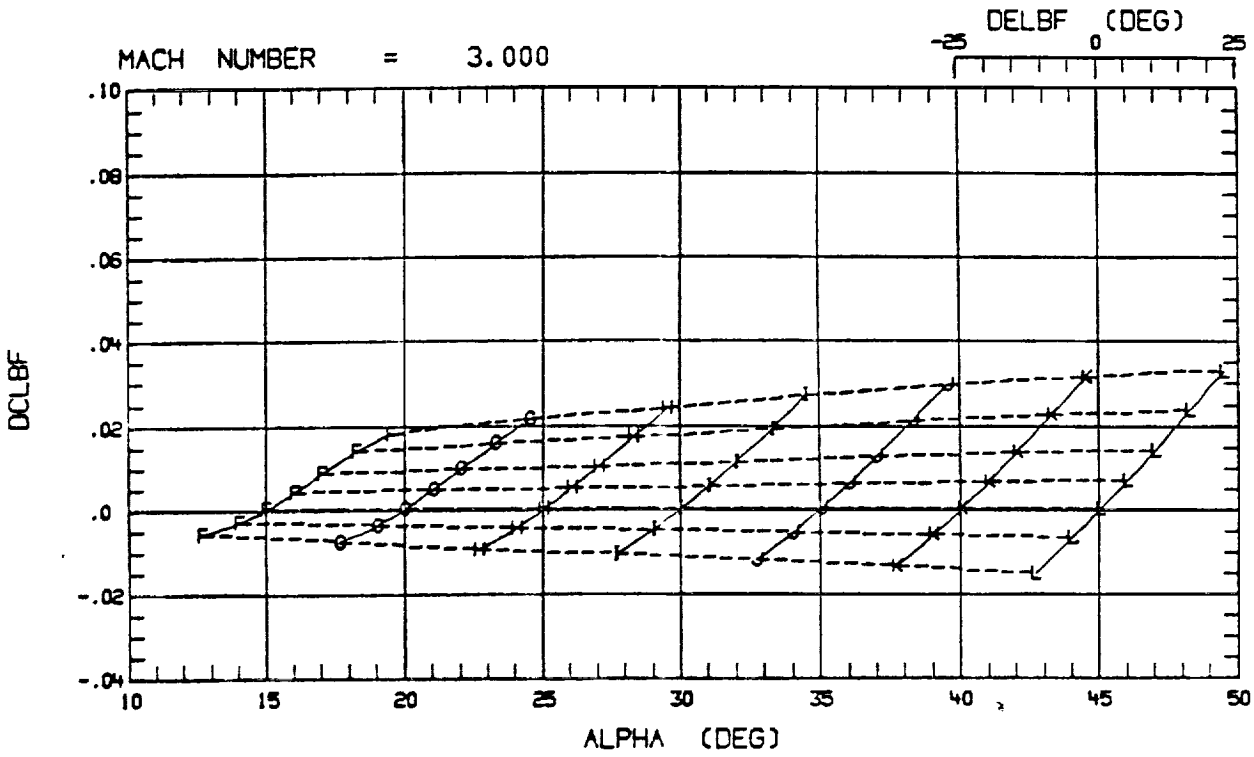


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00050	-0.00180	-0.00222	-0.00372	-0.00478	-0.00600	-0.00756	-0.00957
-5.000	-0.00046	-0.00099	-0.00124	-0.00187	-0.00238	-0.00297	-0.00361	-0.00436
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00082	0.00137	0.00169	0.00258	0.00321	0.00403	0.00477	0.00495
10.000	0.00201	0.00306	0.00381	0.00541	0.00674	0.00869	0.00960	0.01024
16.300	0.00400	0.00550	0.00707	0.00902	0.01128	0.01393	0.01564	0.01707
22.500	0.00650	0.00820	0.01089	0.01264	0.01584	0.01800	0.02153	0.02395

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.1-50
EFFECT OF BODY FLAP

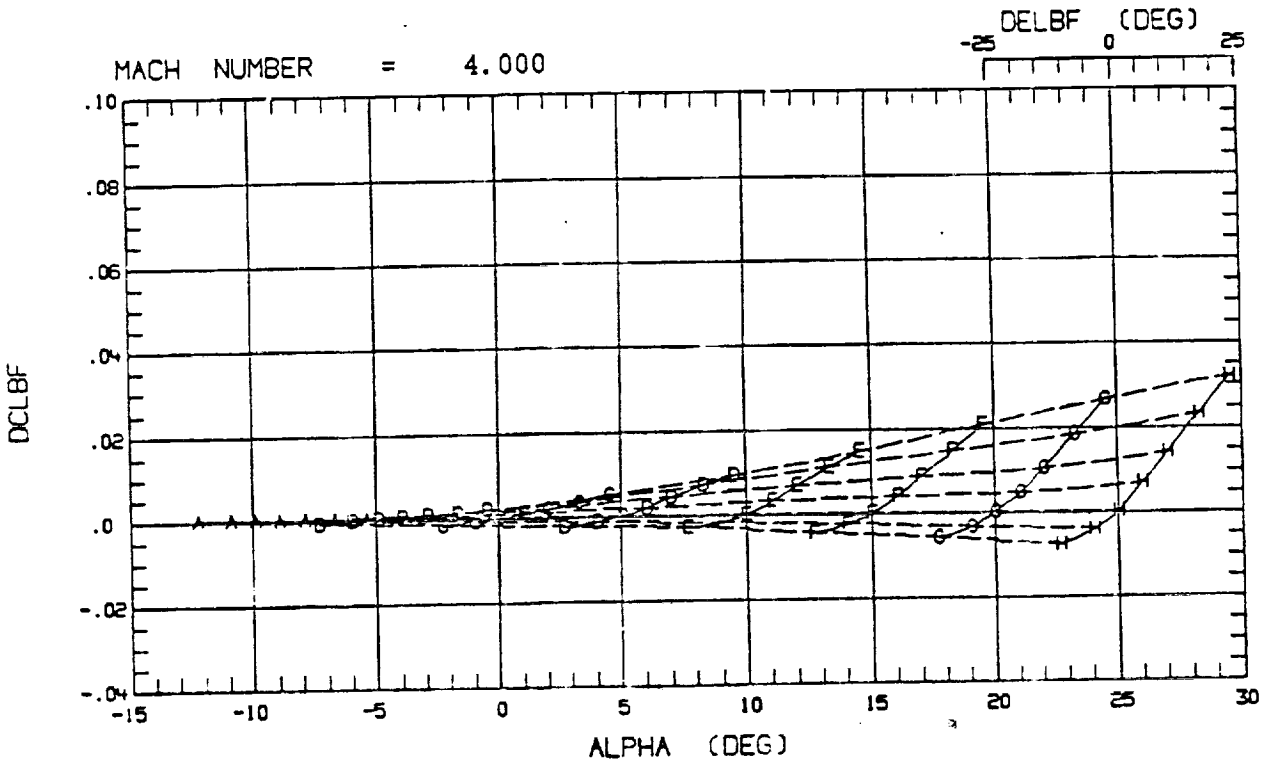


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT						
-11.700	-0.00600	-0.00756	-0.00957	-0.01050	-0.01200	-0.01350	-0.01500
-5.000	-0.00297	-0.00361	-0.00436	-0.00481	-0.00544	-0.00604	-0.00660
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00403	0.00477	0.00495	0.00539	0.00608	0.00659	0.00692
10.000	0.00869	0.00960	0.01024	0.01124	0.01258	0.01354	0.01413
16.300	0.01393	0.01564	0.01707	0.01900	0.02100	0.02250	0.02350
22.500	0.01800	0.02153	0.02395	0.02700	0.02950	0.03150	0.03300

ENGINEER WMZ
DATE 4-20-78

FIGURE 4.1.2.1-51
EFFECT OF BODY FLAP



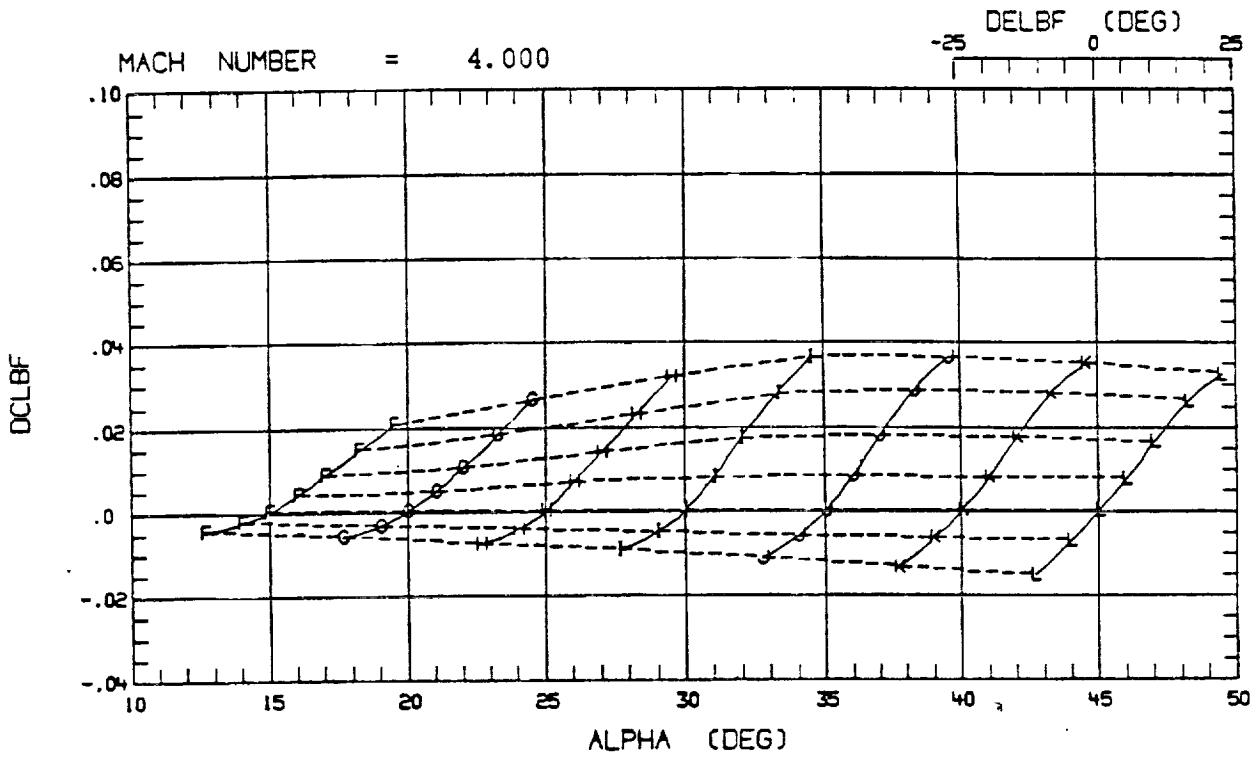
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	0.0	-0.00085	-0.00160	-0.00220	-0.00290	-0.00440	-0.00600	-0.00755
-5.000	-0.00002	-0.00038	-0.00078	-0.00125	-0.00172	-0.00250	-0.00329	-0.00414
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00007	0.00039	0.00094	0.00209	0.00321	0.00402	0.00466	0.00674
10.000	0.00020	0.00080	0.00201	0.00451	0.00682	0.00863	0.01034	0.01390
16.300	0.00030	0.00136	0.00350	0.00725	0.01100	0.01460	0.01820	0.02295
22.500	0.0	0.00199	0.00510	0.00952	0.01470	0.02065	0.02660	0.03194

ENGINEER WMJ
DATE 9-20-78

FIGURE 4.1.2.1-52
EFFECT OF BODY FLAP



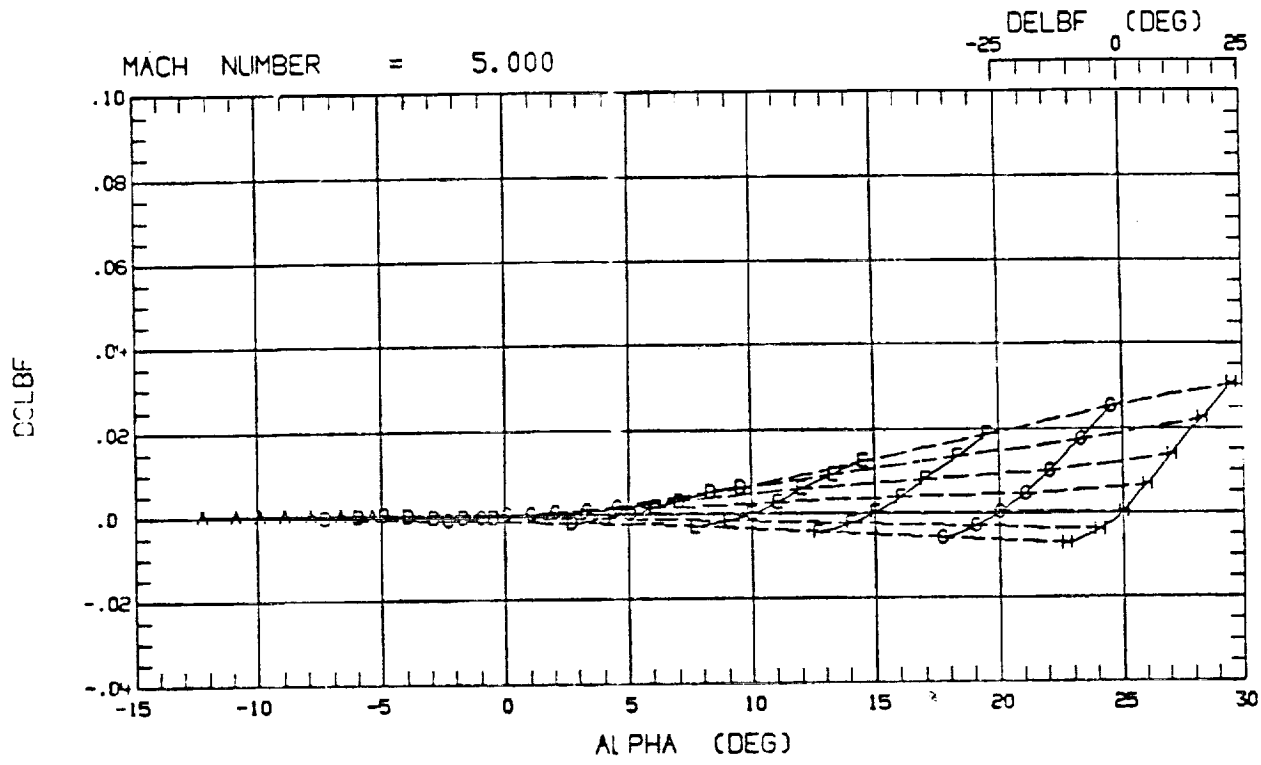
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076 7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LS = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT						
-11.700	-0.00440	-0.00600	-0.00755	-0.00910	-0.01120	-0.01330	-0.01517
-5.000	-0.00250	-0.00329	-0.00414	-0.00499	-0.00573	-0.00636	-0.00685
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00402	0.00466	0.00674	0.00800	0.00818	0.00805	0.00774
10.000	0.00863	0.01034	0.01390	0.01724	0.01782	0.01739	0.01632
16.300	0.01460	0.01820	0.02295	0.02770	0.02850	0.02780	0.02620
22.500	0.02065	0.02660	0.03194	0.03640	0.03637	0.03480	0.03242

ENGINEER WMS
DATE 9-12-78

FIGURE 4.1.2.1-53
EFFECT OF BODY FLAP

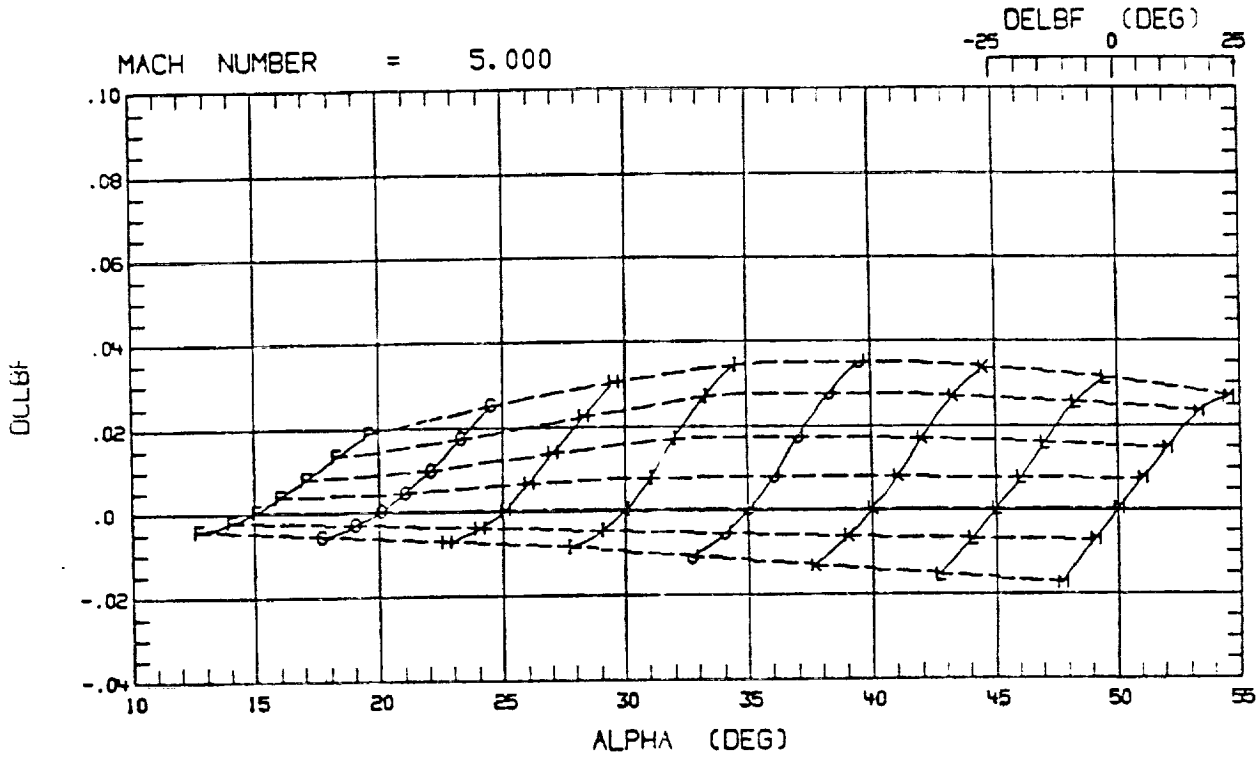


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	0.0	-0.00069	-0.00140	-0.00213	-0.00290	-0.00445	-0.00600	-0.00745
-5.000	0.0	-0.00018	-0.00051	-0.00106	-0.00162	-0.00242	-0.00321	-0.00404
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00012	0.00028	0.00143	0.00266	0.00376	0.00450	0.00669
10.000	0.0	-0.00042	0.00039	0.00309	0.00572	0.00791	0.00988	0.01355
16.300	0.0	-0.00062	0.00070	0.00495	0.00920	0.01320	0.01720	0.02205
22.500	0.0	-0.00046	0.00140	0.00632	0.01210	0.01850	0.02490	0.03027

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.1-54
EFFECT OF BODY FLAP



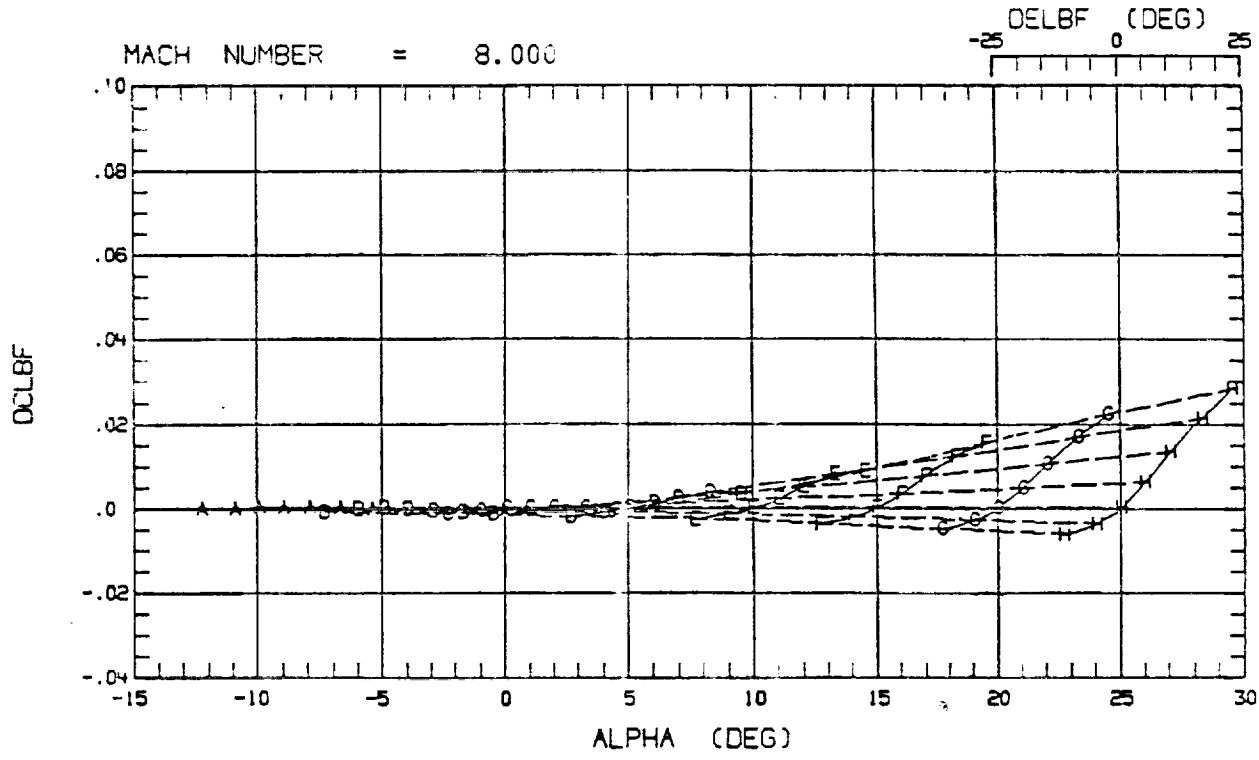
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00445	-0.00600	-0.00745	-0.00890	-0.01105	-0.01320	-0.01535	-0.01750
-5.000	-0.00242	-0.00321	-0.00404	-0.00487	-0.00562	-0.00627	-0.00685	-0.00735
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00376	0.00450	0.00669	0.00767	0.00792	0.00781	0.00754	0.00726
10.000	0.00791	0.00988	0.01355	0.01683	0.01728	0.01682	0.01578	0.01448
16.300	0.01320	0.01720	0.02205	0.02690	0.02762	0.02690	0.02536	0.02280
22.500	0.01850	0.02490	0.03027	0.03440	0.03503	0.03370	0.03095	0.02660

ENGINEER ____
DATE 9-12-78

FIGURE 4.1.2.1-55
EFFECT OF BODY FLAP

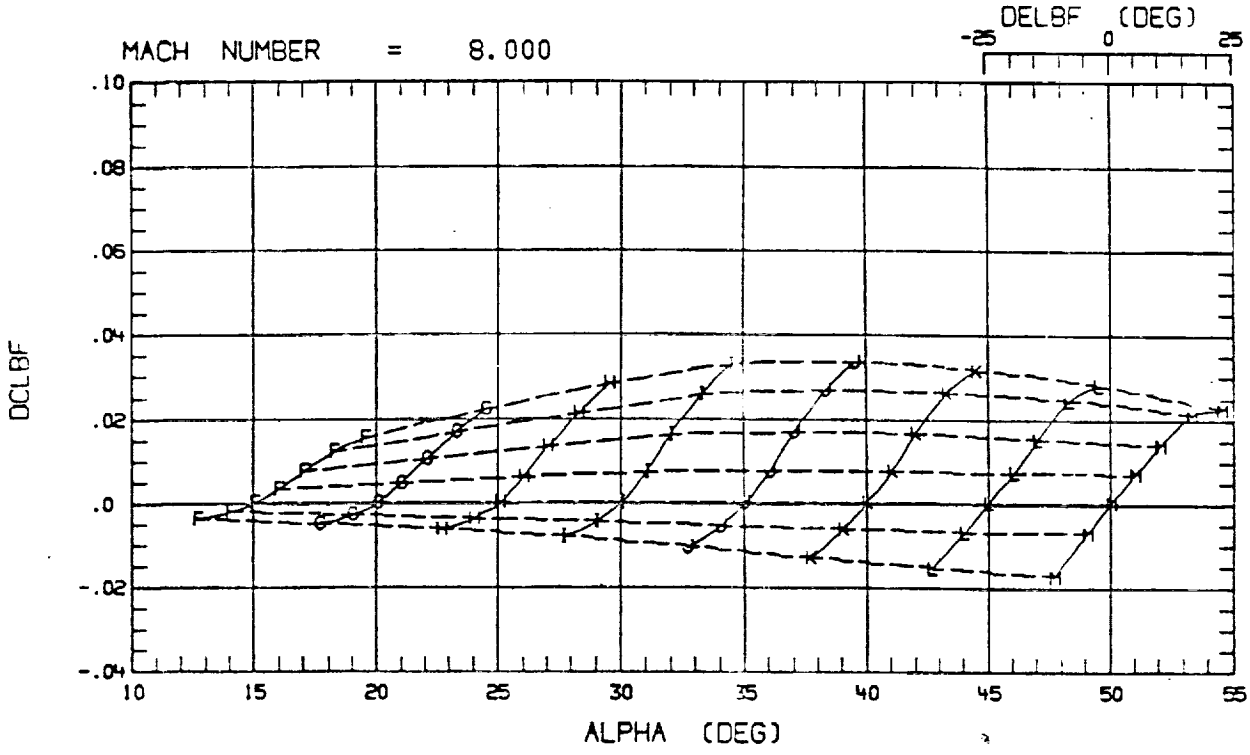


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00030	-0.00084	-0.00140	-0.00198	-0.00260	-0.00370	-0.00500	-0.00638
-5.000	-0.00010	-0.00020	-0.00046	-0.00091	-0.00142	-0.00210	-0.00285	-0.00363
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00006	-0.00028	0.00015	0.00106	0.00216	0.00345	0.00484	0.00615
10.000	0.00007	-0.00061	0.00012	0.00230	0.00496	0.00769	0.01038	0.01313
16.300	0.0	-0.00098	0.0	0.00366	0.00780	0.01225	0.01670	0.02115
22.500	-0.00020	-0.00130	-0.00020	0.00343	0.00960	0.01535	0.02210	0.02809

ENGINEER wm2
DATE 4-12-78

FIGURE 4.1.2.1-56
EFFECT OF BODY FLAP



CONFIGURATION

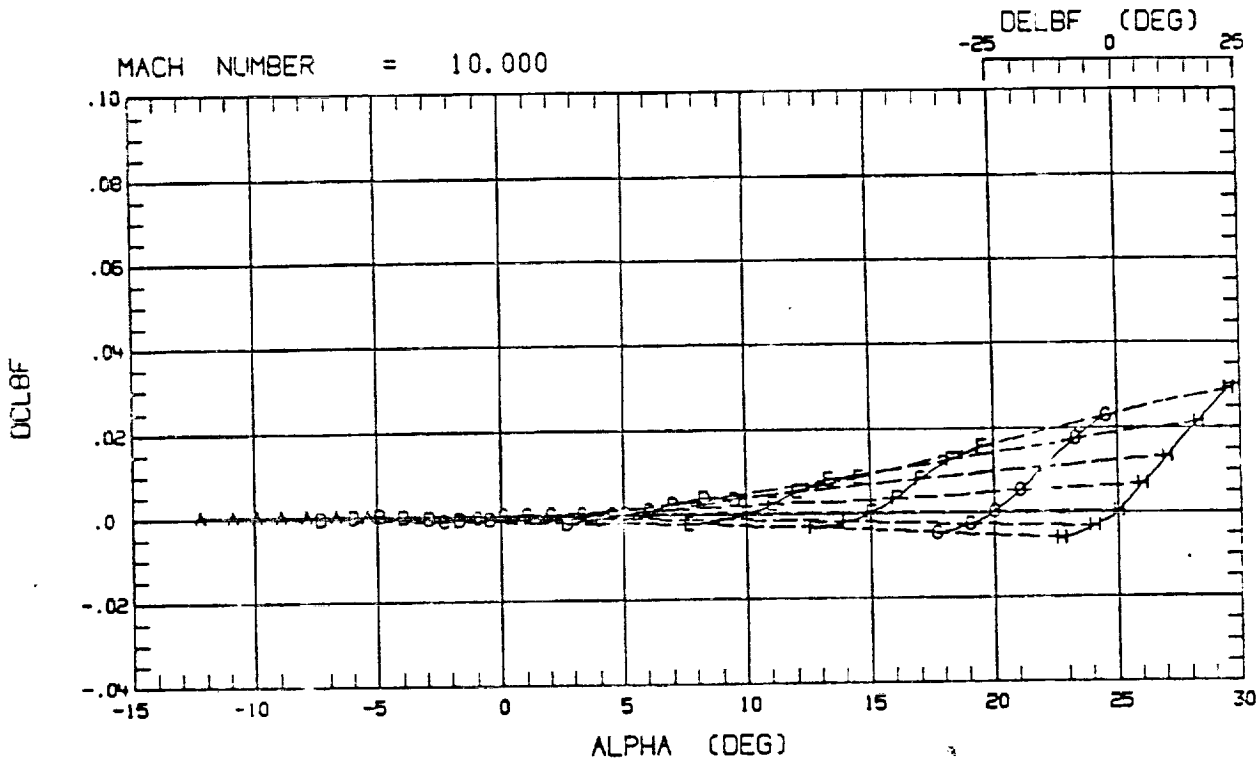
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00370	-0.00500	-0.00638	-0.00800	-0.01055	-0.01310	-0.01539	-0.01750
-5.000	-0.00210	-0.00285	-0.00363	-0.00448	-0.00539	-0.00617	-0.00678	-0.00722
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00345	0.00484	0.00615	0.00731	0.00763	0.00757	0.00725	0.00699
10.000	0.00769	0.01038	0.01313	0.01600	0.01674	0.01636	0.01503	0.01382
16.300	0.01225	0.01670	0.02115	0.02560	0.02670	0.02610	0.02421	0.02090
22.500	0.01535	0.02210	0.02809	0.03300	0.03346	0.03150	0.02779	0.02210

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.1-57
EFFECT OF BODY FLAP



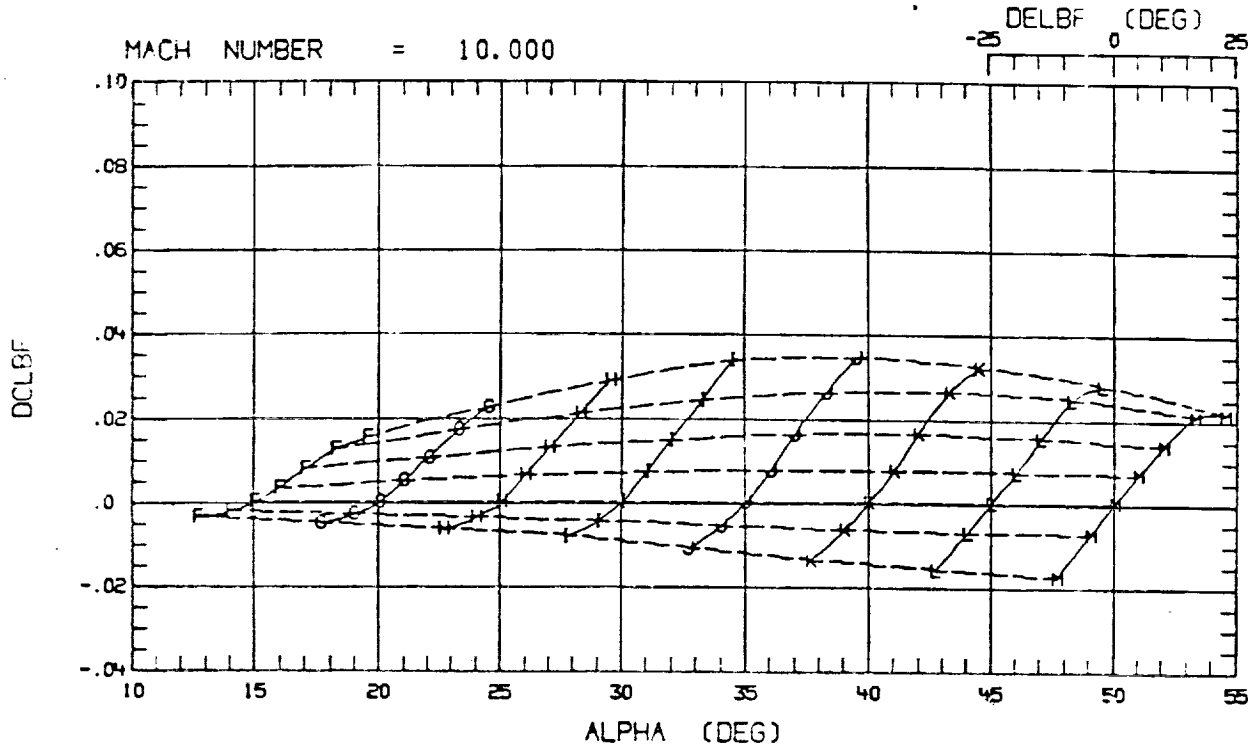
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00185	-0.00240	-0.00342	-0.00470	-0.00613
-5.000	0.0	-0.00015	-0.00042	-0.00086	-0.00135	-0.00203	-0.00278	-0.00354
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00023	0.0	0.00104	0.00215	0.00349	0.00496	0.00638
10.000	0.0	-0.00064	0.0	0.00227	0.00498	0.00783	0.01062	0.01298
16.300	0.0	-0.00098	0.0	0.00359	0.00780	0.01245	0.01710	0.02111
22.500	0.0	-0.00104	0.0	0.00327	0.00830	0.01550	0.02270	0.02894

ENGINEER WMZ
DATE 9-26-78

FIGURE 4.1.2.1-58
EFFECT OF BODY FLAP



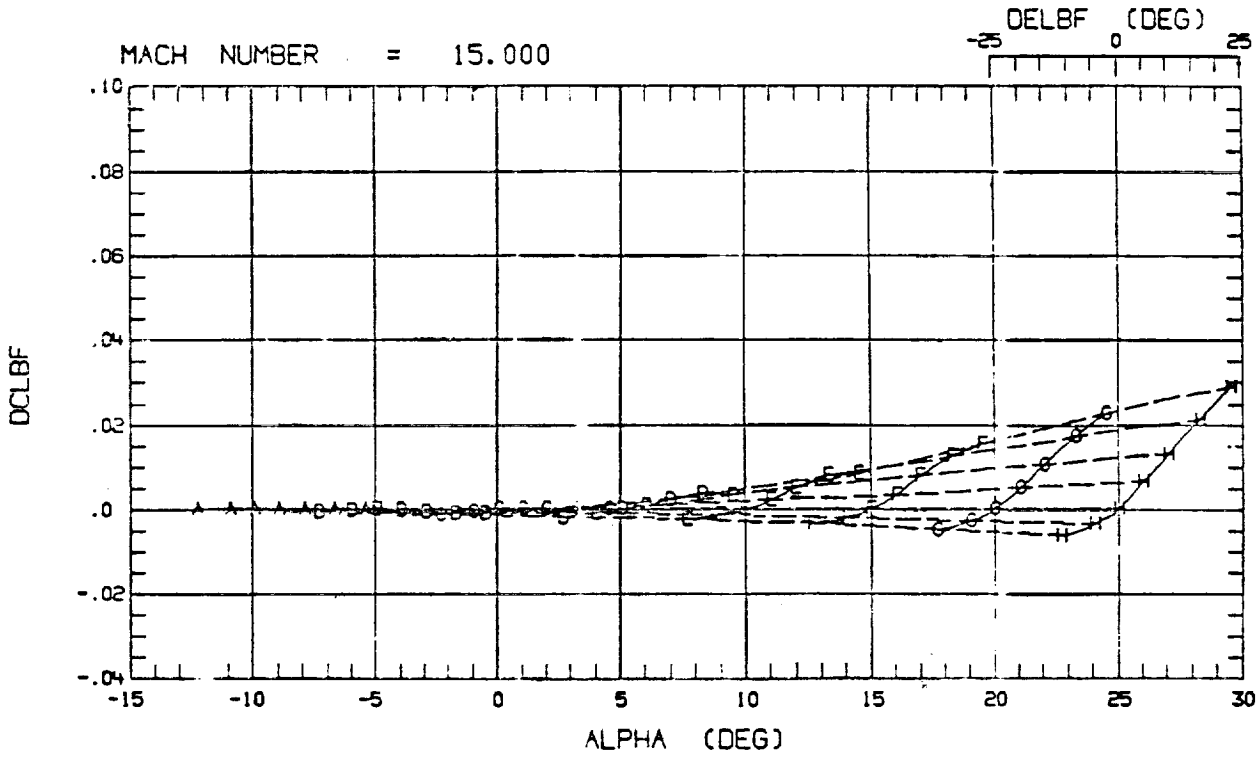
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00342	-0.00470	-0.00613	-0.00790	-0.01075	-0.01360	-0.01577	-0.01750
-5.000	-0.00203	-0.00278	-0.00354	-0.00436	-0.00542	-0.00637	-0.00693	-0.00721
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00349	0.00496	0.00638	0.00723	0.00763	0.00771	0.00737	0.00697
10.000	0.00783	0.01062	0.01298	0.01481	0.01631	0.01659	0.01526	0.01376
16.300	0.01245	0.01710	0.02111	0.02440	0.02623	0.02650	0.02459	0.02070
22.500	0.01550	0.02270	0.02994	0.03390	0.03446	0.03230	0.02794	0.02120

ENGINEER WMZ
DATE 4-20-78

FIGURE 4.1.2.1-59
EFFECT OF BODY FLAP



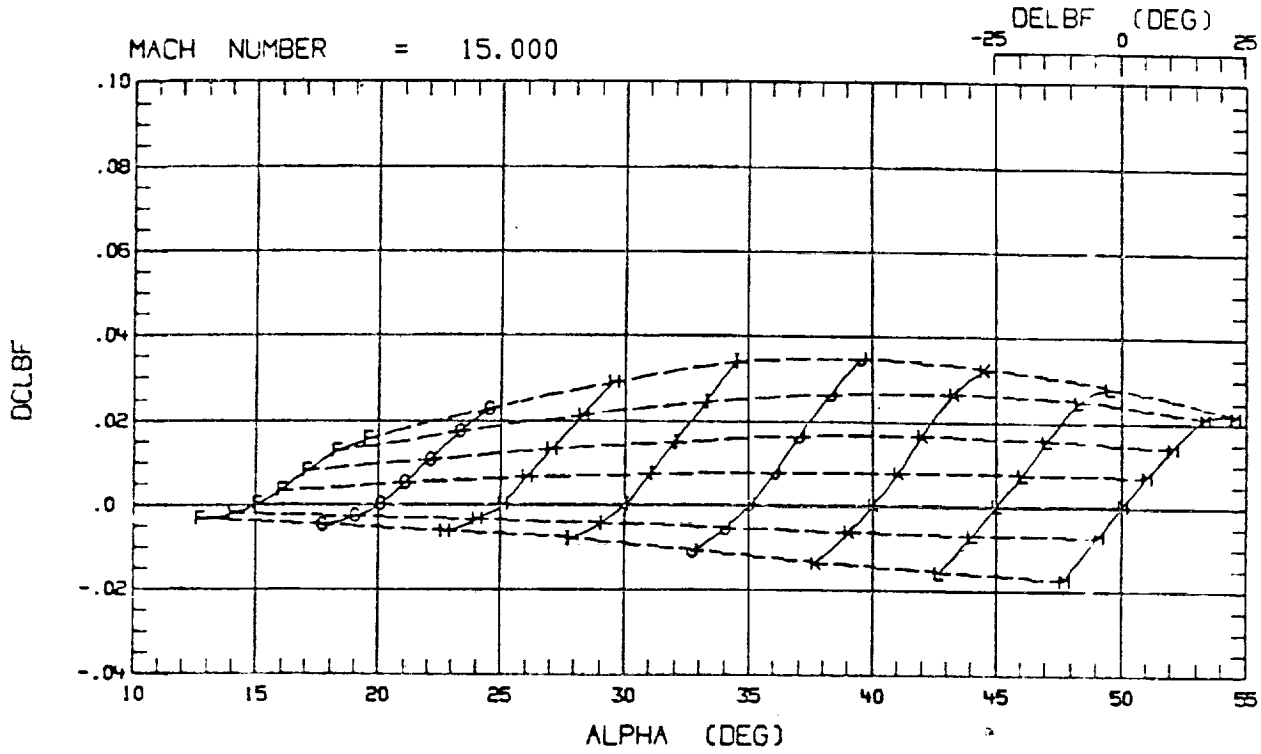
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00185	-0.00240	-0.00342	-0.00470	-0.00613
-5.000	0.0	-0.00015	-0.00042	-0.00086	-0.00135	-0.00203	-0.00278	-0.00354
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00023	0.0	0.00104	0.00215	0.00349	0.00496	0.00638
10.000	0.0	-0.00064	0.0	0.00227	0.00498	0.00783	0.01062	0.01298
16.300	0.0	-0.00098	0.0	0.00359	0.00780	0.01245	0.01710	0.02111
22.500	0.0	-0.00134	0.0	0.00327	0.00830	0.01550	0.02270	0.02894

ENGINEER wmz
DATE 9-20-78

FIGURE 4.1.2.1-60
EFFECT OF BODY FLAP

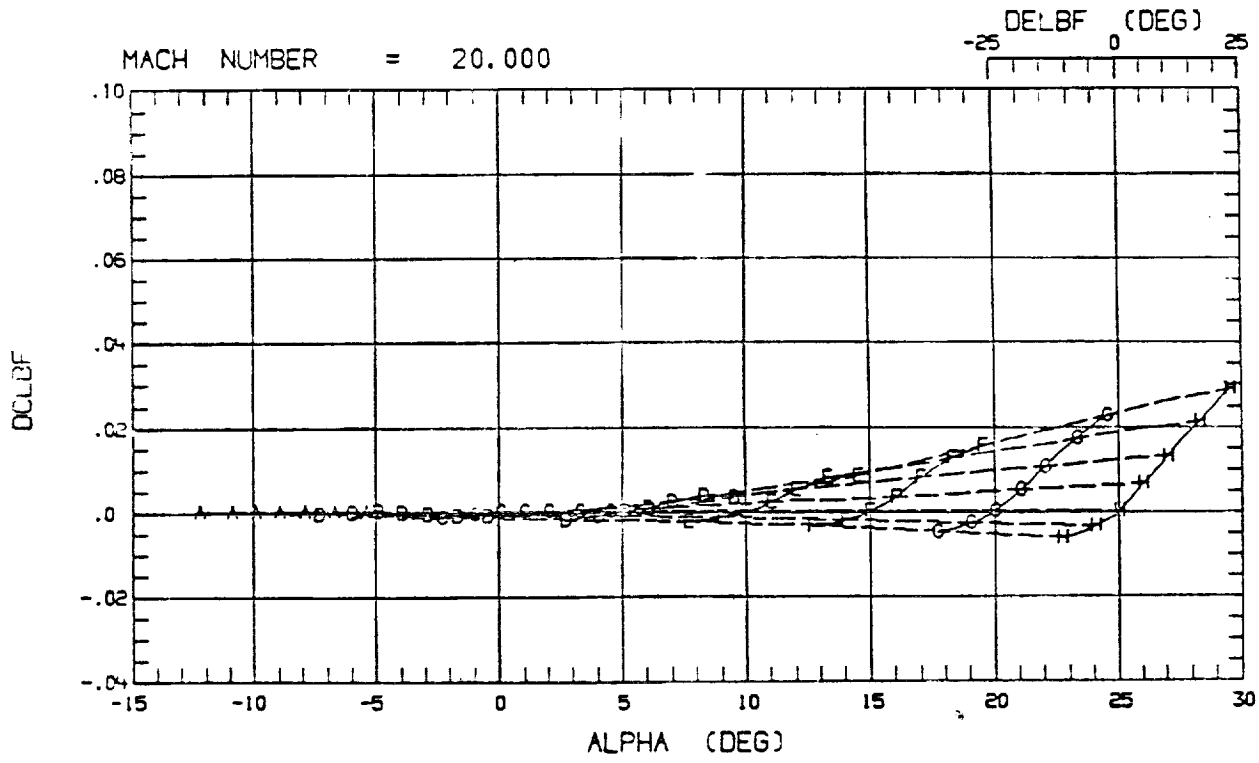


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00342	-0.00470	-0.00613	-0.00790	-0.01075	-0.01360	-0.01577	-0.01750
-5.000	-0.00203	-0.00278	-0.00354	-0.00436	-0.00542	-0.00637	-0.00693	-0.00721
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00349	0.00496	0.00638	0.00723	0.00763	0.00771	0.00737	0.00697
10.000	0.00783	0.01062	0.01298	0.01481	0.01631	0.01659	0.01526	0.01376
16.300	0.01245	0.01710	0.02111	0.02440	0.02623	0.02650	0.02459	0.02070
22.500	0.01550	0.02270	0.02894	0.03390	0.03446	0.03230	0.02794	0.02120

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.2.1-61
EFFECT OF BODY FLAP



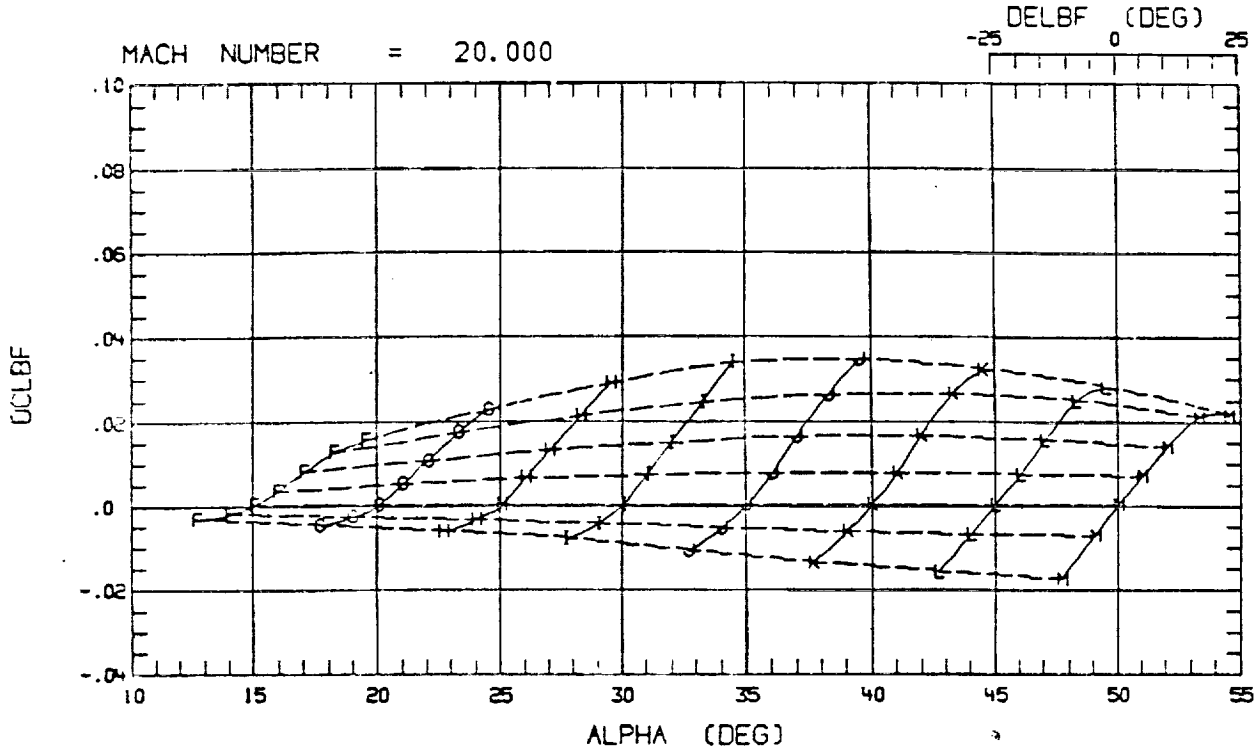
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00185	-0.00240	-0.00342	-0.00470	-0.00613
-5.000	0.0	-0.00015	-0.00042	-0.00086	-0.00135	-0.00203	-0.00278	-0.00354
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00023	0.0	0.00104	0.00215	0.00349	0.00496	0.00638
10.000	0.0	-0.00064	0.0	0.00227	0.00498	0.00783	0.01062	0.01298
16.300	0.0	-0.00098	0.0	0.00359	0.00780	0.01245	0.01710	0.02111
22.500	0.0	-0.00104	0.0	0.00327	0.00830	0.01550	0.02270	0.02894

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.1-62
EFFECT OF BODY FLAP



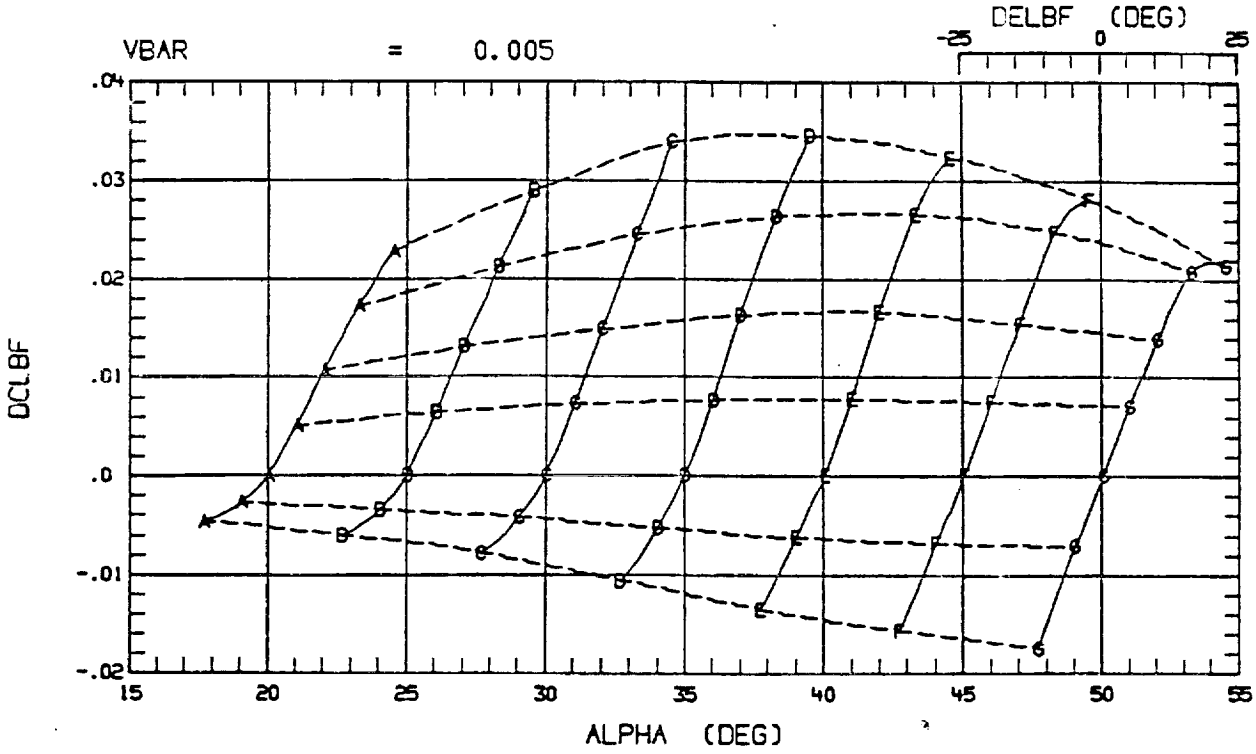
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP LIFT FORCE INCREMENT							
-11.700	-0.00342	-0.00470	-0.00613	-0.00790	-0.01075	-0.01360	-0.01577	-0.01750
-5.000	-0.00203	-0.00278	-0.00354	-0.00436	-0.00542	-0.00637	-0.00693	-0.00721
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00349	0.00496	0.00638	0.00723	0.00763	0.00771	0.00737	0.00697
10.000	0.00783	0.01062	0.01298	0.01481	0.01631	0.01659	0.01526	0.01376
16.300	0.01245	0.01710	0.02111	0.02440	0.02623	0.02650	0.02459	0.02070
22.500	0.01550	0.02270	0.02894	0.03390	0.03446	0.03230	0.02794	0.02120

ENGINEER WMZ
DATE 8-26-78

FIGURE 4.1.2.1-63
EFFECT OF BODY FLAP

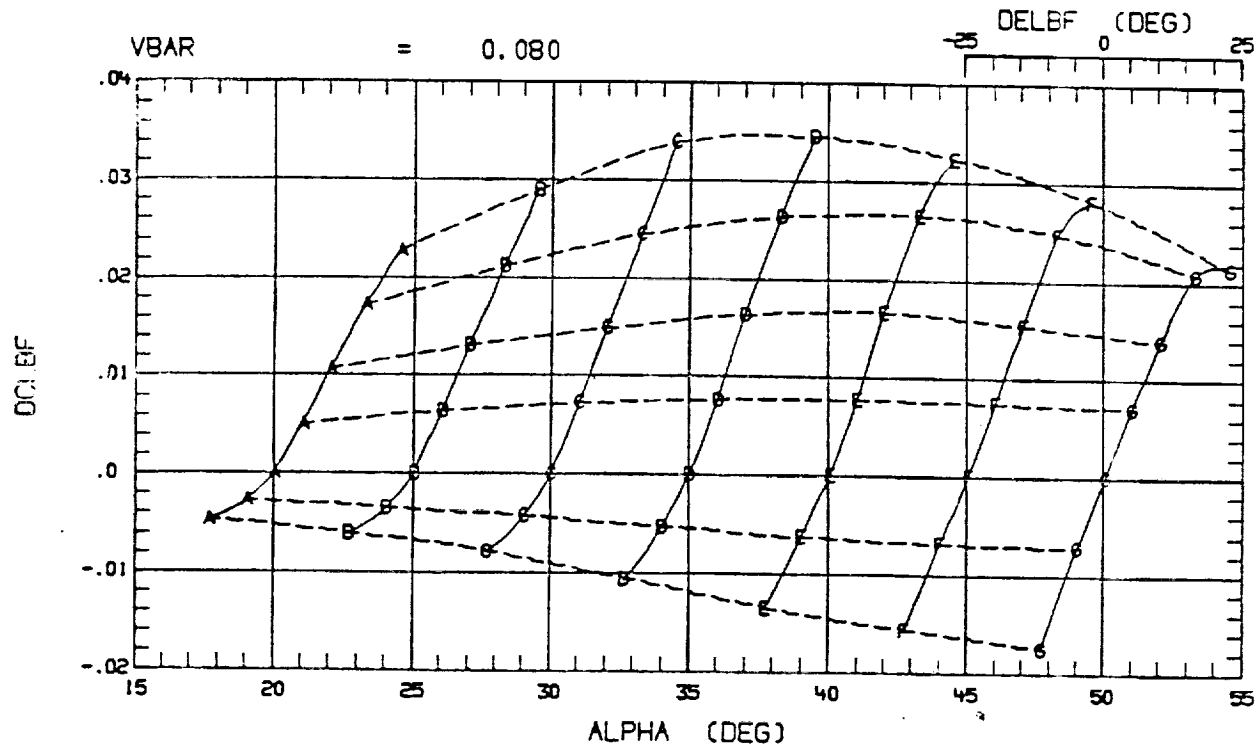


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODYFLAP LIFT INCREMENT						
-11.700	-0.00470	-0.00613	-0.00790	-0.01075	-0.01360	-0.01577	-0.01750
-5.000	-0.00278	-0.00354	-0.00436	-0.00542	-0.00637	-0.00693	-0.00721
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00496	0.00638	0.00723	0.00763	0.00771	0.00737	0.00697
10.000	0.01062	0.01298	0.01481	0.01631	0.01659	0.01526	0.01376
16.300	0.01710	0.02111	0.02440	0.02623	0.02650	0.02459	0.02070
22.500	0.02270	0.02894	0.03390	0.03446	0.03230	0.02794	0.02120

ENGINEER_____
DATE_____

FIGURE 4.1.2.1-64
EFFECT OF BODYFLAP



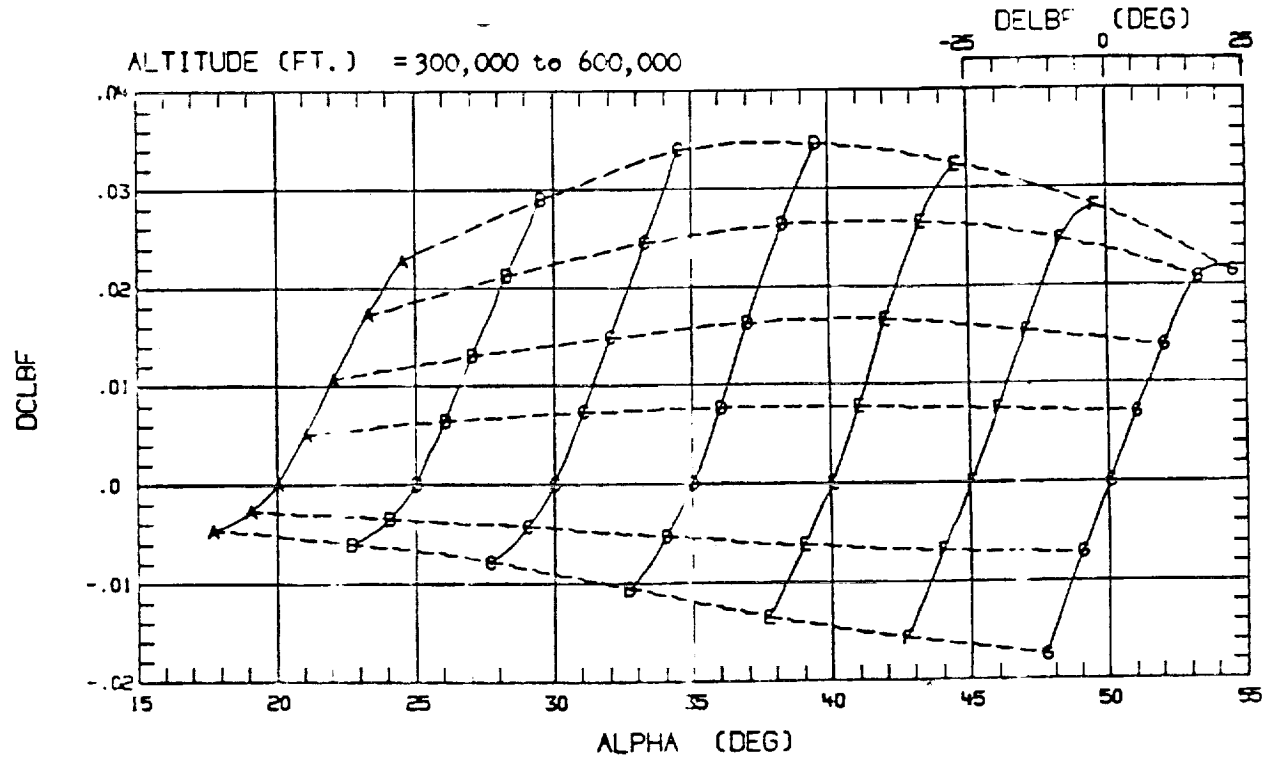
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODYFLAP LIFT INCREMENT						
-11.700	-0.00470	-0.00613	-0.00790	-0.01075	-0.01360	-0.01577	-0.01750
-5.000	-0.00278	-0.00354	-0.00436	-0.00542	-0.00637	-0.00693	-0.00721
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00496	0.00638	0.00723	0.00763	0.00771	0.00737	0.00697
10.000	0.01062	0.01298	0.01481	0.01631	0.01659	0.01526	0.01376
16.300	0.01710	0.02111	0.02440	0.02623	0.02650	0.02459	0.02070
22.500	0.02270	0.02894	0.03390	0.03446	0.03230	0.02794	0.02120

ENGINEER_____
DATE_____

FIGURE 4.1.2.1-65
EFFECT OF BODYFLAP

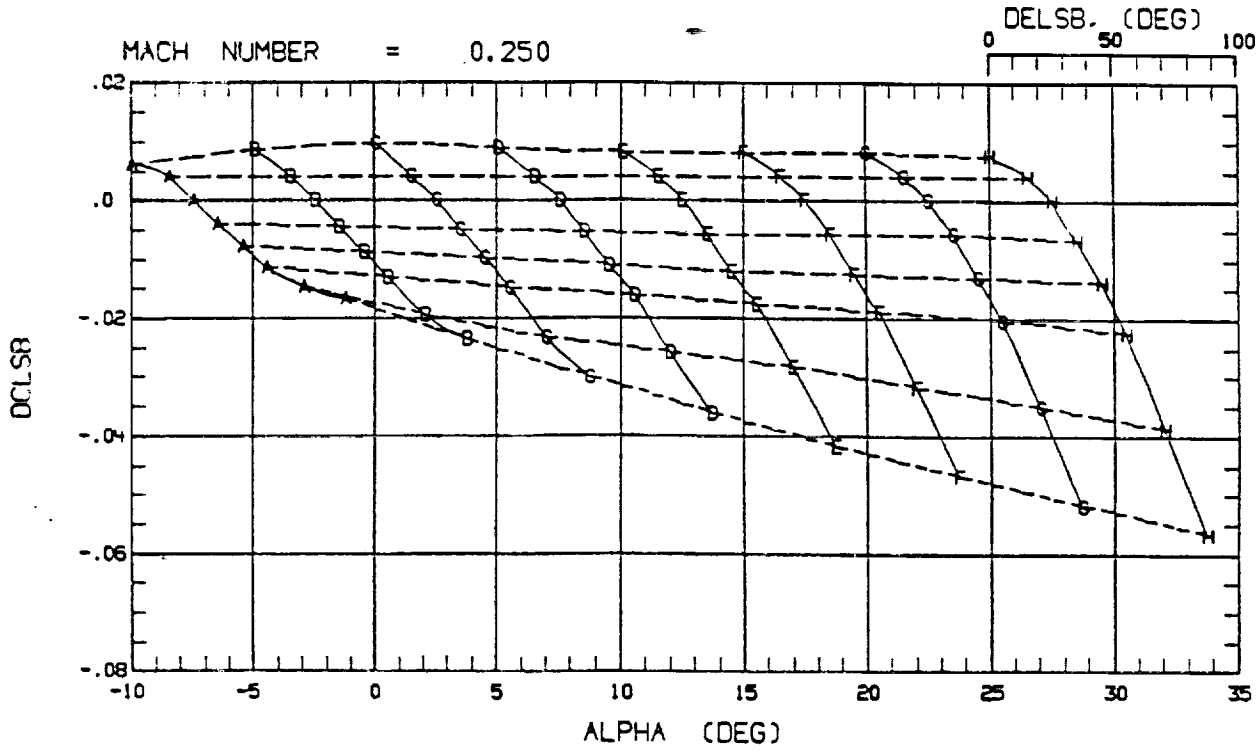


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODYFLAP LIFT INCREMENT						
-11.700	-0.00470	-0.00613	-0.00790	-0.01075	-0.01360	-0.01577	-0.01750
-5.000	-0.00278	-0.00354	-0.00436	-0.00542	-0.00637	-0.00693	-0.00721
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00496	0.00638	0.00723	0.00763	0.00771	0.00737	0.00697
10.000	0.01062	0.01298	0.01481	0.01631	0.01659	0.01526	0.01376
16.300	0.01710	0.02111	0.02440	0.02623	0.02650	0.02459	0.02070
22.500	0.02270	0.02894	0.03390	0.03446	0.03230	0.02794	0.02120

ENGINEER_____
DATE_____

FIGURE 4.1.2.1- 66
EFFECT OF BODYFLAP

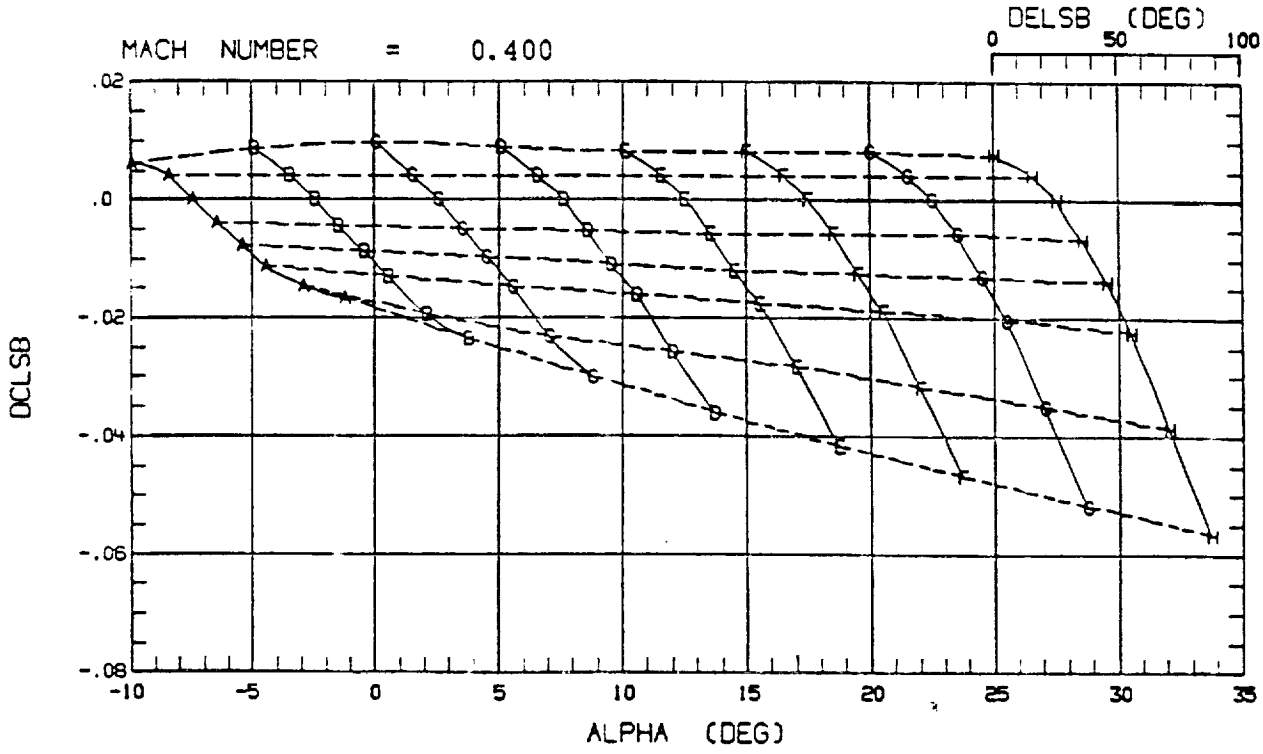


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.00600	0.00852	0.00970	0.00885	0.00800	0.00800	0.00800	0.00750
15.000	0.00400	0.00400	0.00400	0.00400	0.00400	0.00400	0.00400	0.00400
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00400	-0.00450	-0.00500	-0.00550	-0.00600	-0.00600	-0.00600	-0.00700
45.000	-0.00780	-0.00890	-0.01000	-0.01110	-0.01220	-0.01275	-0.01330	-0.01400
55.000	-0.01150	-0.01327	-0.01490	-0.01630	-0.01770	-0.01910	-0.02050	-0.02270
70.000	-0.01470	-0.01957	-0.02350	-0.02600	-0.02950	-0.03192	-0.03540	-0.03890
87.200	-0.01690	-0.02374	-0.03020	-0.03630	-0.04200	-0.04710	-0.05200	-0.05680

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-67
EFFECT OF SPEEDBRAKE



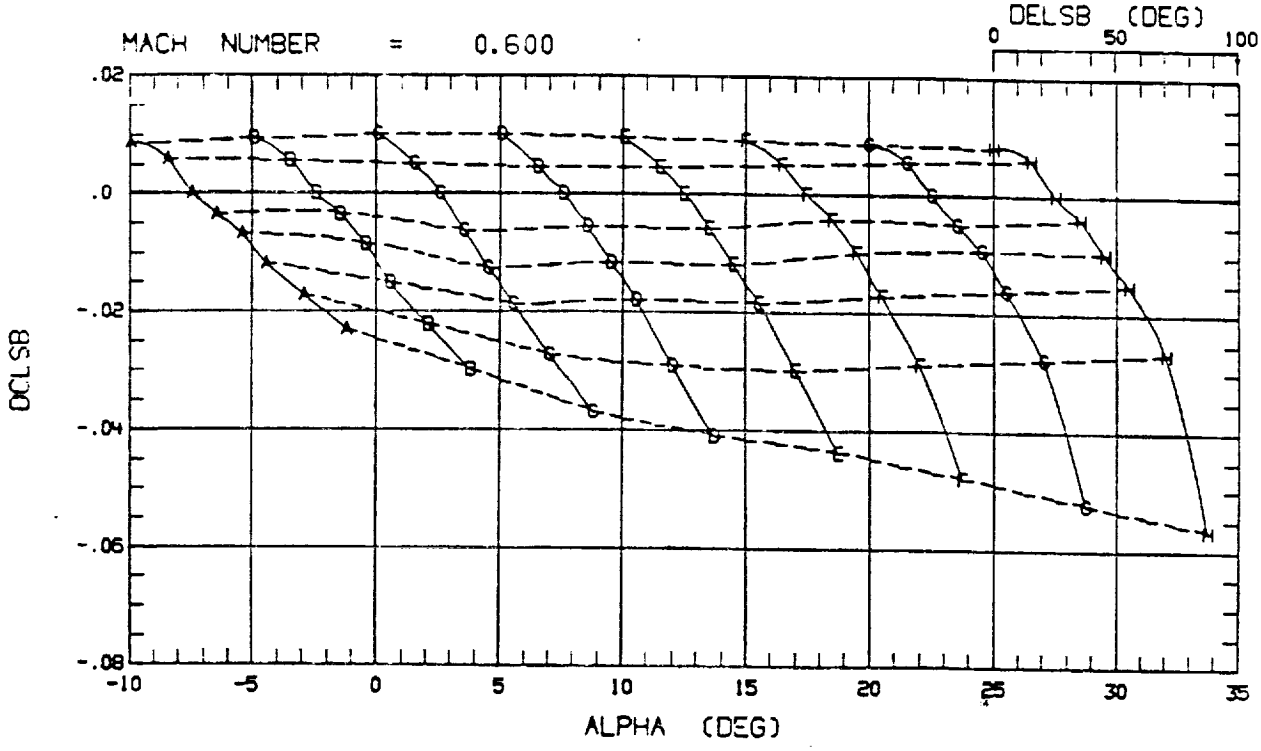
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.00600	0.00852	0.00970	0.00885	0.00800	0.00800	0.00800	0.00750
15.000	0.00400	0.00400	0.00400	0.00400	0.00400	0.00400	0.00400	0.00400
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00400	-0.00450	-0.00500	-0.00550	-0.00600	-0.00600	-0.00600	-0.00700
45.000	-0.00780	-0.00890	-0.01000	-0.01110	-0.01220	-0.01275	-0.01330	-0.01400
55.000	-0.01150	-0.01327	-0.01490	-0.01630	-0.01770	-0.01910	-0.02050	-0.02270
70.000	-0.01470	-0.01957	-0.02350	-0.02600	-0.02850	-0.03192	-0.03540	-0.03890
87.200	-0.01690	-0.02374	-0.03020	-0.03630	-0.04200	-0.04710	-0.05200	-0.05680

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-68
EFFECT OF SPEEDBRAKE



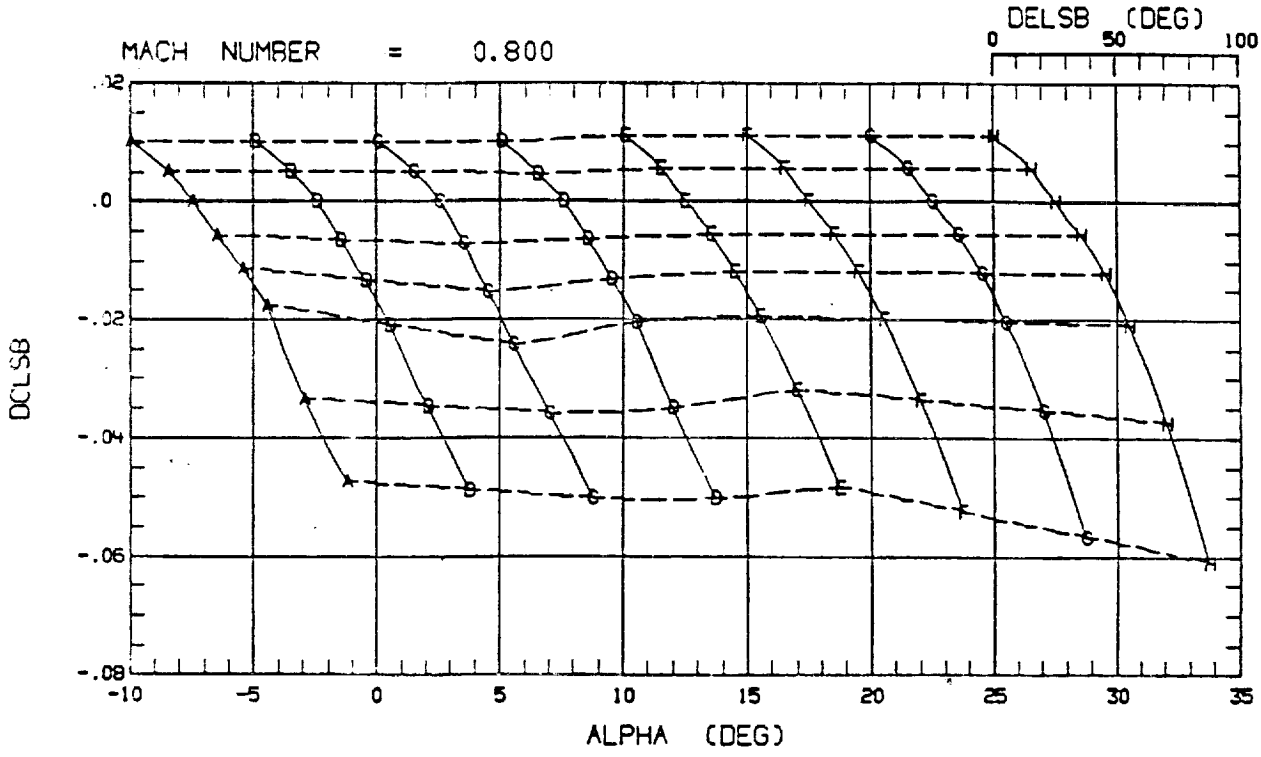
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.00850	0.00925	0.01000	0.01000	0.00950	0.00900	0.00850	0.00800
15.000	0.00588	0.00544	0.00500	0.00450	0.00450	0.00500	0.00550	0.00600
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00350	-0.00349	-0.00639	-0.00567	-0.00592	-0.00425	-0.00500	-0.00400
45.000	-0.00700	-0.00863	-0.01269	-0.01167	-0.01209	-0.00997	-0.00950	-0.01000
55.000	-0.01196	-0.01539	-0.01882	-0.01800	-0.01850	-0.01742	-0.01634	-0.01526
70.000	-0.01724	-0.02235	-0.02746	-0.02935	-0.03000	-0.02900	-0.02800	-0.02700
87.200	-0.02307	-0.03009	-0.03711	-0.04107	-0.04400	-0.04833	-0.05266	-0.05699

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-69
EFFECT OF SPEEDBRAKE



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.01000	0.01000	0.01000	0.01000	0.01100	0.01100	0.01100	0.01100
15.000	0.00500	0.00500	0.00500	0.00450	0.00550	0.00550	0.00550	0.00550
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00581	-0.00654	-0.00727	-0.00639	-0.00559	-0.00558	-0.00558	-0.00558
45.000	-0.01159	-0.01361	-0.01563	-0.01325	-0.01194	-0.01203	-0.01212	-0.01221
55.000	-0.01778	-0.02114	-0.02450	-0.02058	-0.01950	-0.02000	-0.02050	-0.02100
70.000	-0.03349	-0.03474	-0.03599	-0.03507	-0.03200	-0.03383	-0.03566	-0.03749
87.200	-0.04758	-0.04898	-0.05038	-0.05028	-0.04850	-0.05271	-0.05692	-0.06113

ENGINEER DGD
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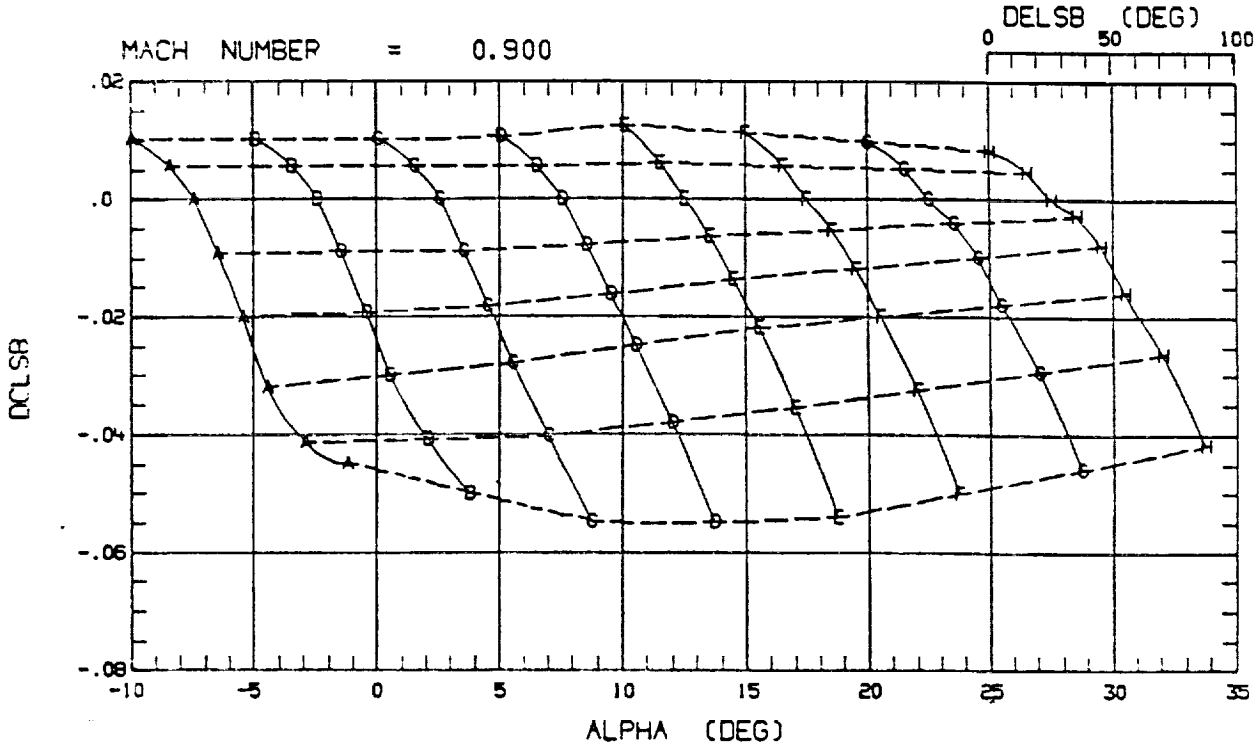
FIGURE 4.1.2.1-70
EFFECT OF SPEEDBRAKE



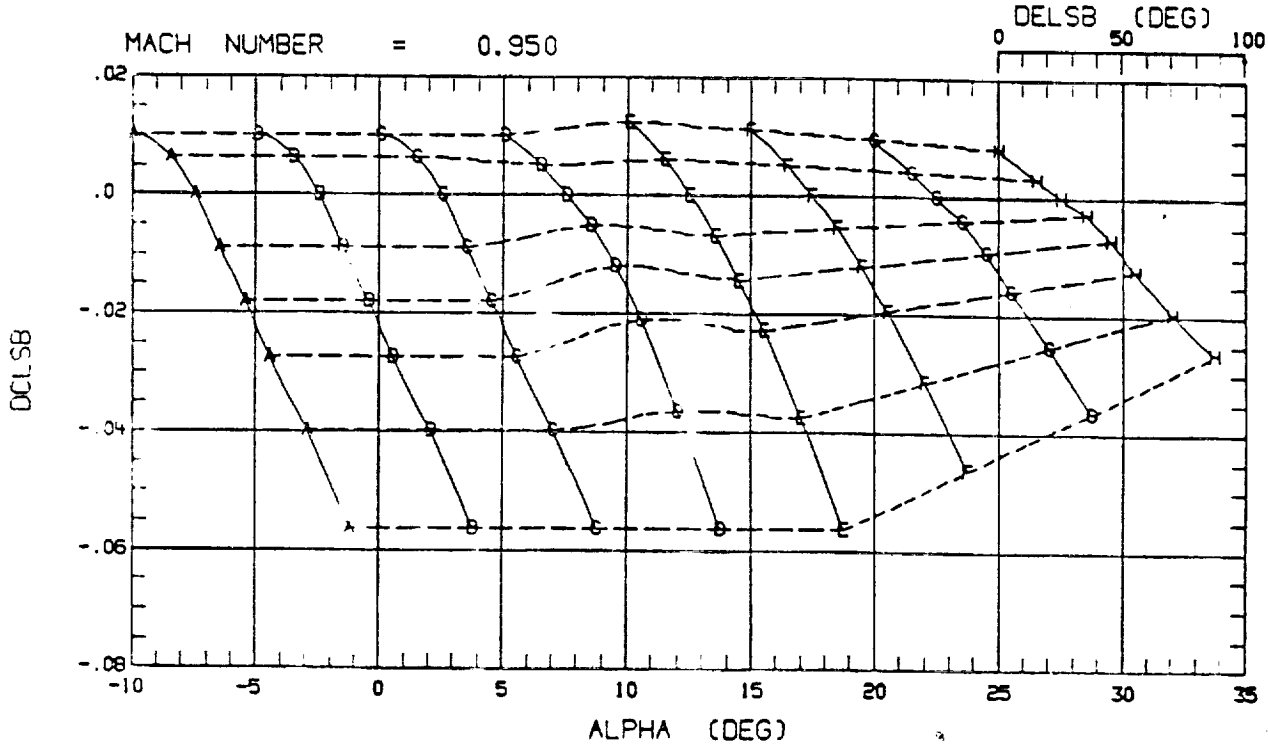
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.01000	0.01000	0.01000	0.01050	0.01250	0.01100	0.00950	0.00800
15.000	0.00550	0.00550	0.00550	0.00550	0.00600	0.00550	0.00500	0.00450
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00924	-0.00904	-0.00865	-0.00785	-0.00648	-0.00530	-0.00412	-0.00294
45.000	-0.02019	-0.01924	-0.01829	-0.01633	-0.01380	-0.01187	-0.00993	-0.00800
55.000	-0.03200	-0.03000	-0.02800	-0.02500	-0.02200	-0.02000	-0.01800	-0.01600
70.000	-0.04150	-0.04100	-0.04050	-0.03800	-0.03550	-0.03250	-0.02950	-0.02650
87.200	-0.04500	-0.05000	-0.05500	-0.05500	-0.05400	-0.05000	-0.04600	-0.04200

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-71
EFFECT OF SPEEDBRAKE



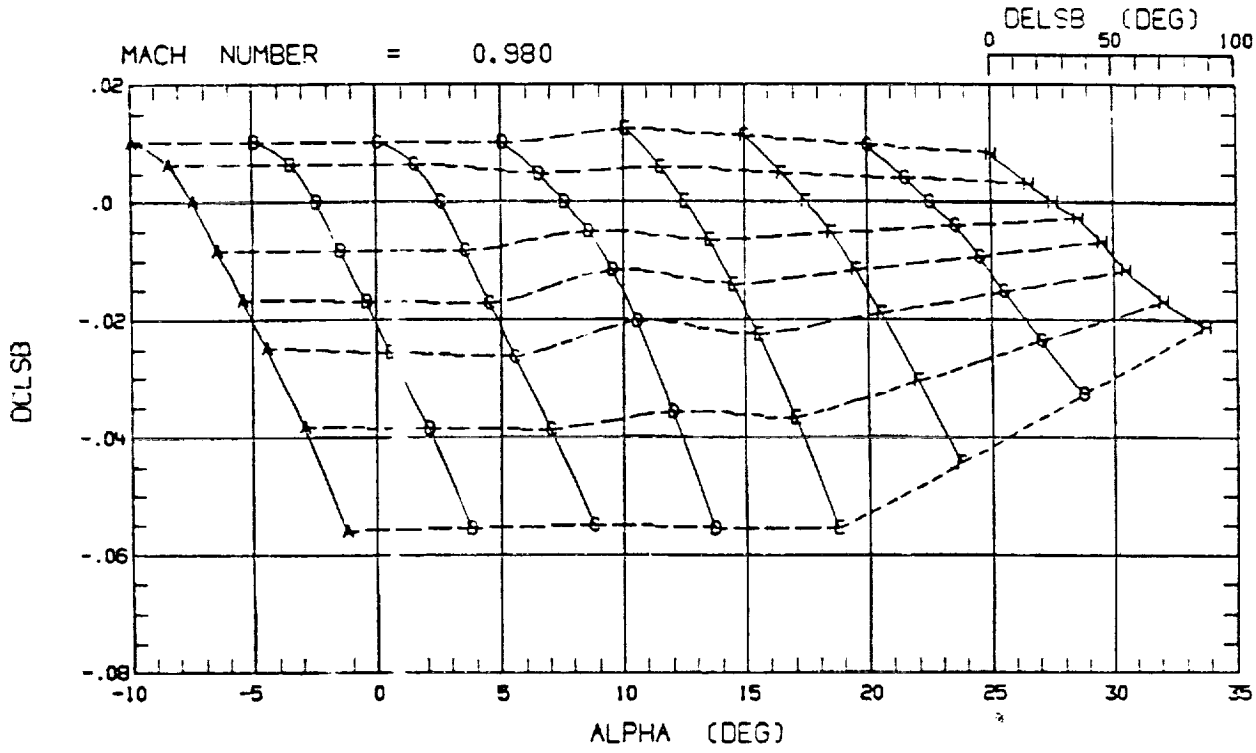
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.01000	0.01000	0.01000	0.01000	0.01250	0.01100	0.00950	0.00800
15.000	0.00630	0.00630	0.00630	0.00500	0.00600	0.00500	0.00400	0.00300
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00892	-0.00892	-0.00892	-0.00517	-0.00679	-0.00546	-0.00414	-0.00282
45.000	-0.01814	-0.01814	-0.01814	-0.01192	-0.01444	-0.01198	-0.00952	-0.00706
55.000	-0.02750	-0.02750	-0.02750	-0.02100	-0.02300	-0.01950	-0.01600	-0.01250
70.000	-0.04000	-0.04000	-0.04000	-0.03650	-0.03750	-0.03150	-0.02550	-0.01950
87.200	-0.05650	-0.05650	-0.05650	-0.05650	-0.05650	-0.04650	-0.03650	-0.02650

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-72
EFFECT OF SPEEDBRAKE



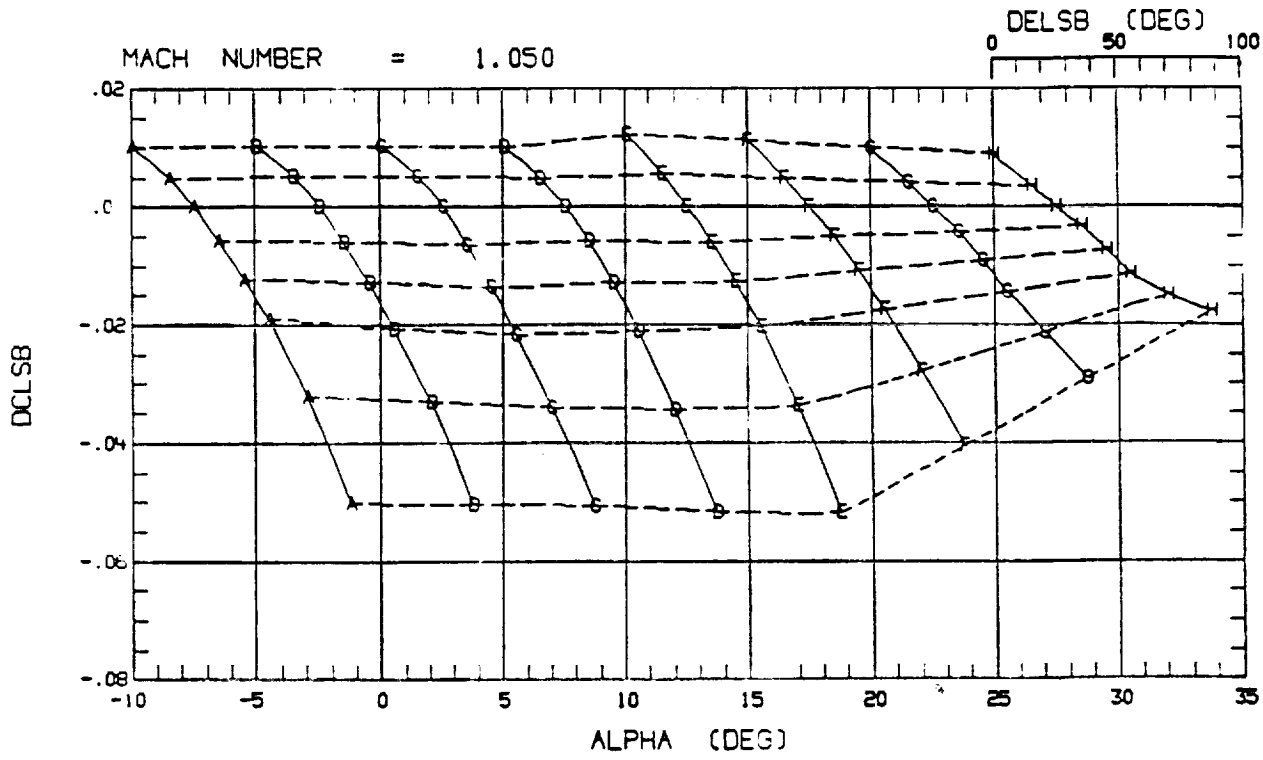
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	Z = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.01000	0.01000	0.01000	0.01000	0.01243	0.01100	0.00957	0.00813
15.000	0.00623	0.00623	0.00623	0.00486	0.00591	0.00482	0.00390	0.00311
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00835	-0.00844	-0.00852	-0.00503	-0.00671	-0.00542	-0.00417	-0.00290
45.000	-0.01668	-0.01704	-0.01736	-0.01160	-0.01425	-0.01179	-0.00936	-0.00690
55.000	-0.02494	-0.02578	-0.02637	-0.02046	-0.02267	-0.01901	-0.01540	-0.01174
70.000	-0.03838	-0.03862	-0.03882	-0.03577	-0.03681	-0.03063	-0.02374	-0.01707
87.200	-0.05613	-0.05559	-0.05503	-0.05551	-0.05555	-0.04459	-0.03289	-0.02134

ENGINEER
DATE 9-13-88

FIGURE 4.1.2.1-73
EFFECT OF SPEEDBRAKE



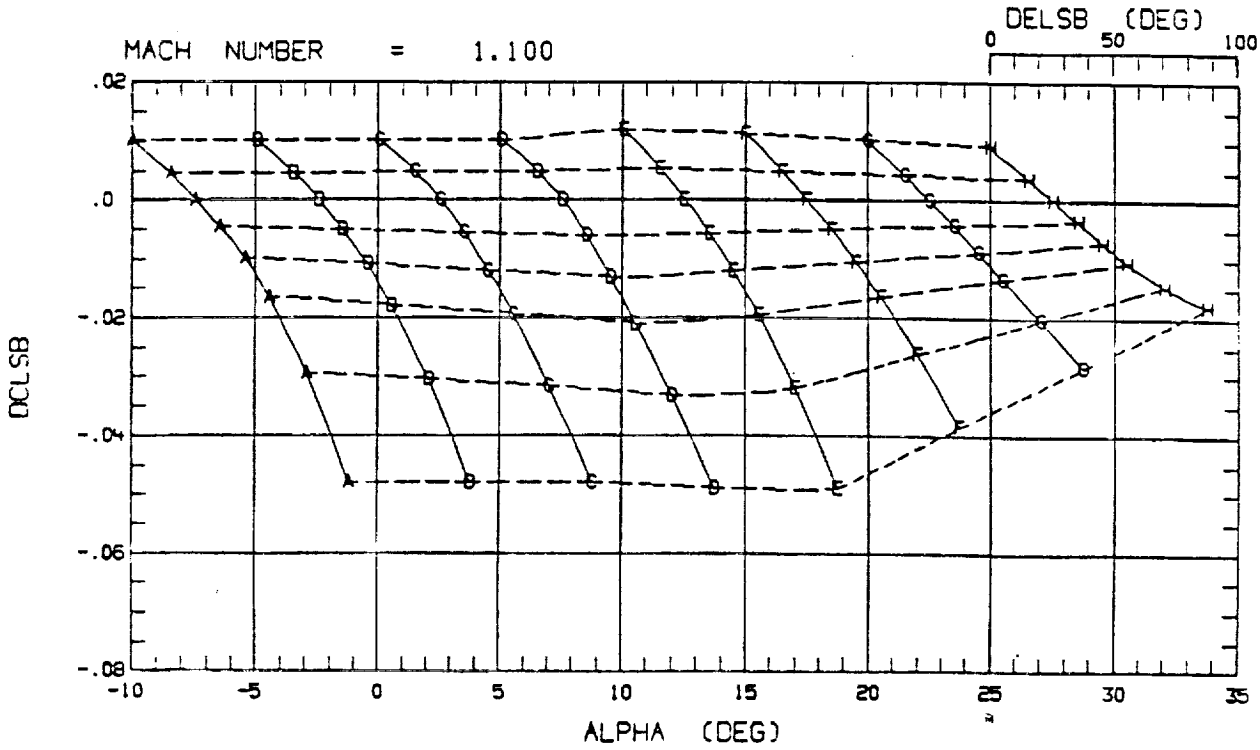
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.01000	0.01000	0.01000	0.01000	0.01214	0.01100	0.00986	0.00871
15.000	0.00481	0.00494	0.00507	0.00480	0.00546	0.00468	0.00403	0.00339
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00582	-0.00616	-0.00653	-0.00597	-0.00609	-0.00521	-0.00432	-0.00344
45.000	-0.01243	-0.01307	-0.01385	-0.01311	-0.01284	-0.01103	-0.00920	-0.00739
55.000	-0.01921	-0.02093	-0.02179	-0.02122	-0.02048	-0.01747	-0.01444	-0.01143
70.000	-0.03239	-0.03327	-0.03420	-0.03447	-0.03379	-0.02789	-0.02128	-0.01498
87.200	-0.05040	-0.05058	-0.05077	-0.05179	-0.05179	-0.04072	-0.02920	-0.01783

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1- 74
EFFECT OF SPEEDBRAKE



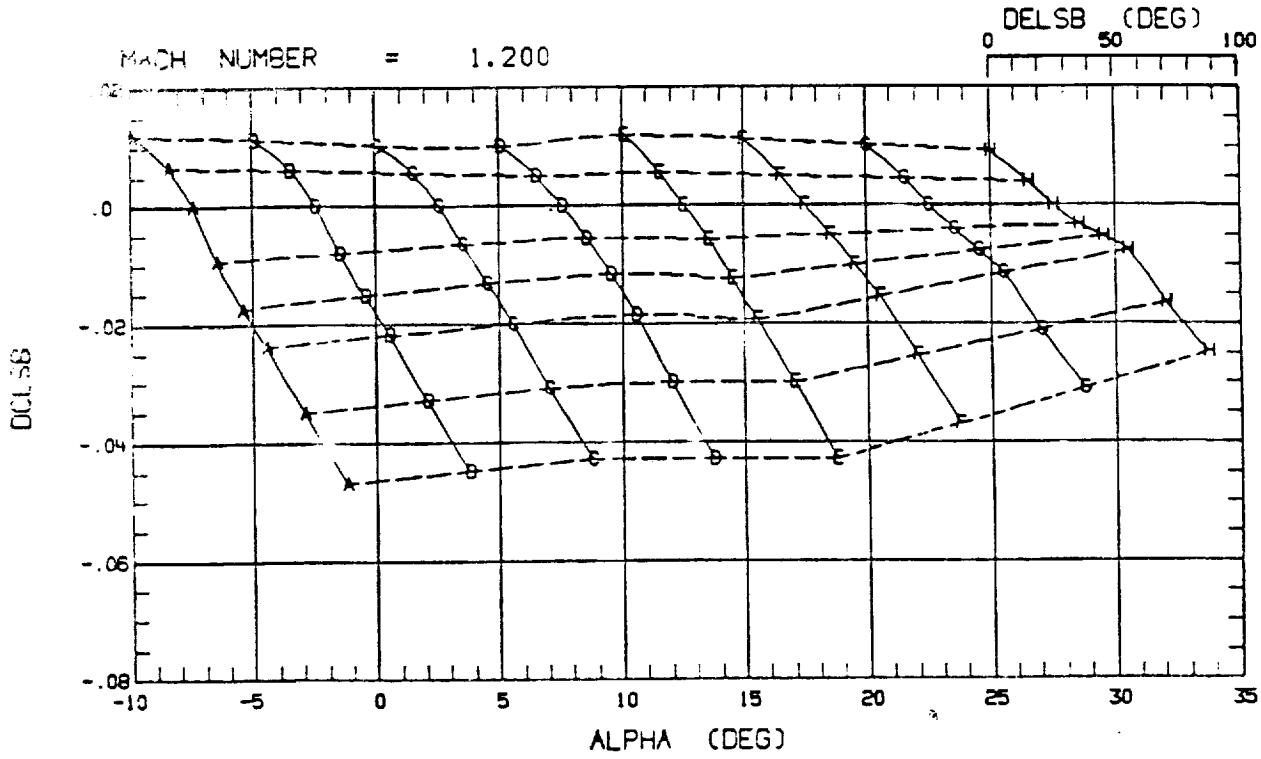
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.01000	0.01000	0.01000	0.01000	0.01200	0.01100	0.01000	0.00900
15.000	0.00441	0.00455	0.00468	0.00482	0.00526	0.00470	0.00415	0.00359
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00474	-0.00519	-0.00565	-0.00618	-0.00582	-0.00510	-0.00438	-0.00366
45.000	-0.00998	-0.01109	-0.01220	-0.01335	-0.01224	-0.01061	-0.00897	-0.00733
55.000	-0.01654	-0.01802	-0.01950	-0.02100	-0.01950	-0.01655	-0.01360	-0.01065
70.000	-0.02943	-0.03062	-0.03180	-0.03334	-0.03214	-0.02631	-0.02048	-0.01465
87.200	-0.04800	-0.04800	-0.04800	-0.04900	-0.04900	-0.03872	-0.02944	-0.01815

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-75
EFFECT OF SPEEDBRAKE



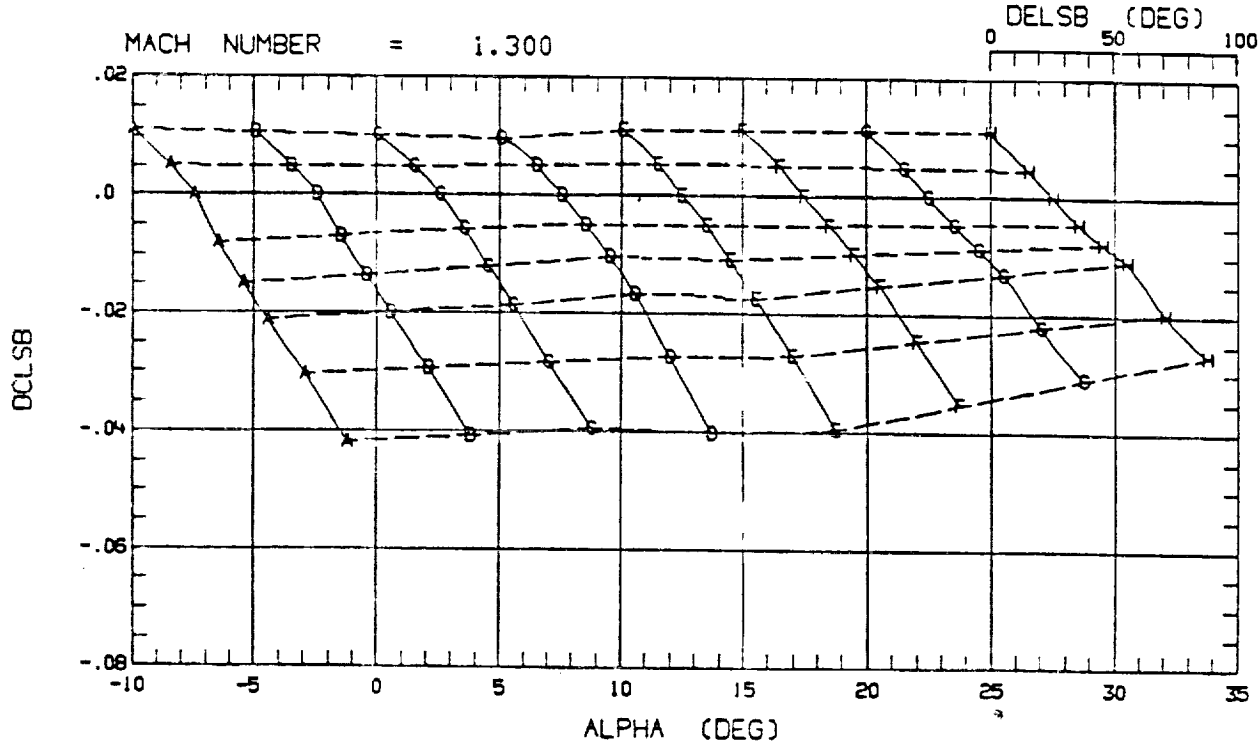
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.01200	0.01100	0.01000	0.01000	0.01200	0.01100	0.01000	0.00900
15.000	0.00650	0.00600	0.00550	0.00500	0.00550	0.00500	0.00450	0.00400
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00951	-0.00809	-0.00667	-0.00551	-0.00587	-0.00500	-0.00413	-0.00327
45.000	-0.01744	-0.01539	-0.01333	-0.01167	-0.01245	-0.01009	-0.00773	-0.00537
55.000	-0.02400	-0.02200	-0.02000	-0.01850	-0.01945	-0.01550	-0.01155	-0.00760
70.000	-0.03500	-0.03300	-0.03100	-0.03000	-0.03000	-0.02550	-0.02100	-0.01650
87.200	-0.04700	-0.04500	-0.04300	-0.04300	-0.04300	-0.03700	-0.03100	-0.02500

ENGINEER DGD
DATE 9-15-78

FIGURE 4.1.2.1-76
EFFECT OF SPEEDBRAKE



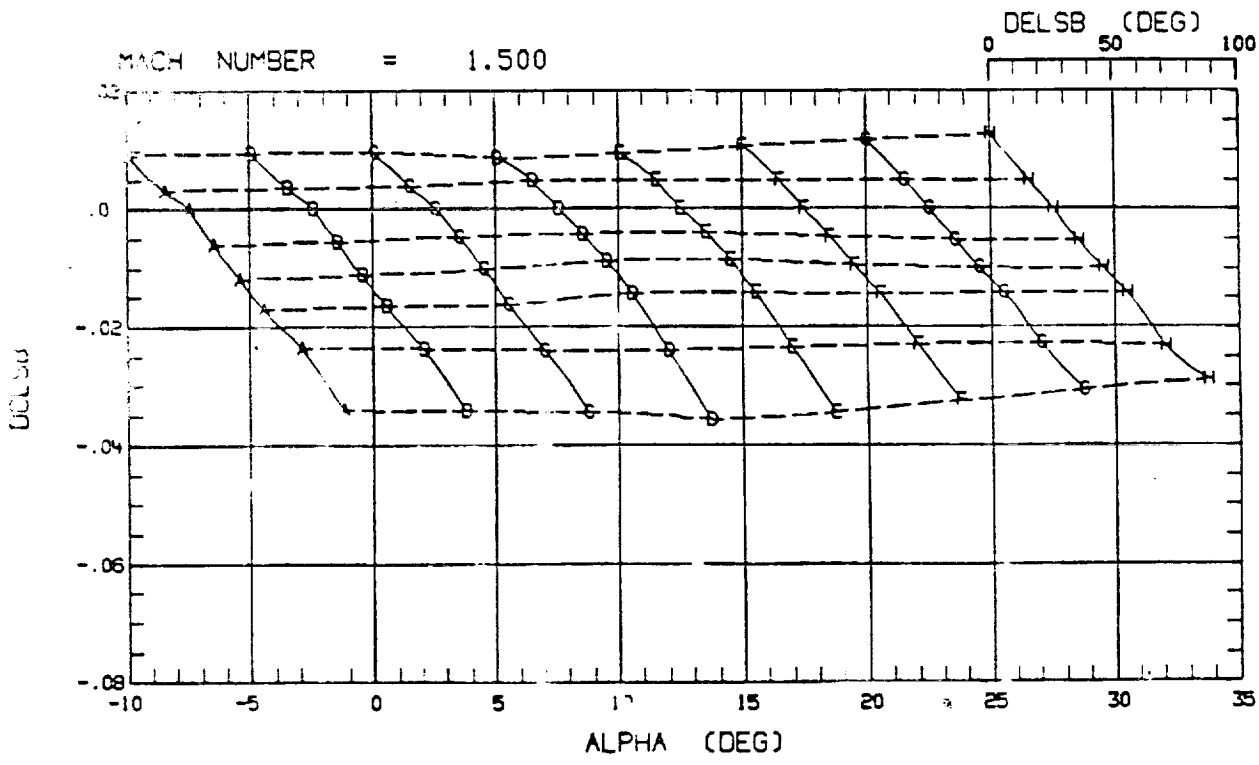
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.01100	0.01052	0.01000	0.00950	0.01100	0.01100	0.01100	0.01100
15.000	0.00492	0.00483	0.00475	0.00505	0.00528	0.00506	0.00480	0.00450
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00817	-0.00704	-0.00592	-0.00503	-0.00525	-0.00500	-0.00475	-0.00451
45.000	-0.01515	-0.01369	-0.01223	-0.01057	-0.01109	-0.01005	-0.00902	-0.00799
55.000	-0.02125	-0.02000	-0.01875	-0.01685	-0.01747	-0.01531	-0.01315	-0.01100
70.000	-0.03051	-0.02950	-0.02849	-0.02754	-0.02725	-0.02475	-0.02225	-0.01975
87.200	-0.04200	-0.04100	-0.03973	-0.04034	-0.03971	-0.03544	-0.03112	-0.02683

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-77
EFFECT OF SPEEDBRAKE



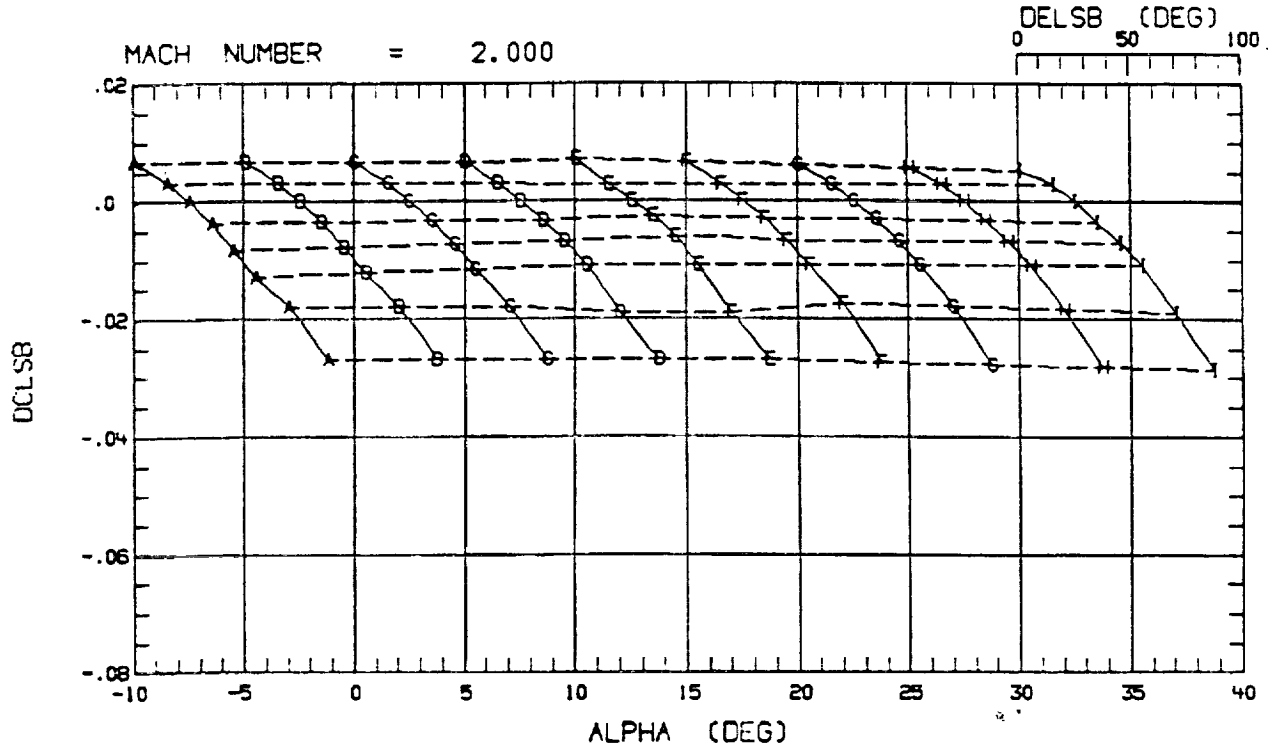
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.00916	.00946	0.00960	0.00855	0.00925	0.01053	0.01164	0.01270
15.000	0.00305	.00343	0.00375	0.00477	0.00468	0.00477	0.00483	0.00485
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00619	-0.00557	-0.00476	-0.00428	-0.00412	-0.00480	-0.00526	-0.00548
45.000	-0.01188	-0.01130	-0.01030	-0.00894	-0.00871	-0.00966	-0.01005	-0.01007
55.000	-0.01711	-0.01662	-0.01635	-0.01443	-0.01436	-0.01455	-0.01425	-0.01432
70.000	-0.02364	-0.02380	-0.02405	-0.02404	-0.02356	-0.02306	-0.02296	-0.02328
87.200	-0.03416	-0.03433	-0.03462	-0.03574	-0.03462	-0.03256	-0.03075	-0.02896

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-78
EFFECT OF SPEEDBRAKE



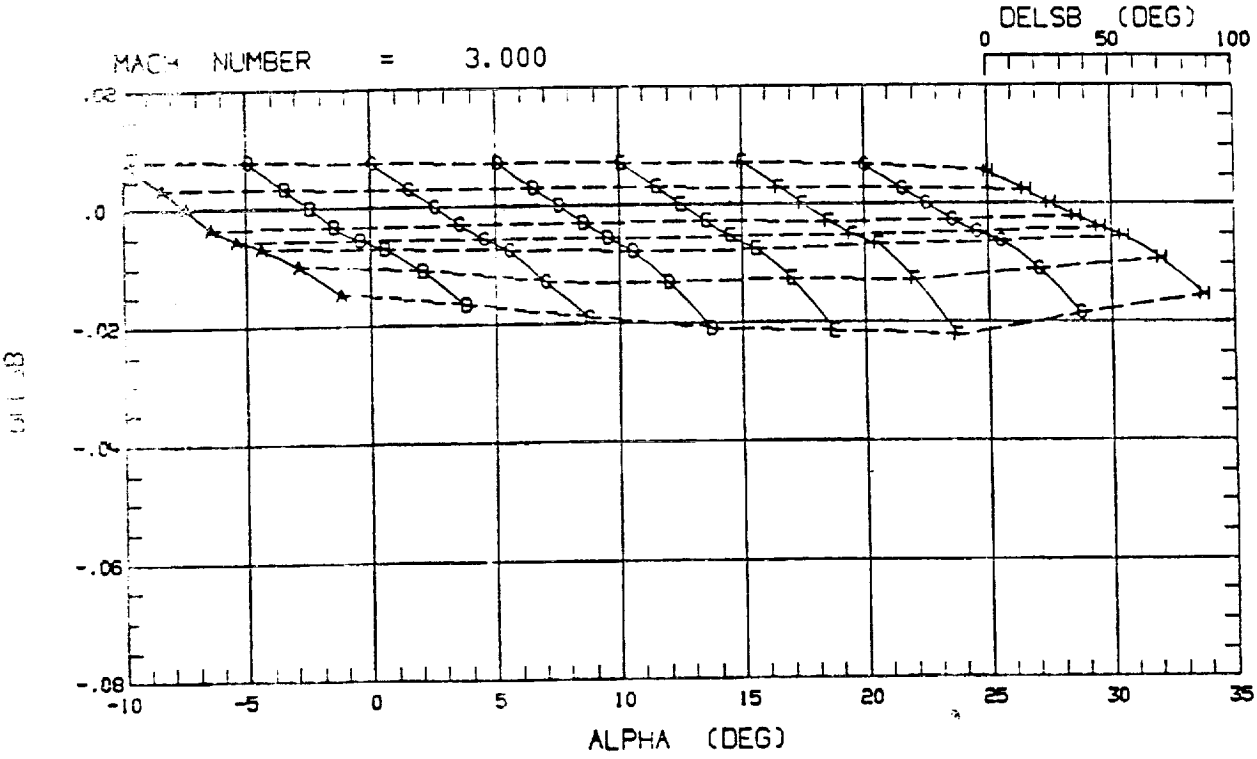
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT								
0.0	0.00650	0.00650	0.00650	0.00650	0.00700	0.00650	0.00600	0.00550	0.00500
15.000	0.00308	0.00302	0.00295	0.00289	0.00275	0.00279	0.00275	0.00271	0.00267
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00375	-0.00358	-0.00342	-0.00326	-0.00266	-0.00299	-0.00322	-0.00345	-0.00368
45.000	-0.00838	-0.00788	-0.00738	-0.00688	-0.00614	-0.00678	-0.00689	-0.00700	-0.00711
55.000	-0.01293	-0.01227	-0.01161	-0.01095	-0.01100	-0.01104	-0.01100	-0.01096	-0.01092
70.000	-0.01800	-0.01800	-0.01800	-0.01900	-0.01900	-0.01745	-0.01800	-0.01855	-0.01910
87.200	-0.02700	-0.02700	-0.02700	-0.02700	-0.02700	-0.02750	-0.02792	-0.02934	-0.02876

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-79
EFFECT OF SPEEDBRAKE

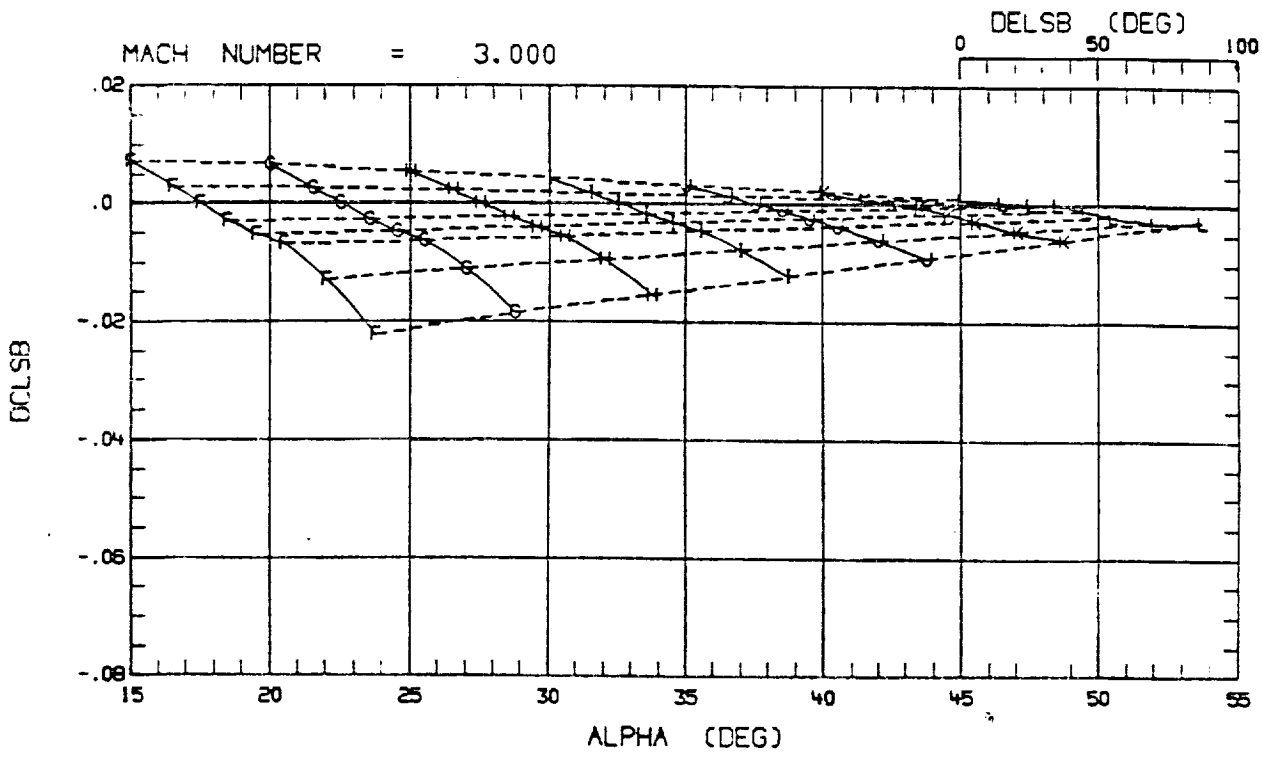


CONFIGURATION			
BASELINE OR ITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.00808	0.00782	0.00755	0.00728	0.00717	0.00712	0.00648	0.00533
15.000	0.00323	0.00313	0.00302	0.00291	0.00287	0.00285	0.00259	0.00213
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00355	-0.00336	-0.00318	-0.00300	-0.00296	-0.00302	-0.00275	-0.00223
45.000	-0.00555	-0.00557	-0.00559	-0.00560	-0.00548	-0.00526	-0.00479	-0.00402
55.000	-0.00688	-0.00724	-0.00760	-0.00796	-0.00774	-0.00702	-0.00640	-0.00555
70.000	-0.01000	-0.01100	-0.01300	-0.01313	-0.01278	-0.01301	-0.01112	-0.00950
87.200	-0.01487	-0.01692	-0.01897	-0.02102	-0.02152	-0.02232	-0.01866	-0.01550

ENGINEER
DATE 9-12-78

FIGURE 4.1.2.1-80
EFFECT OF SPEEDBRAKE

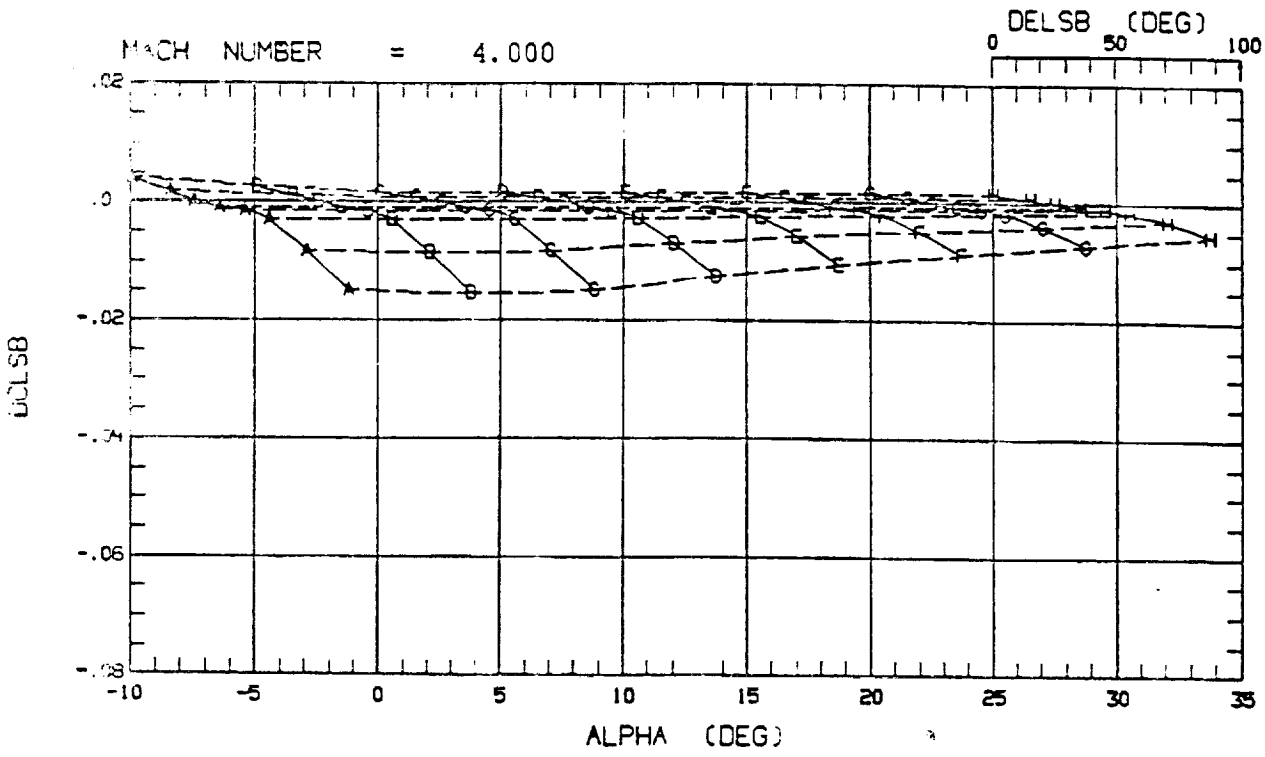


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT						
0.0	0.00712	0.00648	0.00533	0.00418	0.00303	0.00188	0.00073
15.000	0.00285	0.00259	0.00213	0.00167	0.00121	0.00075	0.00029
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00302	-0.00275	-0.00223	-0.00171	-0.00119	-0.00067	-0.00015
45.000	-0.00526	-0.00479	-0.00402	-0.00326	-0.00249	-0.00173	-0.00096
55.000	-0.00702	-0.00640	-0.00555	-0.00470	-0.00385	-0.00300	-0.00215
70.000	-0.01301	-0.01112	-0.00960	-0.00788	-0.00626	-0.00464	-0.00302
87.200	-0.02232	-0.01866	-0.01550	-0.01234	-0.00918	-0.00602	-0.00286

ENGINEER DGD
DATE 1-12-78

FIGURE 4.1.2.1-81
EFFECT OF SPEEDBRAKE

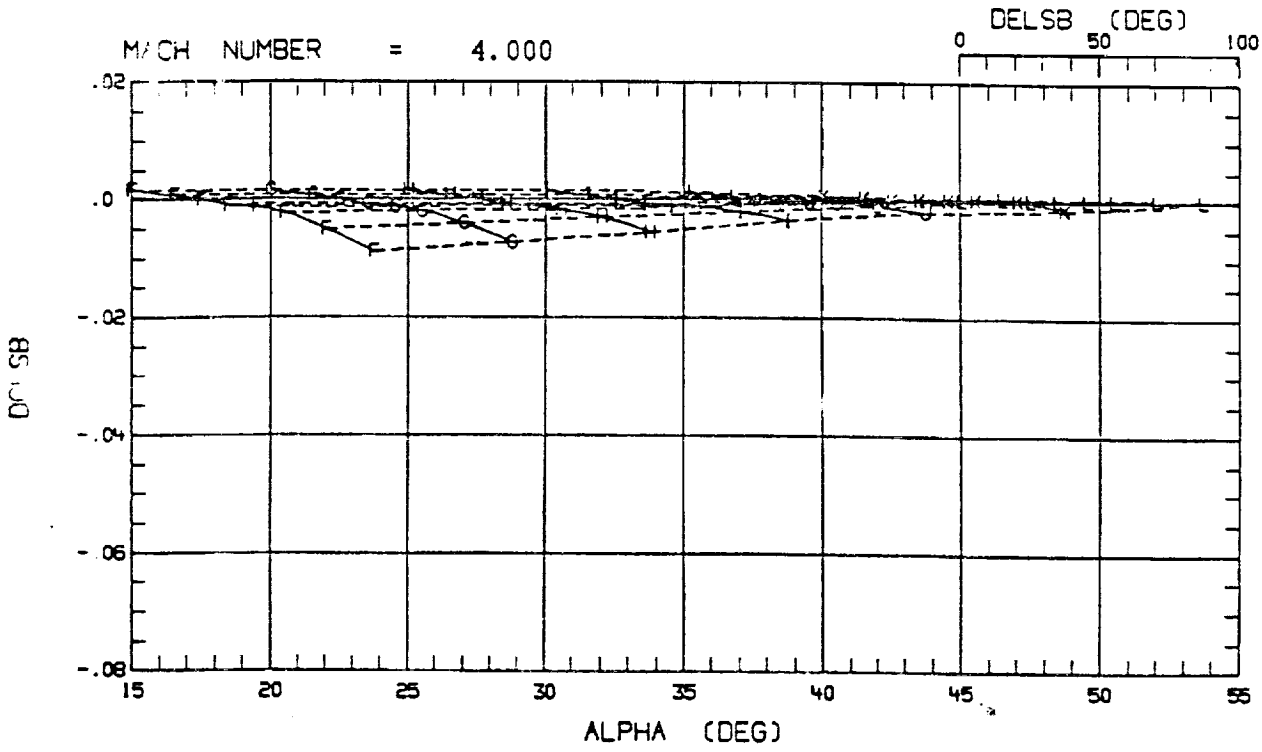


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.00400	0.00244	0.00150	0.00150	0.00150	0.00150	0.00150	0.00150
15.000	0.00160	0.00097	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00110	-0.00111	-0.00110	-0.00105	-0.00100	-0.00095	-0.00090	-0.00090
45.000	-0.00160	-0.00161	-0.00160	-0.00156	-0.00150	-0.00142	-0.00130	-0.00100
55.000	-0.00310	-0.00316	-0.00310	-0.00287	-0.00260	-0.00230	-0.00200	-0.00180
70.000	-0.00840	-0.00871	-0.00840	-0.00715	-0.00590	-0.00500	-0.00410	-0.00300
87.200	-0.01500	-0.01555	-0.01500	-0.01280	-0.01060	-0.00892	-0.00730	-0.00570

ENGINEER DGD
DATE 1-[illegible]

FIGURE 4.1.2.1-82
EFFECT OF SPEEDBRAKE

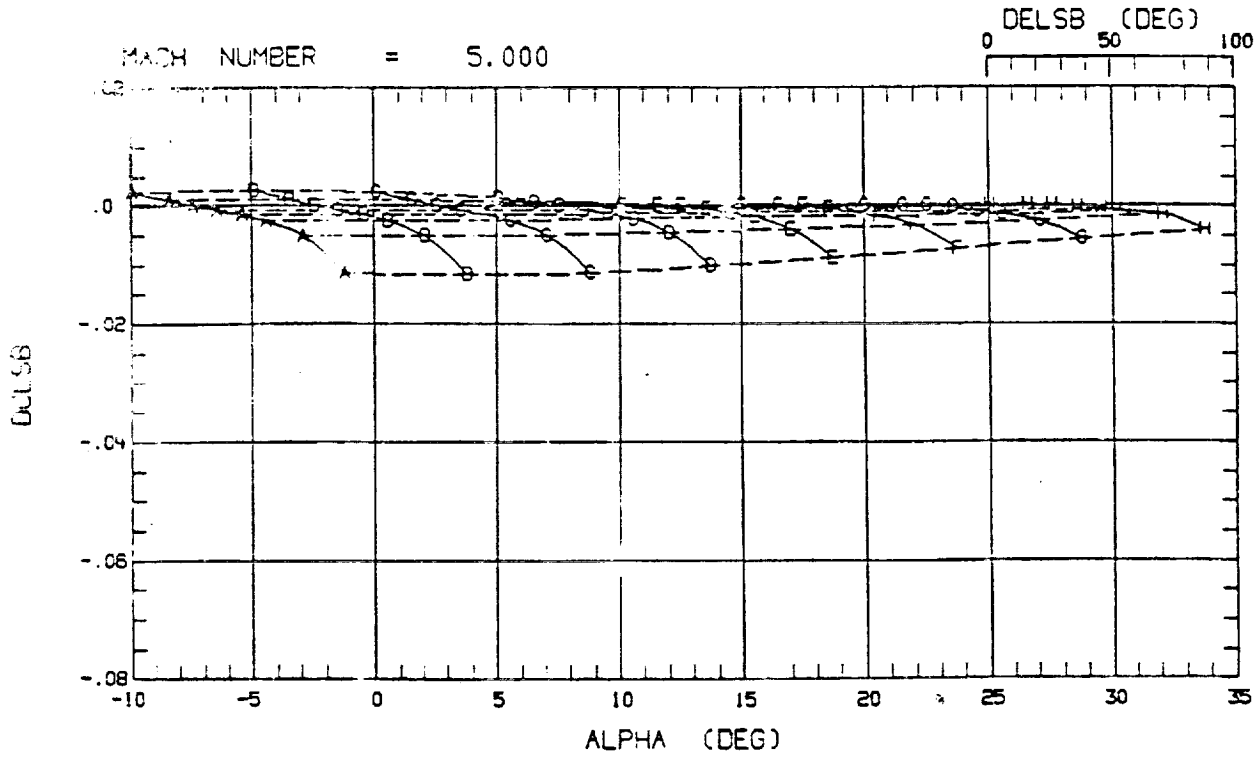


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT						
0.0	0.00150	0.00150	0.00150	0.00150	0.00117	0.00050	0.0
15.000	0.00060	0.00060	0.00060	0.00060	0.00050	0.00030	0.00015
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00095	-0.00090	-0.00090	-0.00080	-0.00050	0.0	0.0
45.000	-0.00142	-0.00130	-0.00100	-0.00100	-0.00067	0.0	0.0
55.000	-0.00230	-0.00200	-0.00180	-0.00120	-0.00060	0.0	0.0
70.000	-0.00500	-0.00410	-0.00300	-0.00200	-0.00100	0.0	0.0
87.200	-0.00892	-0.00730	-0.00570	-0.00350	-0.00217	-0.00170	0.0

ENGINEER DSD
DATE 9-12-78

FIGURE 4.1.2.1-83
EFFECT OF SPEEDBRAKE

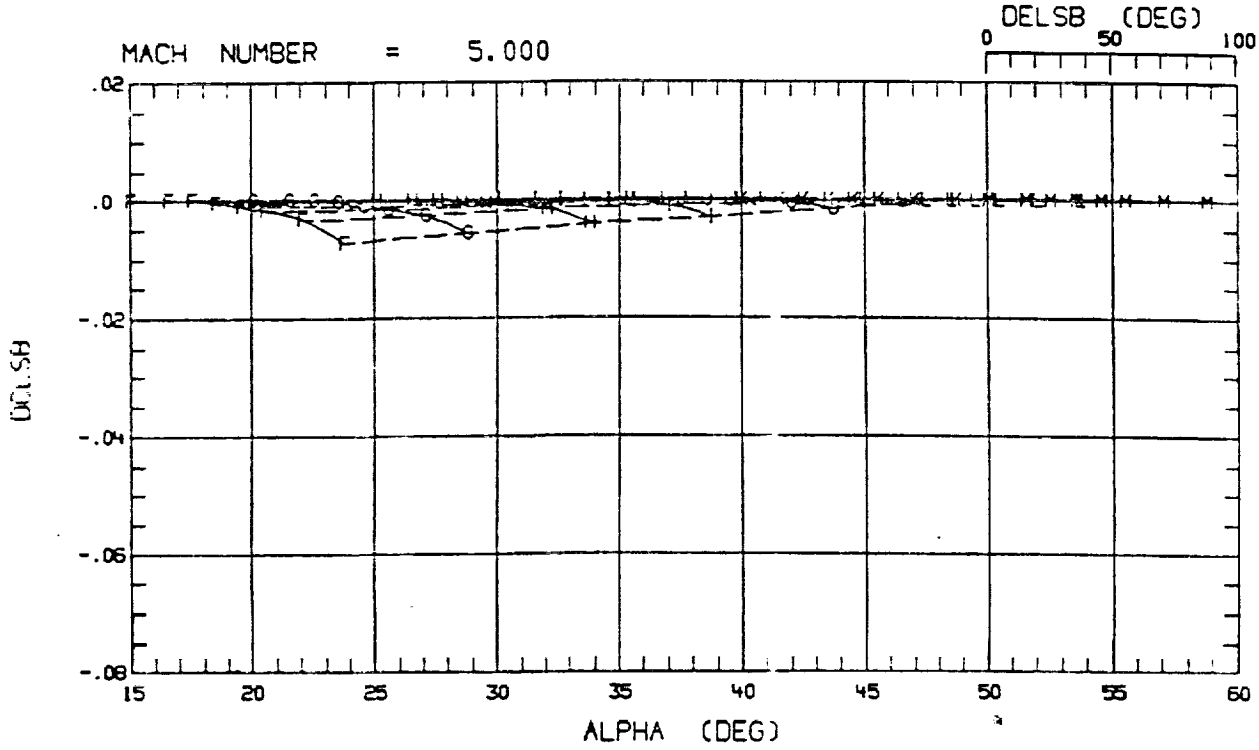


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.00220	0.00247	0.00220	0.00110	0.0	0.0	0.0	0.0
15.000	0.00090	0.00101	0.00090	0.00045	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00080	-0.00082	-0.00080	-0.00070	-0.00060	-0.00050	-0.00040	-0.00030
45.000	-0.00160	-0.00165	-0.00160	-0.00140	-0.00120	-0.00115	-0.00110	-0.00060
55.000	-0.00260	-0.00269	-0.00260	-0.00225	-0.00190	-0.00175	-0.00160	-0.00100
70.000	-0.00500	-0.00512	-0.00500	-0.00456	-0.00400	-0.00341	-0.00270	-0.00150
87.200	-0.01150	-0.01182	-0.01150	-0.01032	-0.00890	-0.00730	-0.00570	-0.00410

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.1-84
EFFECT OF SPEEDBRAKE



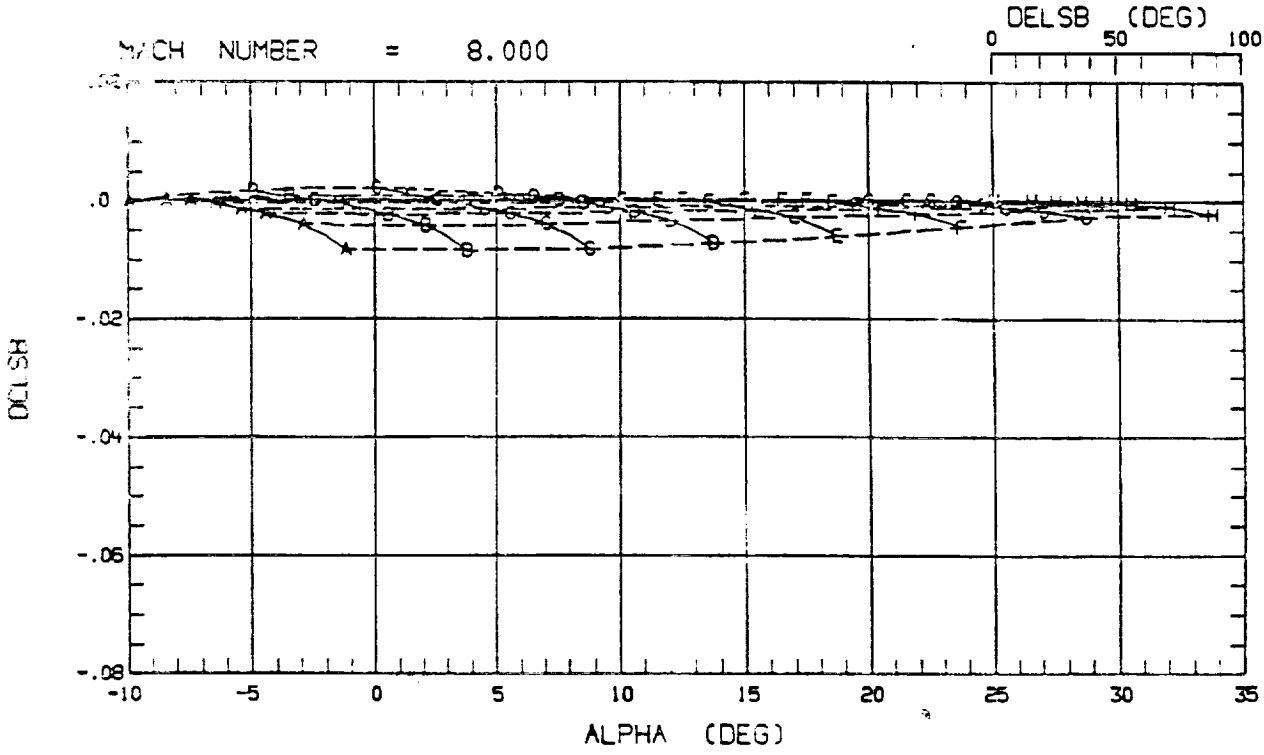
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00050	-0.00040	-0.00030	-0.00020	-0.00010	0.0	0.0	0.0
45.000	-0.00115	-0.00110	-0.00060	-0.00030	-0.00011	0.0	0.0	0.0
55.000	-0.00175	-0.00160	-0.00100	-0.00030	-0.00009	0.0	0.0	0.0
70.000	-0.00341	-0.00270	-0.00150	-0.00100	-0.00050	0.0	0.0	0.0
87.200	-0.00730	-0.00570	-0.00410	-0.00300	-0.00150	0.0	0.0	0.0

ENGINEER DGD
DATE 9-11-2018

FIGURE 4.1.2.1-85
EFFECT OF SPEEDBRAKE



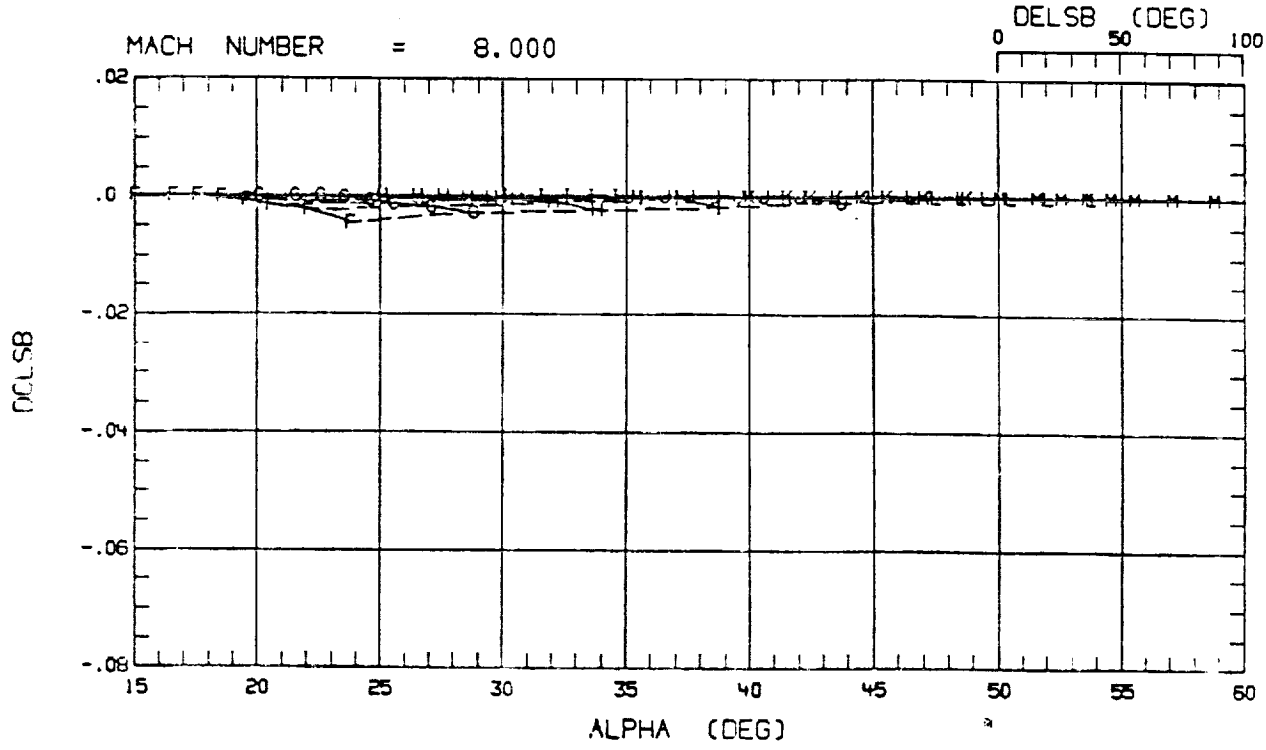
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BOC LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.00157	0.00210	0.00105	0.0	0.0	0.0	0.0
15.000	0.0	0.00060	0.00080	0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00050	-0.00051	-0.00050	-0.00045	-0.00040	-0.00035	-0.00030	-0.00020
45.000	-0.00150	-0.00155	-0.00150	-0.00130	-0.00110	-0.00090	-0.00070	-0.00040
55.000	-0.00240	-0.00247	-0.00240	-0.00210	-0.00180	-0.00150	-0.00120	-0.00060
70.000	-0.00420	-0.00436	-0.00420	-0.00355	-0.00290	-0.00235	-0.00180	-0.00110
87.200	-0.00930	-0.00856	-0.00830	-0.00744	-0.00620	-0.00455	-0.00290	-0.00240

ENGINEER
DATE 9-12-78

FIGURE 4.1.2.1-86
EFFECT OF SPEEDBRAKE



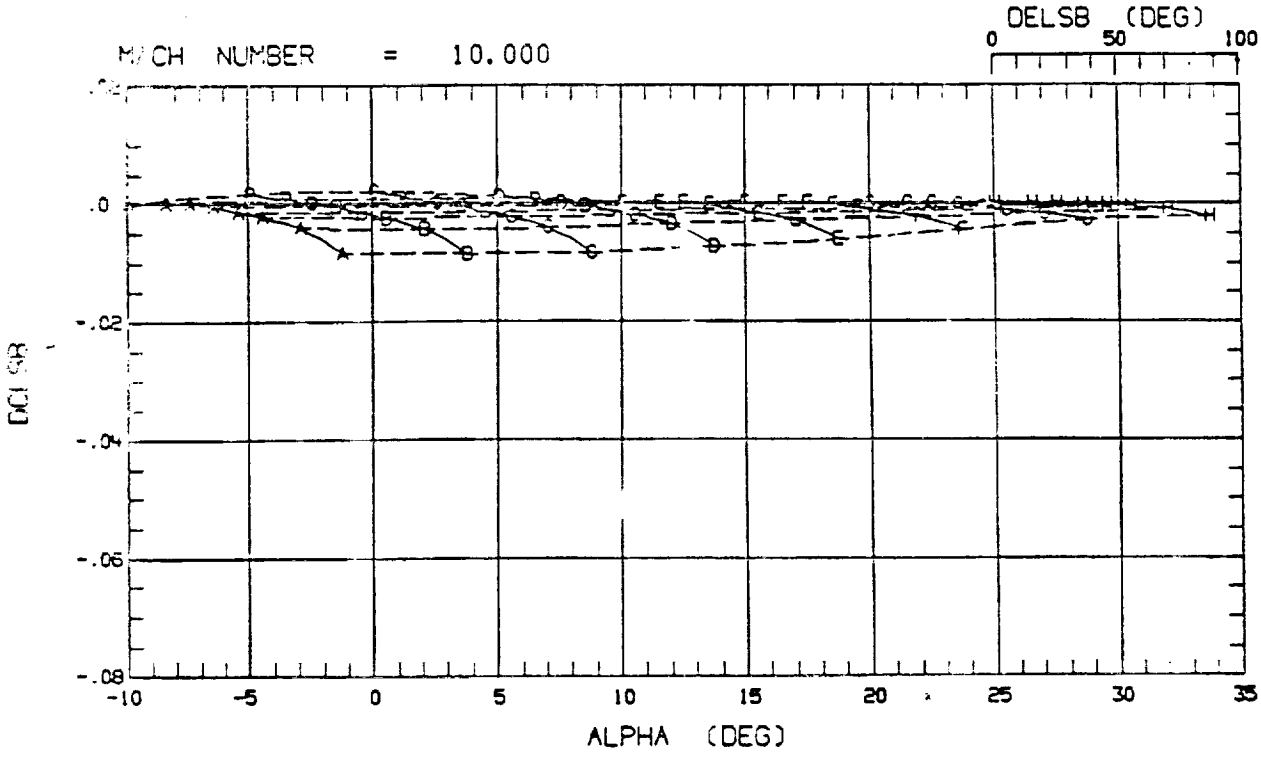
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00035	-0.00030	-0.00020	0.0	0.0	0.0	0.0	0.0
45.000	-0.00090	-0.00070	-0.00040	0.0	0.0	0.0	0.0	0.0
55.000	-0.00150	-0.00120	-0.00060	-0.00020	-0.00006	0.0	0.0	0.0
70.000	-0.00235	-0.00180	-0.00110	-0.00040	-0.00012	0.0	0.0	0.0
87.200	-0.00455	-0.00290	-0.00240	-0.00190	-0.00095	0.0	0.0	0.0

ENGINEER DeD
DATE 9/15/88

FIGURE 4.1.2.1-87
EFFECT OF SPEEDBRAKE



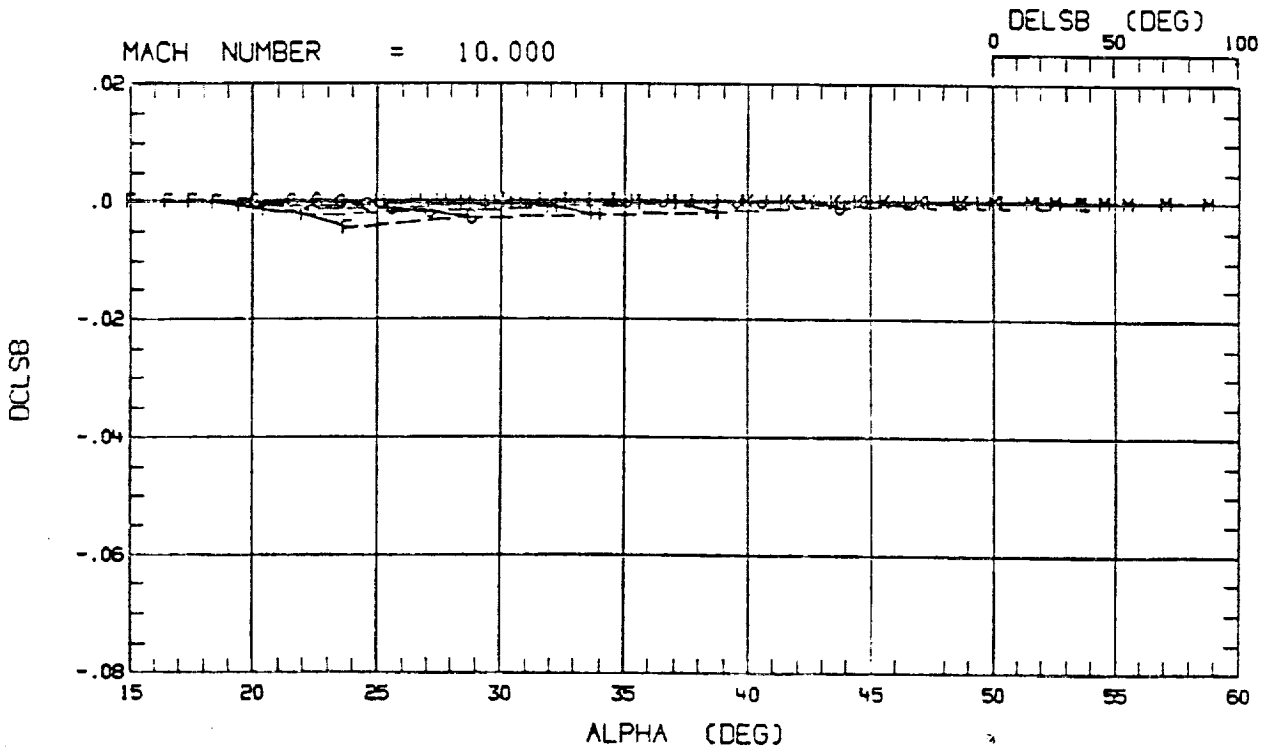
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.00157	0.00210	0.00105	0.0	0.0	0.0	0.0
15.000	0.0	0.00060	0.00080	0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00050	-0.00051	-0.00050	-0.00045	-0.00040	-0.00035	-0.00030	-0.00020
45.000	-0.00150	-0.00155	-0.00150	-0.00130	-0.00110	-0.00090	-0.00070	-0.00040
55.000	-0.00240	-0.00247	-0.00240	-0.00210	-0.00180	-0.00150	-0.00120	-0.00060
70.000	-0.00420	-0.00436	-0.00420	-0.00355	-0.00290	-0.00235	-0.00180	-0.00110
87.200	-0.00830	-0.00856	-0.00830	-0.00744	-0.00620	-0.00455	-0.00290	-0.00240

ENGINEER DGD
DATE 9-25-78

FIGURE 4.1.2.1- 88
EFFECT OF SPEEDBRAKE



CONFIGURATION

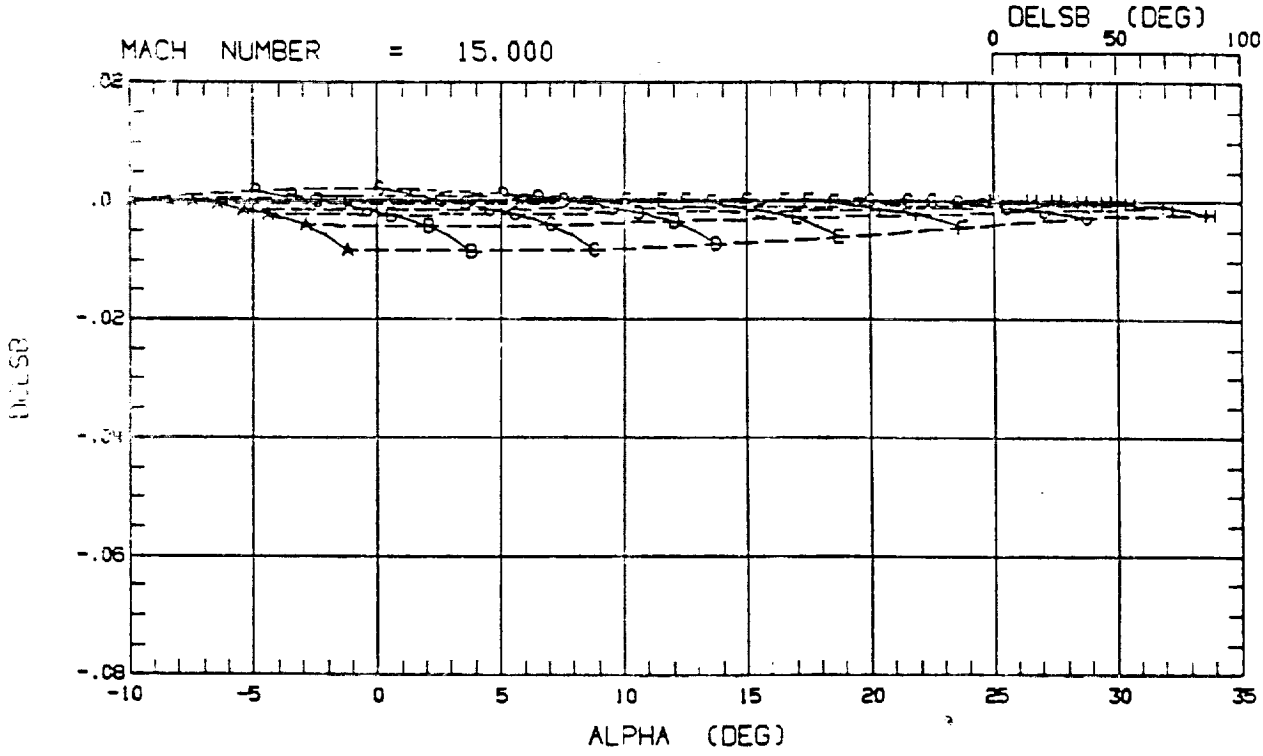
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00035	-0.00030	-0.00020	0.0	0.0	0.0	0.0	0.0
45.000	-0.00090	-0.00070	-0.00040	0.0	0.0	0.0	0.0	0.0
55.000	-0.00150	-0.00120	-0.00060	-0.00020	-0.00006	0.0	0.0	0.0
70.000	-0.00235	-0.00180	-0.00110	-0.00040	-0.00012	0.0	0.0	0.0
87.200	-0.00455	-0.00290	-0.00240	-0.00190	-0.00095	0.0	0.0	0.0

ENGINEER
DATE 9-12-80

FIGURE 4.1.2.1-89
EFFECT OF SPEEDBRAKE



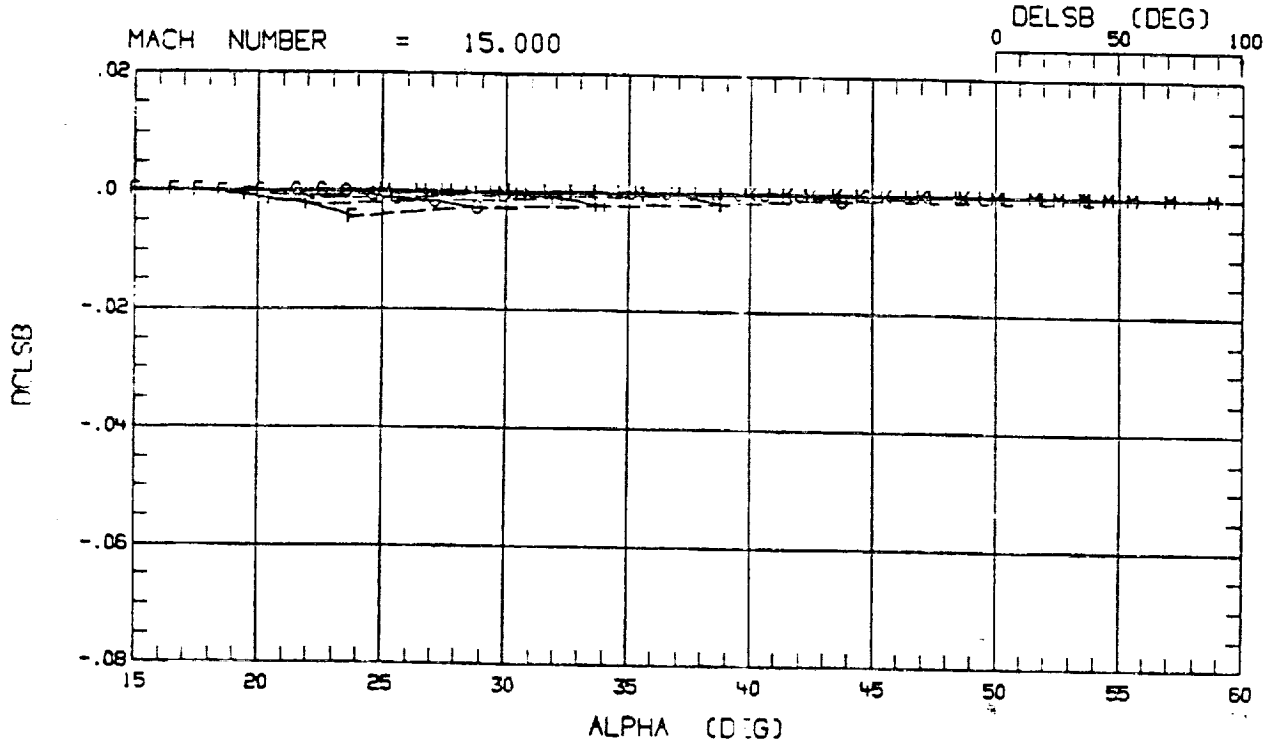
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.00157	0.00210	0.00105	0.0	0.0	0.0	0.0
15.000	0.0	0.00080	0.00080	0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00050	-0.00051	-0.00050	-0.00045	-0.00040	-0.00035	-0.00030	-0.00020
45.000	-0.00150	-0.00155	-0.00150	-0.00130	-0.00110	-0.00090	-0.00070	-0.00040
55.000	-0.00240	-0.00247	-0.00240	-0.00210	-0.00180	-0.00150	-0.00120	-0.00060
70.000	-0.00420	-0.00436	-0.00420	-0.00355	-0.00290	-0.00235	-0.00180	-0.00110
87.200	-0.00830	-0.00856	-0.00830	-0.00744	-0.00620	-0.00455	-0.00290	-0.00240

ENGINEER DGD
DATE 8/15/78

FIGURE 4.1.2.1-90
EFFECT OF SPEEDBRAKE



CONFIGURATION

BASELINE ORBITER VEHICLE

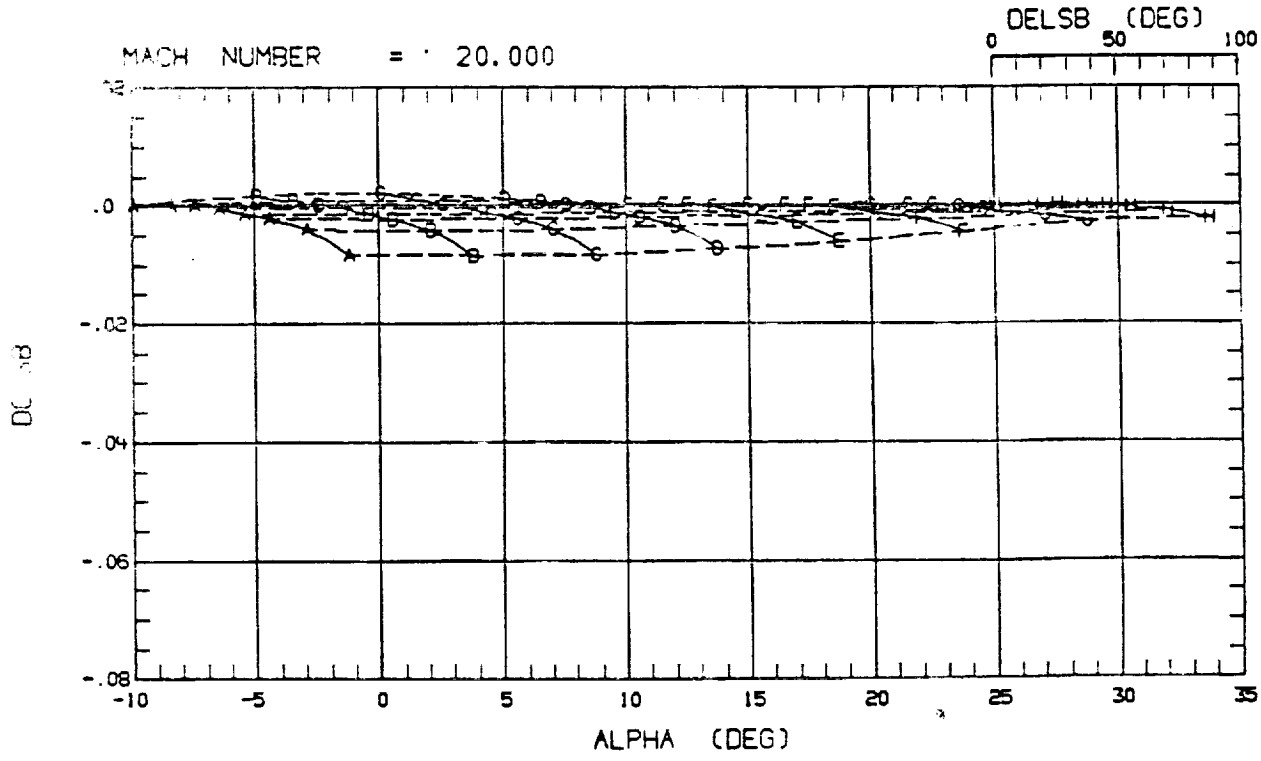
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

REFERENCE DIMENSIONS

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00035	-0.00030	-0.00020	0.0	0.0	0.0	0.0	0.0
45.000	-0.00090	-0.00070	-0.00040	0.0	0.0	0.0	0.0	0.0
55.000	-0.00150	-0.00120	-0.00060	-0.00020	-0.00006	0.0	0.0	0.0
70.000	-0.00235	-0.00180	-0.00110	-0.00040	-0.00012	0.0	0.0	0.0
87.200	-0.00455	-0.00290	-0.00240	-0.00190	-0.00095	0.0	0.0	0.0

ENGINEER
DATE

FIGURE 4.1.2.1-91
EFFECT OF SPEEDBRAKE



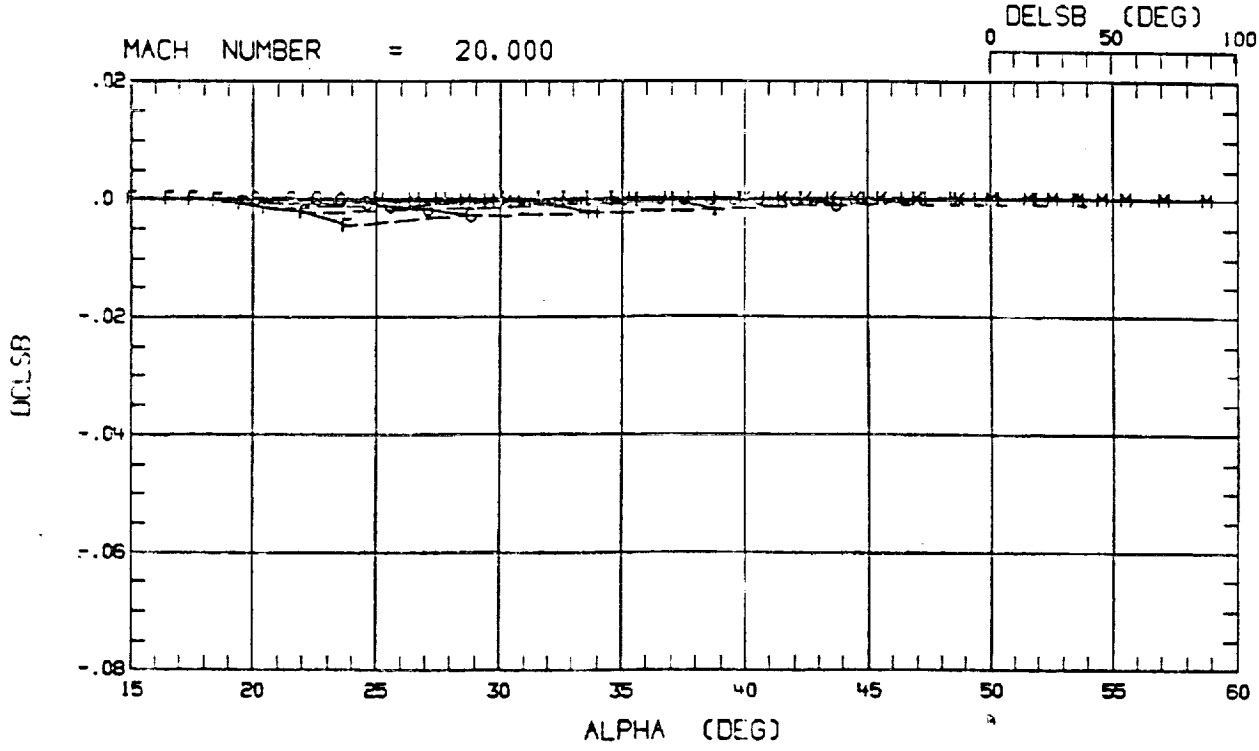
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.00157	0.00210	0.00105	0.0	0.0	0.0	0.0
15.000	0.0	0.00060	0.00080	0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00050	-0.00051	-0.00050	-0.00045	-0.00040	-0.00035	-0.00030	-0.00020
45.000	-0.00150	-0.00155	-0.00150	-0.00130	-0.00110	-0.00090	-0.00070	-0.00040
55.000	-0.00240	-0.00247	-0.00240	-0.00210	-0.00180	-0.00150	-0.00120	-0.00060
70.000	-0.00420	-0.00436	-0.00420	-0.00355	-0.00290	-0.00235	-0.00180	-0.00110
87.200	-0.00830	-0.00856	-0.00830	-0.00744	-0.00620	-0.00455	-0.00290	-0.00240

ENGINEER DGD
DATE 9-17-79

FIGURE 4.1.2.1-92
EFFECT OF SPEEDBRAKE



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

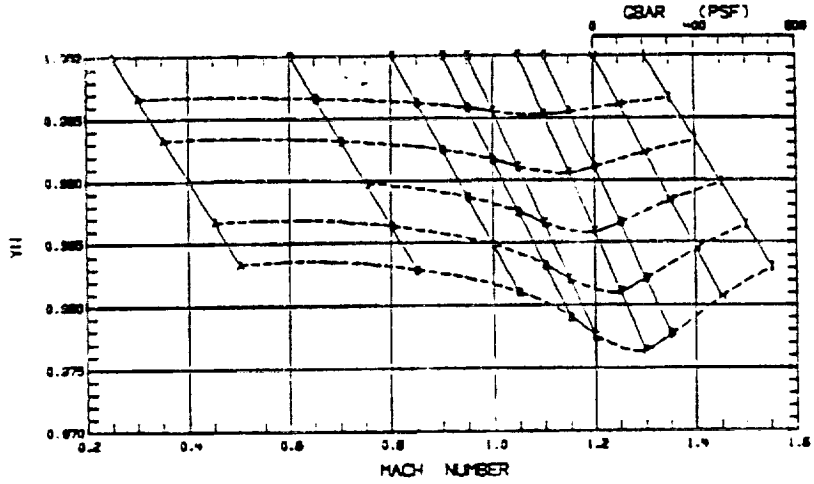
	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE LIFT FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00035	-0.00030	-0.00020	0.0	0.0	0.0	0.0	0.0
45.000	-0.00090	-0.00070	-0.00040	0.0	0.0	0.0	0.0	0.0
55.000	-0.00150	-0.00120	-0.00060	-0.00020	-0.00006	0.0	0.0	0.0
70.000	-0.00235	-0.00180	-0.00110	-0.00040	-0.00012	0.0	0.0	0.0
87.200	-0.00455	-0.00290	-0.00240	-0.00190	-0.00095	0.0	0.0	0.0

ENGINEER DGD
DATE 9-12-78

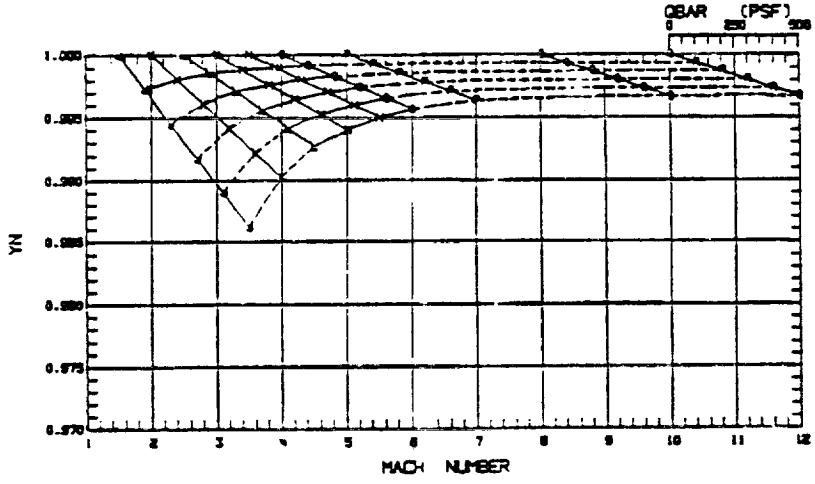
FIGURE 4.1.2.1- 93
EFFECT OF SPEEDBRAKE

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	S = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	B = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	C = 39.580 FT.
		BODY LENGTH	LB = 1292.3 IN.



QBAR (PSF)	MACH NUMBER 0.250 A	0.400 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	F/B NORMAL FORCE OR LIFT SLOPE								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99887	0.99887	0.99880	0.99880	0.99850	0.99827	0.99853	0.99813	0.99880
200.000	0.99333	0.99313	0.9924-0	0.99160	0.99100	0.99053	0.99107	0.99027	0.99320
300.000	0.99000	0.99870	0.99850	0.9974-0	0.99850	0.99880	0.99880	0.9934-0	0.99880
400.000	0.99887	0.99827	0.994-80	0.99320	0.99200	0.99107	0.99813	0.994-53	0.9964-0
500.000	0.99333	0.99293	0.99100	0.9[illegible]900	0.9[illegible]720	0.97533	0.97767	0.99067	0.99300



QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.300 O	5.000 P	8.000 Q	10.000 R
	F/B NORMAL FORCE (OR LIFT) SLOPE								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99723	0.99803	0.99853	0.99880	0.99900	0.99813	0.99827	0.99833	0.99833
200.000	0.99447	0.99607	0.99707	0.99760	0.99800	0.99627	0.99653	0.99667	0.99667
300.000	0.99170	0.99410	0.99560	0.9964-0	0.99700	0.99440	0.99780	0.99800	0.99800
400.000	0.98893	0.99213	0.994-13	0.99520	0.99600	0.99253	0.99707	0.99733	0.99733
500.000	0.9861[illegible]	0.99017	0.99267	0.99-00	0.99500	0.99067	0.99633	0.99667	0.99667

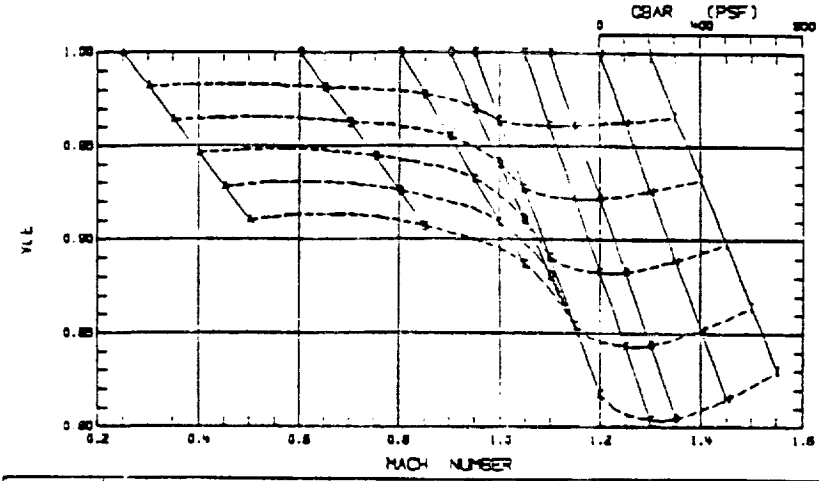
ENGINEER
DATE 4-13-72

FIGURE 4.1.2.1-94
FLEX/RIGID NORMAL FORCE (OR LIFT) SLOPE WITH ALPHA

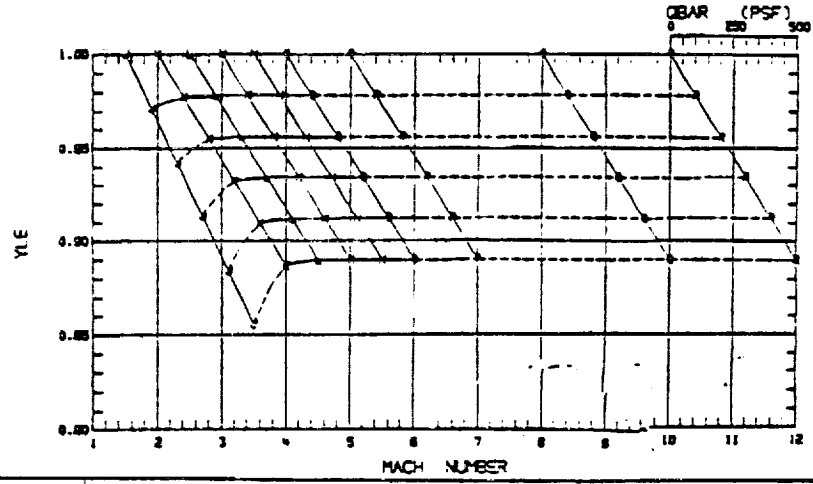
CONFIGURATION

BASELINE ORBITER VEHICLE — REFERENCE DIMENSIONS

CENTER OF GRAVITY XO = FS 1078.7 IN. — WING AREA SW = 2690.00 SQ.FT.
OR YO = BL 0.0 IN. — WING SPAN BW = 78.056 FT.
MOMENT REFERENCE ZO = WL 375.0 IN. — M.A.C. CW = 38.560 FT.
BODY LENGTH L = 1292.3 IN



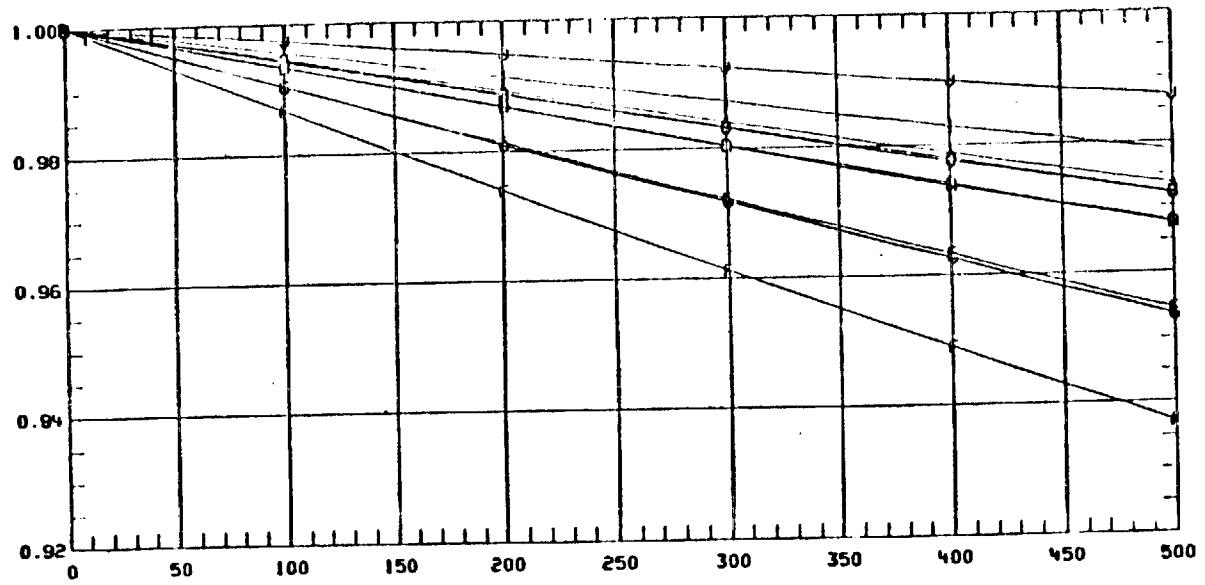
QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 J
	F/B ELEVON LIFT EFFECTIVENESS								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98800	0.98133	0.97733	0.97020	0.96347	0.96067	0.96080	0.96300	0.96600
200.000	0.98400	0.96267	0.95467	0.94040	0.92693	0.92133	0.92160	0.92800	0.93200
300.000	0.97800	0.94533	0.93200	0.91080	0.88040	0.88200	0.88270	0.89600	0.89800
400.000	0.96800	0.92533	0.90933	0.88080	0.85387	0.84267	0.84360	0.85200	0.86400
500.000	0.91000	0.90667	0.88667	0.85100	0.81733	0.80533	0.80450	0.81600	0.83000

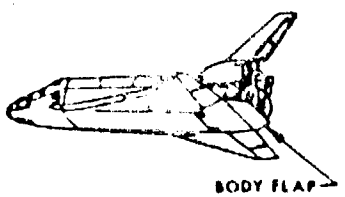


QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.500 O	5.000 P	8.000 Q	10.000 R
	F/B ELEVON LIFT EFFECTIVENESS								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97107	0.97733	0.97760	0.97787	0.97800	0.97800	0.97800	0.97800	0.97800
200.000	0.94213	0.95467	0.95587	0.95573	0.95600	0.95600	0.95600	0.95600	0.95600
300.000	0.91320	0.93200	0.93380	0.93360	0.93400	0.93400	0.93400	0.93400	0.93400
400.000	0.88427	0.90933	0.91173	0.91147	0.91200	0.91200	0.91200	0.91200	0.91200
500.000	0.85533	0.88667	0.88987	0.88933	0.89000	0.89000	0.89000	0.89000	0.89000

ENGINEER [signature]
DATE 4-2-92

FIGURE 4.1.2.1-95
FLEXIBLE/RIGID ELEVON LIFT EFFECTIVENESS





Body Flap Effectiveness

$$\eta_{L_{BF}} = \frac{C_{L_{\delta_{BF}}}^{F}}{C_{L_{\delta_{BF}}}^{R}}$$

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{L_{BF}}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99457	0.99432	0.99425	0.99336	0.99047	0.98668	0.99033	0.99324	0.99563	0.99738
200.000	0.98919	0.98870	0.98856	0.98681	0.98114	0.97372	0.98084	0.98650	0.99129	0.99478
300.000	0.98386	0.98314	0.98293	0.98035	0.97202	0.96110	0.97153	0.98002	0.98699	0.99219
400.000	0.97857	0.97763	0.97735	0.97399	0.96311	0.94886	0.96240	0.97355	0.98272	0.98961
500.000	0.97349	0.97215	0.97184	0.96755	0.95418	0.93666	0.95339	0.96743	0.97864	0.98708

ENGINEER: DTD
DATE: 9/21/72
REVISED:

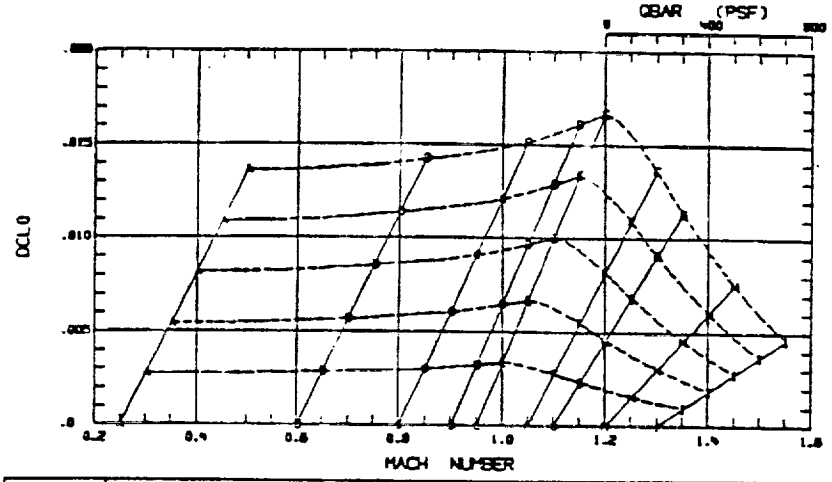
Figure 4.1.2.1-96
AEROELASTIC RATIOS

Rockwell International
Space Division

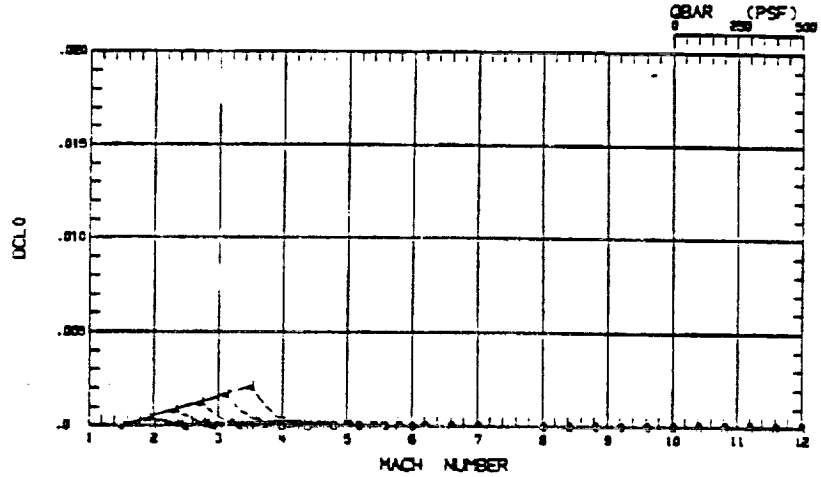
CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS	1078.7	IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0	IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0	IN.	M.A.C.	CM = 39.588 FT.
				BODY LENGTH	LB = 1290.3 IN.



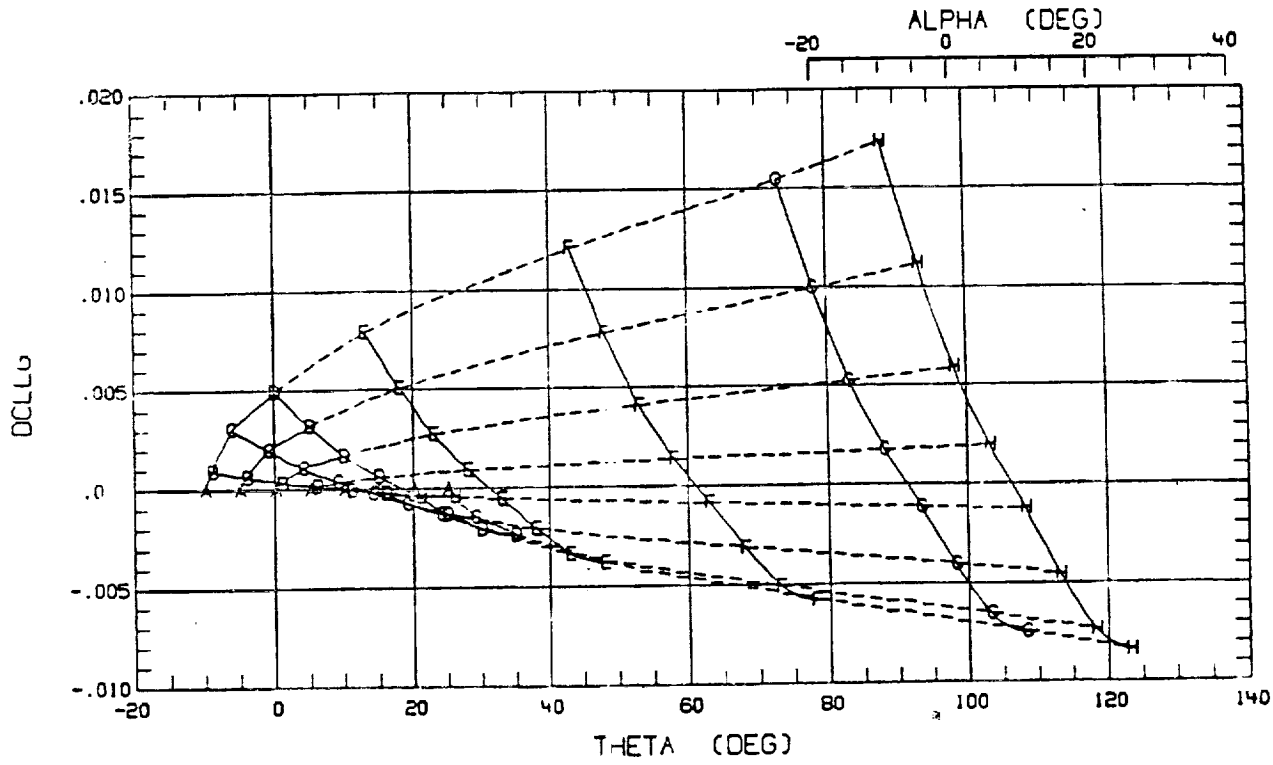
QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.000 F	1.100 G	1.200 H	1.300 I
	FLEX LIFT INCREMENT AT ALPHA=0								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	0.00272	0.00284	0.00302	0.00322	0.00333	0.00272	0.00227	0.00150	0.00082
200.000	0.00543	0.00568	0.00605	0.00644	0.00667	0.00543	0.00453	0.00300	0.00165
300.000	0.00815	0.00852	0.00907	0.00966	0.01000	0.00815	0.00680	0.00450	0.00247
400.000	0.01087	0.01136	0.01209	0.01288	0.01333	0.01087	0.00907	0.00600	0.00329
500.000	0.01359	0.01420	0.01512	0.01610	0.01667	0.01358	0.01133	0.00750	0.00411



QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
	FLEX LIFT INCREMENT AT ALPHA=0								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	0.00043	0.00008	0.00003	0.00001	0.00001	0.0	0.0	0.0	0.0
200.000	0.00085	0.00016	0.00006	0.00003	0.00001	0.0	0.0	0.0	0.0
300.000	0.00128	0.00025	0.00009	0.00004	0.00002	0.0	0.0	0.0	0.0
400.000	0.00171	0.00033	0.00012	0.00005	0.00003	0.0	0.0	0.0	0.0
500.000	0.00213	0.00041	0.00015	0.00007	0.00003	0.0	0.0	0.0	0.0

ENGINEER GFG
DATE 4-2-84

FIGURE 4.1.2.1-97
FLEXIBLE LIFT INCREMENT AT ZERO ANGLE OF ATTACK



CONFIGURATION

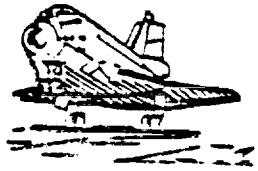
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	THETA (DEG)							
	0.0	1.000	4.000	10.000	23.000	53.000	83.000	98.000
	A	B	C	D	E	F	G	H
ALPHA (DEG)	LANDING GEAR LIFT INCREMENT							
-10.000	0.0	0.00090	0.00301	0.00489	0.00791	0.01205	0.01544	0.01732
-5.000	0.0	0.00058	0.00194	0.00315	0.00509	0.00776	0.00994	0.01115
0.0	0.0	0.00031	0.00102	0.00166	0.00269	0.00410	0.00525	0.00589
5.000	0.0	0.00010	0.00034	0.00055	0.00088	0.00134	0.00172	0.00193
10.000	0.0	-0.00007	-0.00022	-0.00036	-0.00058	-0.00089	-0.00114	-0.00128
15.000	0.0	-0.00024	-0.00079	-0.00129	-0.00209	-0.00318	-0.00407	-0.00457
20.000	0.0	-0.00039	-0.00129	-0.00209	-0.00338	-0.00515	-0.00660	-0.00740
25.000	0.0	-0.00044	-0.00146	-0.00238	-0.00384	-0.00585	-0.00750	-0.00841

ENGINEER
DATE 9/27/78

FIGURE 4.1.2.1-98
LANDING GEAR LIFT COEFFICIENT INCREMENT

Landing Gear Down



$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$

CONFIGURATION

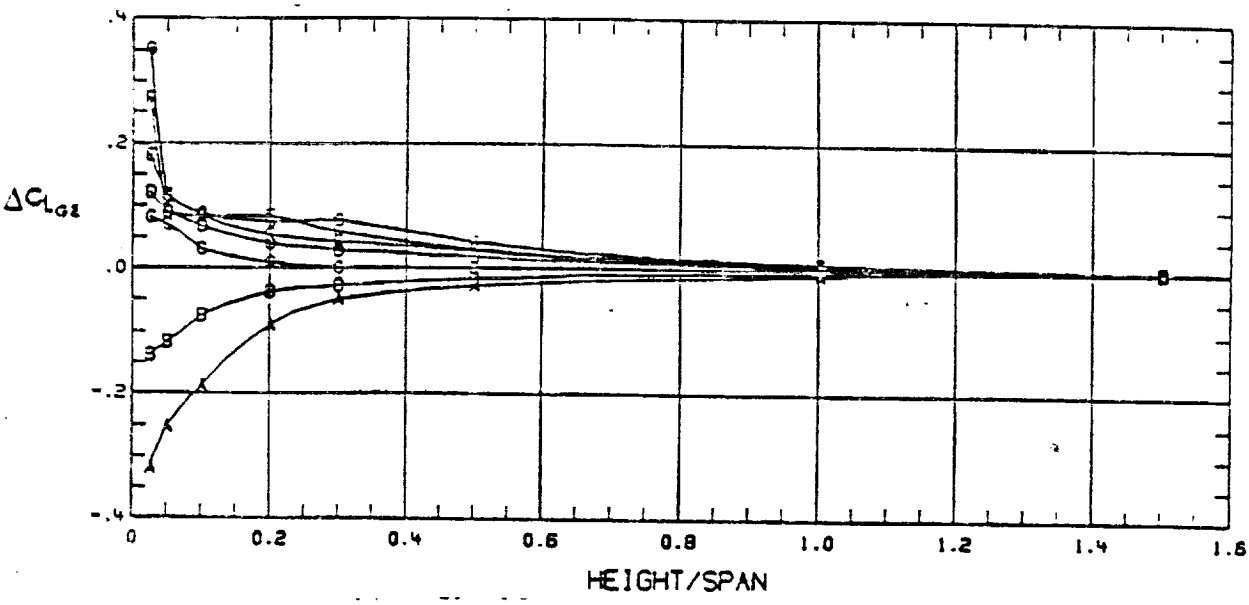
BASELINE ORBITER VEHICLE

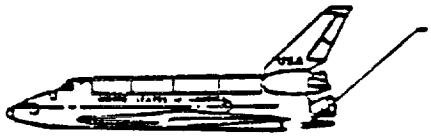
CENTER OF GRAVITY
OR
MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -40.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} = All$





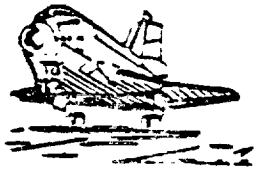
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	0.32000	-0.14000	0.08000	0.12000	0.18000	0.27000	0.35000
0.050	-0.25540	-0.11810	0.06970	0.09000	0.11580	0.08890	0.11450
0.100	-0.18800	-0.07600	0.03030	0.06600	0.08390	0.08280	0.08720
0.200	-0.09020	-0.03880	0.00830	0.03810	0.05190	0.06380	0.07350
0.300	-0.04950	-0.02960	0.0	0.02800	0.03990	0.05850	0.07630
0.500	-0.02830	-0.01720	0.0	0.01650	0.02730	0.02980	0.04100
1.000	-0.01000	-0.00500	0.0	0.00200	0.00400	0.00600	0.00800
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER JB 3
DATE 9-14-77
REVISED:

Figure 4.1.2.1-99
GROUND EFFECT

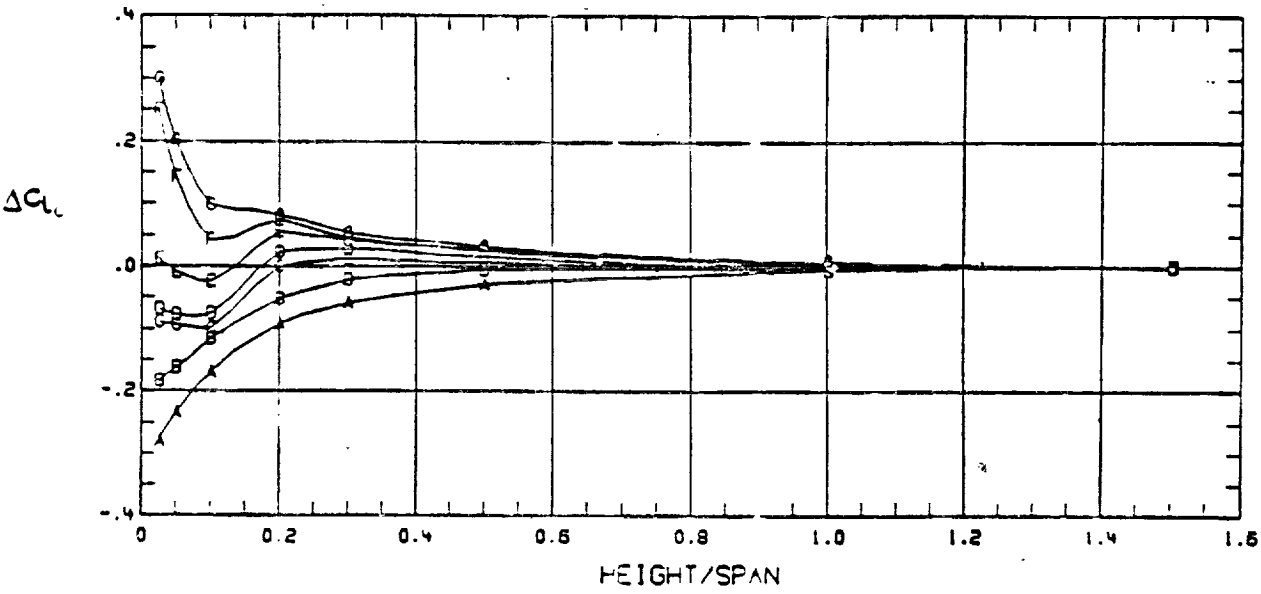
Landing Gear Down

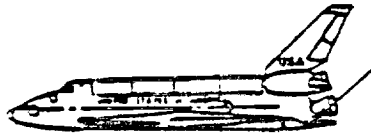
$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$



CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -30.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} = \underline{All}$





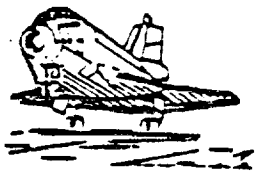
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	-0.28000	-0.18500	-0.09000	-0.07 00	0.01000	0.25000	0.30000
0.050	-0.23590	-0.16380	-0.09500	-0.07810	-0.01000	0.14210	0.20040
0.100	-0.16930	-0.11730	-0.09880	-0.07 00	-0.02460	0.04040	0.09660
0.200	-0.09270	-0.05340	-0.00010	0.02 30	0.05530	0.07310	0.08200
0.300	-0.05940	-0.02240	0.01070	0.02 80	0.04060	0.04480	0.05340
0.500	-0.03030	-0.00620	0.00530	0.01410	0.02510	0.02660	0.03200
1.000	-0.00700	-0.00500	0.0	0.00.00	0.00400	0.00600	0.00800
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE 6-14-77
REVISED

Figure 4.1.2.1-100
GROUND EFFECT

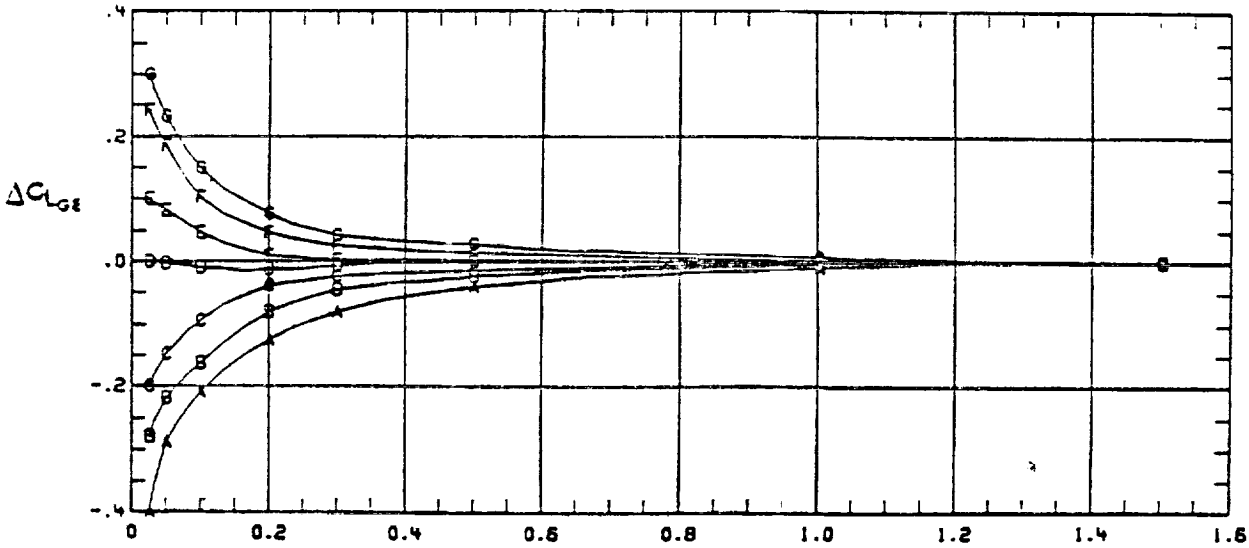
Landing Gear Down



$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -20.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} =$ All



Reference Point for h/b
X_o 1506.84
Z_o 282.71

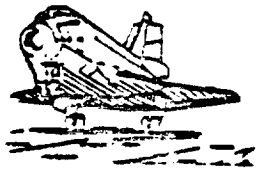
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	-0.40000	-0.28000	-0.20000	0.0	0.10000	0.24000	0.30000
0.050	-0.29000	-0.22000	-0.15000	-0.00340	0.08070	0.18380	0.23000
0.100	-0.21000	-0.16320	-0.09440	-0.01120	0.04600	0.10170	0.14910
0.200	-0.12500	-0.08060	-0.03940	-0.01390	0.00910	0.04560	0.07590
0.300	-0.08000	-0.04600	-0.02500	-0.00730	0.00100	0.02450	0.04000
0.500	-0.04000	-0.02500	-0.01500	-0.00110	0.0	0.01290	0.02610
1.000	-0.01000	-0.00500	-0.00400	-0.00200	0.0	0.00200	0.00500
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE 9-14-77
REVISED

Figure 4.1.2.1-101
GROUND EFFECT

Landing Gear Down

$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$



CONFIGURATION

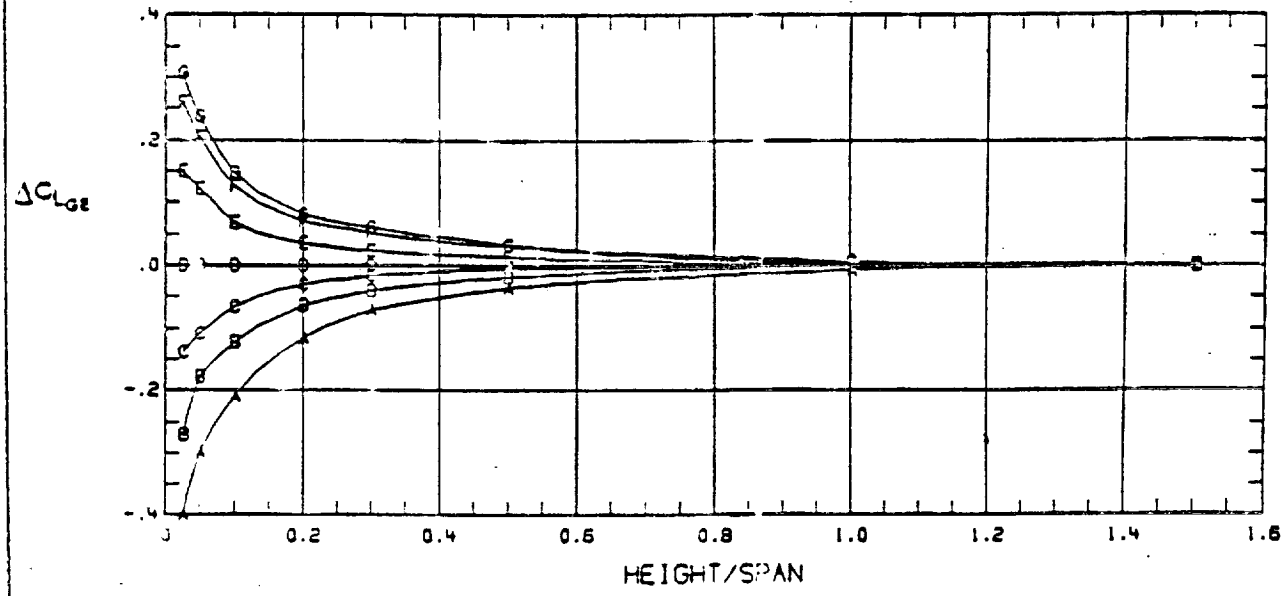
BASELINE ORBITER VEHICLE

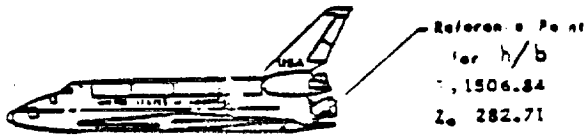
CENTER OF GRAVITY X_{cg} = 1078.78
OR Y_{cg} = 0.00
MOMENT REFERENCE Z_{cg} = 375.00

REFERENCE DIMENSIONS

AREA S_{ref} = 2690.000 ft²
SPAN b_{ref} = 78.056 ft
MAC c_{ref} = 39.560 ft
BODY LENGTH L_b = 1296.000 in

$\delta_e = -15.000°$ $\delta_{sf} = -11.7°$ $\delta_{sb} = All$





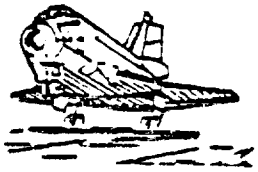
Reference Point for h/b
Y_e = 1506.84
Z_e = 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	-0.40000	-0.27000	-0.14000	0.0	0.15000	0.26000	0.30500
0.050	-0.29910	-0.18050	-0.11010	0.0	0.12070	0.20270	0.23480
0.100	-0.20950	-0.12330	-0.06700	0.	0.06740	0.12590	0.14680
0.200	-0.11600	-0.06520	-0.03070	0.0	0.03340	0.06910	0.08150
0.300	-0.07140	-0.04130	-0.01790	0.0	0.02250	0.05120	0.05870
0.500	-0.03660	-0.01900	-0.00550	0	0.01210	0.02830	0.03280
1.000	-0.00800	-0.00200	-0.00100	0.0	0.00200	0.00400	0.00600
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE 9-14-77
REVISED:

Figure 4.1.2.-102
GROUND EFFECT

Landing Gear Down



$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

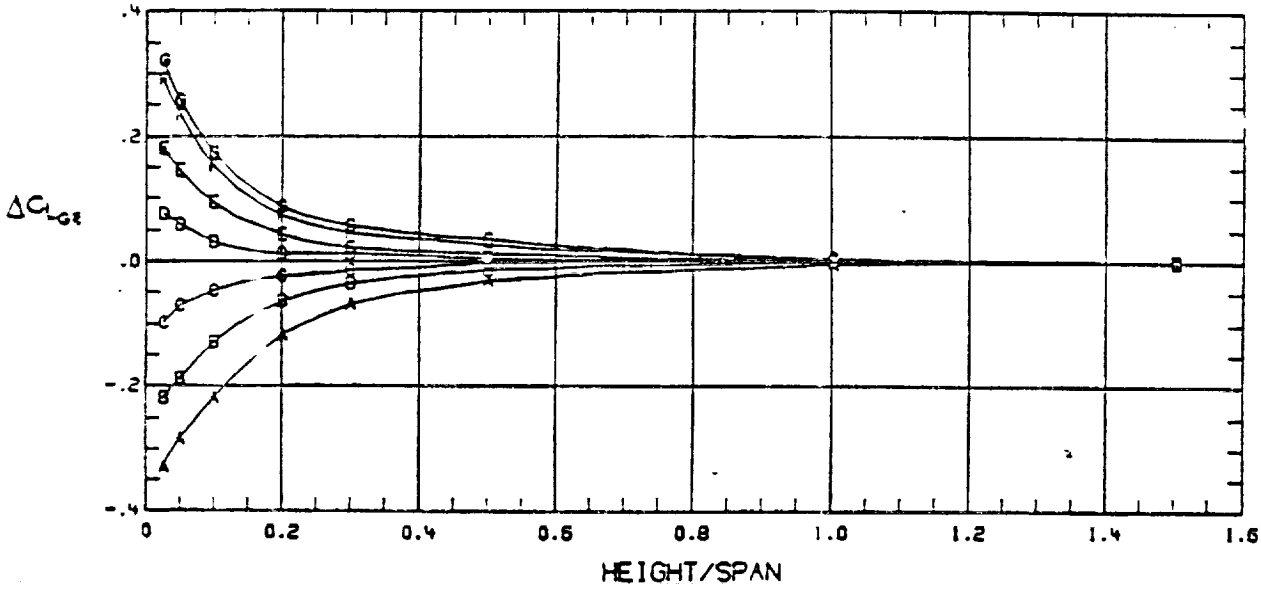
AREA

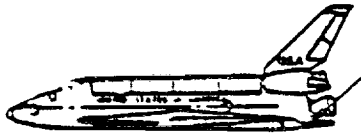
SPAN

MAC

BODY LENGTH

$\delta_e = -10.000°$ $\delta_{s_F} = -11.7°$ $\delta_{s_B} = All$





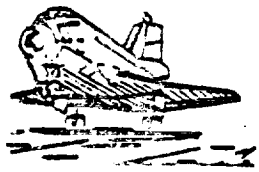
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	-0.33000	-0.22000	-0.10000	0.07500	0.18000	0.29000	0.32000
0.050	-0.28500	-0.18780	-0.07180	0.05800	0.14380	0.23290	0.25590
0.100	-0.22030	-0.13060	-0.04780	0.03000	0.09280	0.15150	0.17360
0.200	-0.11880	-0.06380	-0.02430	0.01000	0.04120	0.07060	0.08500
0.300	-0.07030	-0.03630	-0.01640	0.01090	0.02000	0.04380	0.05450
0.500	-0.03220	-0.01530	-0.00440	0.00440	0.01000	0.02550	0.03310
1.000	-0.00700	-0.00200	0.0	0.0	0.00100	0.00200	0.00300
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE 9-14-77
REVISED

Figure 4.1.2.1-10
GROUND EFFECT

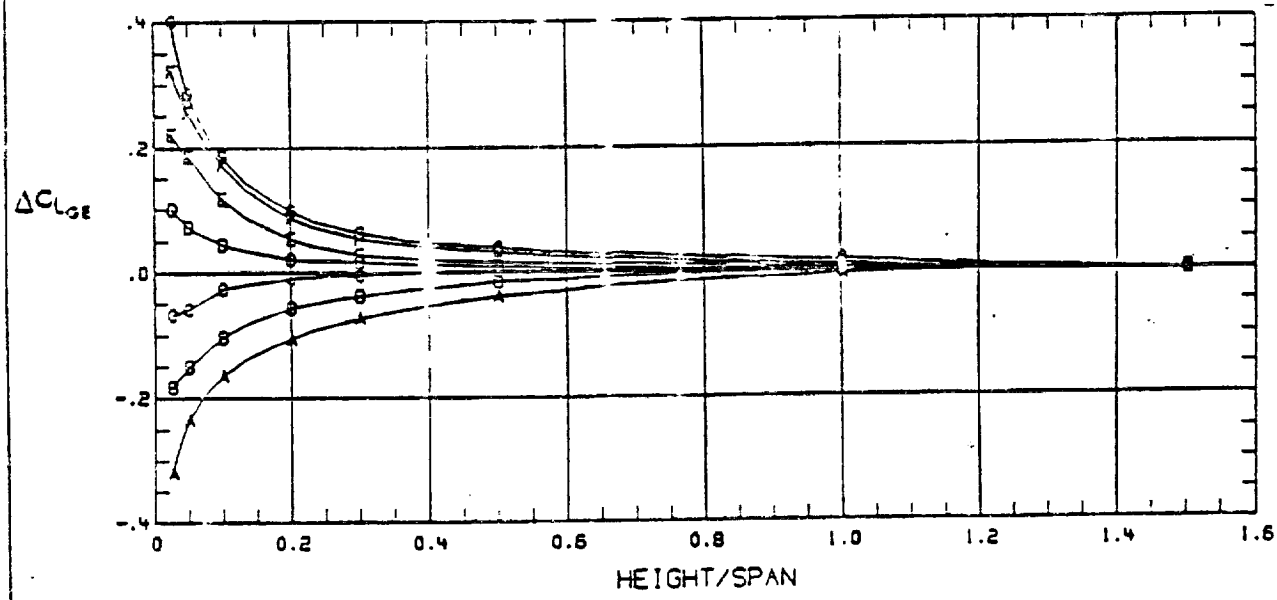
Landing Gear Down

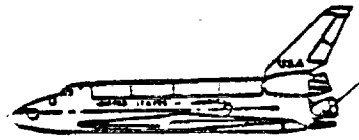


$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY X_{cg} = 1076.78
OR Y_{cg} = 0.00
MOMENT REFERENCE Z_{cg} = 375.00
REFERENCE DIMENSIONS
AREA S_w = 2690.000 ft²
SPAN b_w = 78.056 ft
MAC c_w = 35.569 ft
BODY LENGTH l_b = 1296.300 in

$\delta_e = \pm 5.000°$ $\delta_{SF} = -11.7°$ $\delta_{SB} =$ All



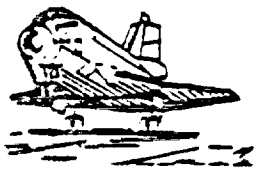


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	-0.32000	-0.18500	-0.07000	0.10000	0.22000	0.32000	0.40000
0.050	-0.23500	-0.15240	-0.05900	0.07200	0.18380	0.25480	0.28440
0.100	-0.18620	-0.10430	-0.02760	0.04430	0.11720	0.16900	0.18370
0.200	-0.10580	-0.05860	-0.01070	0.02090	0.05260	0.08590	0.09760
0.300	-0.07300	-0.03760	-0.00480	0.01530	0.02770	0.05230	0.06100
0.500	-0.03850	-0.01610	0.00170	0.00830	0.01530	0.03130	0.03770
1.000	-0.00600	0.0	0.0	0.00300	0.00700	0.01100	0.01700
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 4-14-77
REVISED:

Figure 4.1.2.1-104
GROUND EFFECT

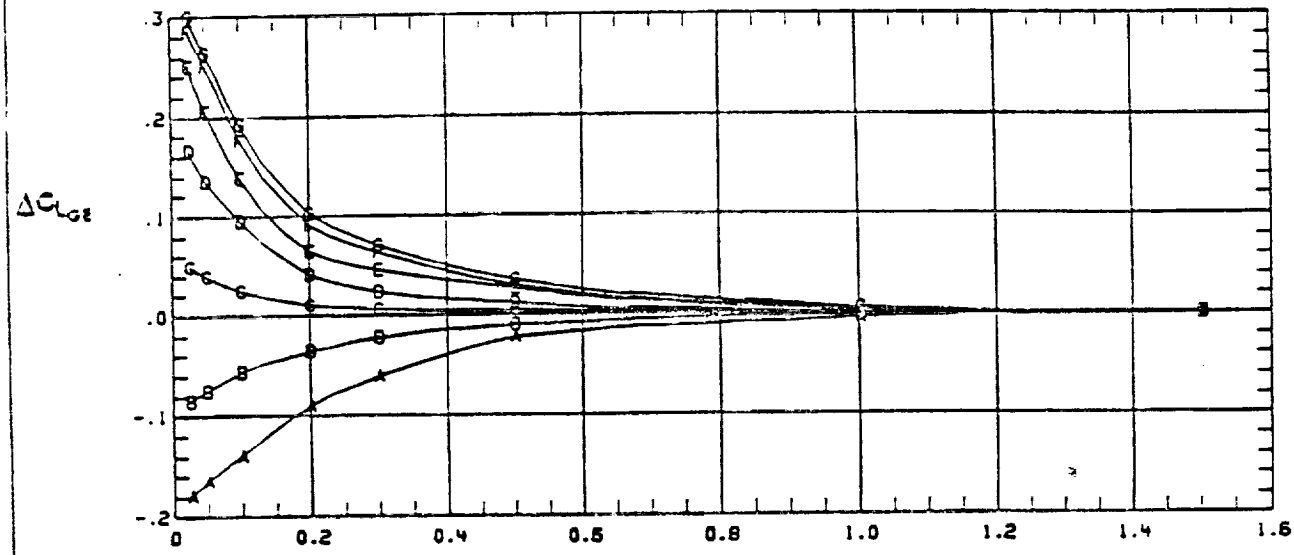
Landing Gear Down

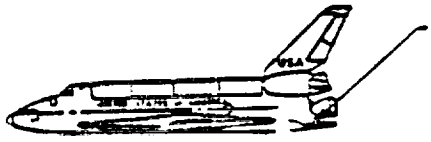


$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 0.0°$ $\delta_{BF} = -11.7°$ $\delta_{SB} = \underline{All}$





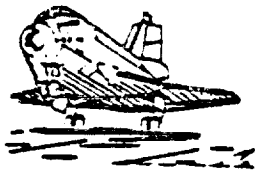
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	-0.18000	0.08500	0.05000	0.16500	0.25000	0.28500	0.30000
0.050	-0.16500	-0.07520	0.03930	0.13490	0.20540	0.25040	0.26350
0.100	-0.13920	-0.05580	0.02480	0.09540	0.13690	0.17580	0.19110
0.200	-0.08950	-0.03590	0.01010	0.04040	0.06390	0.09060	0.10230
0.300	-0.06060	-0.02230	0.00510	0.02230	0.04450	0.06200	0.06940
0.500	-0.02240	-0.01080	0.00350	0.01090	0.02580	0.02900	0.03430
1.000	-0.00500	-0.00200	0.0	0.0	0.00200	0.00400	0.00600
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JJ
DATE: 9-14-77
REVISED:

Figure 4.1.2.1-105
GROUND EFFECT

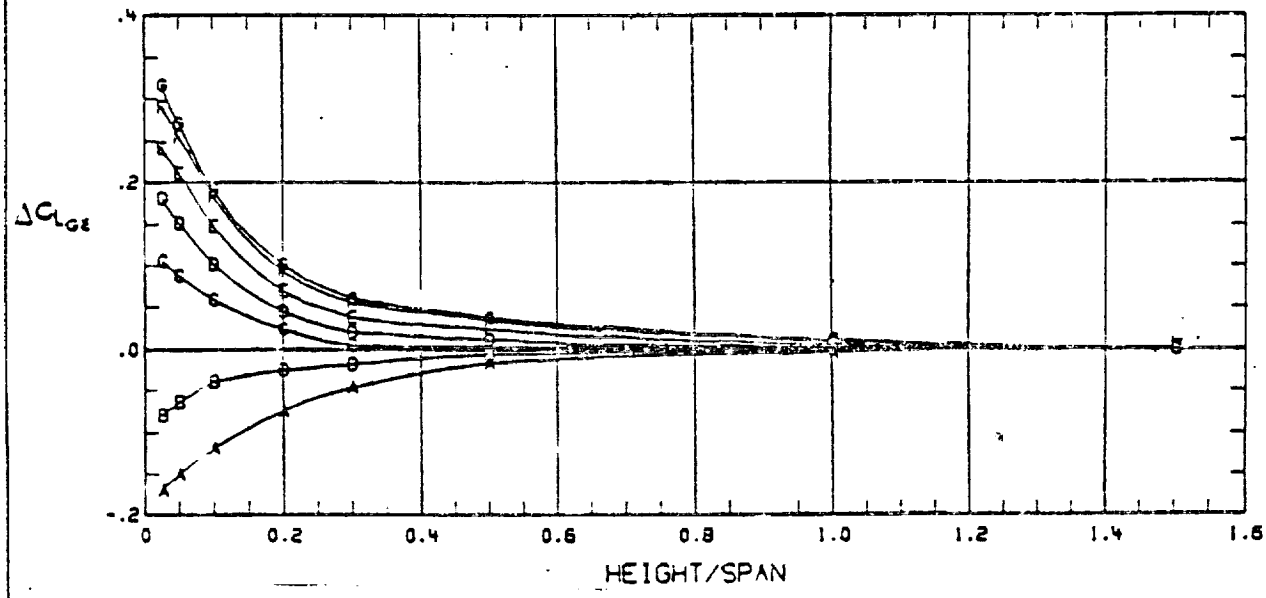
Landing Gear Down

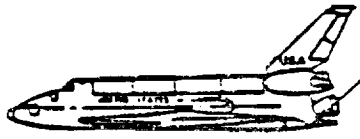
$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$



CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 5.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} = All$



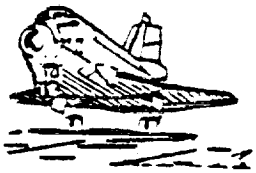


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	-0.17000	-0.08000	0.10500	0.18000	0.24000	0.29000	0.31500
0.050	-0.15000	-0.06530	0.08710	0.14950	0.20970	0.25380	0.27000
0.100	-0.11990	-0.04020	0.05890	0.10160	0.14710	0.18220	0.19030
0.200	-0.07430	-0.02620	0.02280	0.04370	0.06890	0.09190	0.10100
0.300	-0.04650	-0.01830	0.00330	0.01980	0.03720	0.05500	0.06070
0.500	-0.01870	-0.00710	0.00240	0.01070	0.02260	0.03470	0.03840
1.000	-0.00400	-0.00200	0.0	0.00200	0.00600	0.01000	0.01200
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER JJ
DATE 9-14-77
REVISED

Figure 4.1.2.1-106
GROUND EFFECT

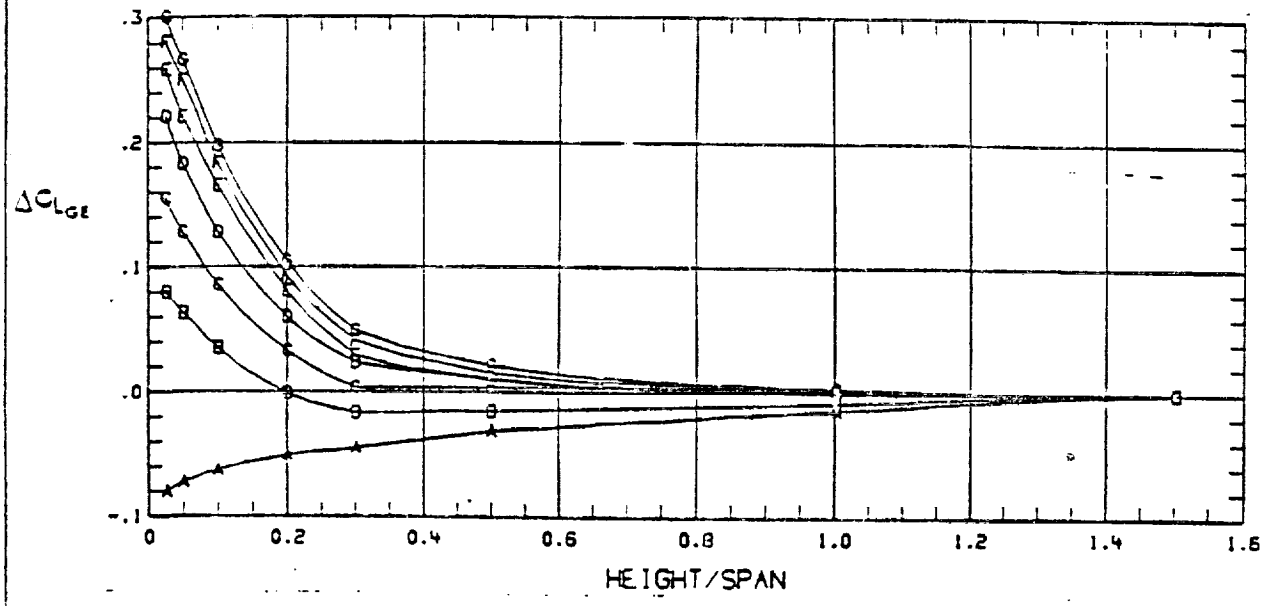
Landing Gear Down



$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 10.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} = All$

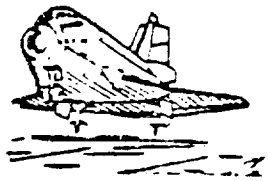


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	-0.08000	0.08000	0.15500	0.22000	0.25800	0.29000	0.30000
0.050	-0.07210	0.06360	0.12770	0.18310	0.22000	0.24930	0.26550
0.100	-0.06240	0.03460	0.08520	0.12810	0.16530	0.18240	0.19710
0.200	-0.05090	-0.00130	0.03260	0.05960	0.08070	0.09270	0.10390
0.300	-0.04490	-0.01670	0.00330	0.02310	0.02850	0.04080	0.04850
0.500	-0.03130	-0.01520	0.00380	0.00980	0.00950	0.01550	0.02100
1.000	-0.01400	-0.00800	0.0	0.0	0.00100	0.00200	0.00300
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE 9-14-77
REVISED

Figure 4.1.2.1-107
GROUND EFFECT

Landing Gear Down



$$\Delta C_{L_{GROUND\ EFFECT}} = C_{L_{GROUND\ EFFECT}} - C_{L_{FREE\ STREAM}}$$

CONFIGURATION

BASELINE ORBITER (ENCLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

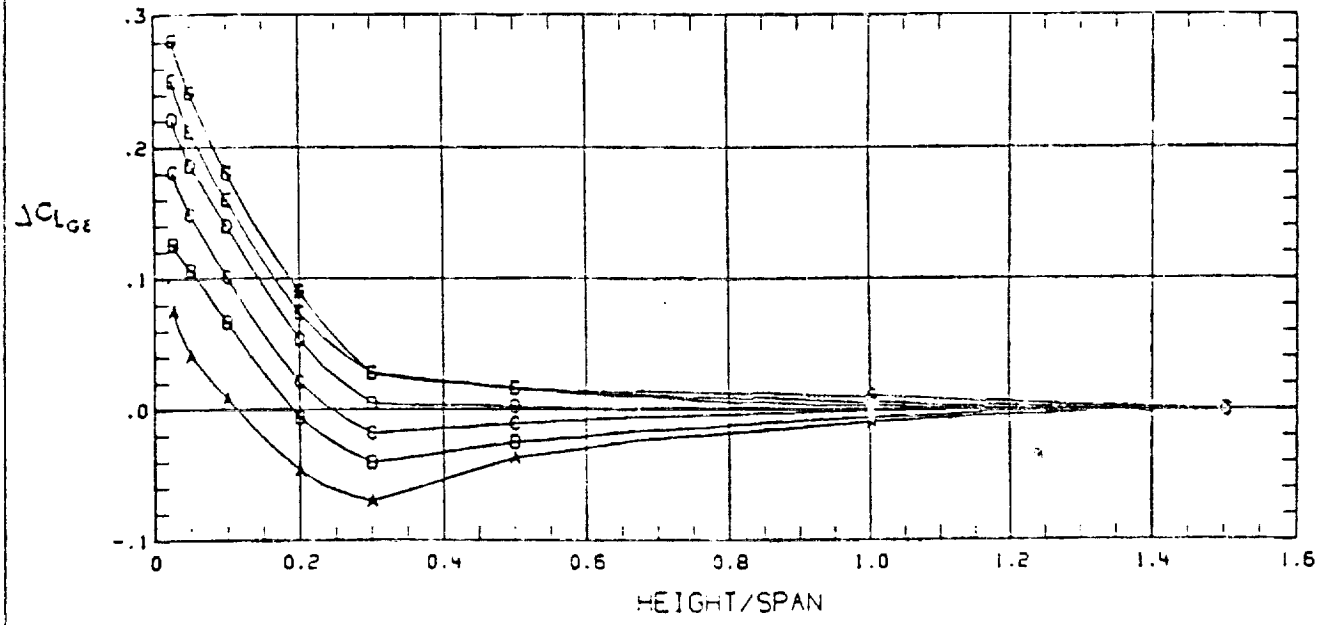
AREA

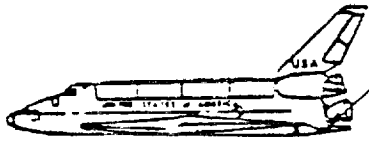
SPAN

MAC

BODY LENGTH

$\delta_e = 15.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$





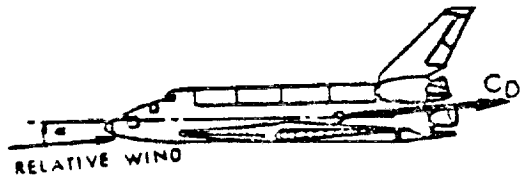
Reference Point for h/b
X_o 15-6.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Lift Force Coefficient, $\Delta C_{L_{GRND\ EFFECT}}$						
0.025	0.07500	0.12500	0.16000	0.22000	0.25000	0.28000	0.28000
0.050	0.04090	0.10500	0.14790	0.18560	0.21050	0.24300	0.24000
0.100	0.00840	0.06640	0.10060	0.13890	0.15870	0.18090	0.17900
0.200	-0.04650	-0.00560	0.02140	0.05310	0.07330	0.08930	0.08960
0.300	-0.06910	-0.03980	-0.01810	0.00420	0.02790	0.02920	0.02740
0.500	-0.03700	-0.02480	-0.01050	0.00240	0.01620	0.01650	0.01640
1.000	-0.01000	-0.00600	-0.00200	0.0	0.00300	0.00600	0.01000
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE
REVISED

Figure 4.1.2.1-108
GROUND EFFECT

4.1.2.2 DRAG COEFFICIENT. The Orbiter Vehicle aerodynamic drag force coefficient is defined in this section. The basic aerodynamic drag force coefficient data are presented in three forms: 1) as a function of angle of attack and Mach number from 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_{\infty}^{1}$) from 0.005 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet to 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.1.1.2]. Uncertainties associated with the drag force characteristics are available in Section 6.0.



The RCS flow field interaction data are presented as a contribution to the drag force (D) rather than the coefficient (C_D) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where the RCS is used in conjunction with the aerodynamic force (cf. Section 3.6); i.e., the aerodynamic coefficient must be converted to a dimensional force *before* adding the RCS flow field interaction effect (see also Appendix B).

The total drag force is:

$$D_{TOTAL} = \bar{q}\, S\, C_{D_{\substack{TOTAL \\ AERO}}} + D_{RCS}$$

* The total aerodynamic drag force coefficient is obtained by the following equation:

$$C_{D_{\substack{TOTAL \\ AERO}}} = C_{D_{BASIC}} + [\Delta C_{D_{ELEVATOR}} + \Delta C_{D_{AILERON}}]_{ELEVON} + \Delta C_{D_{\substack{BODY \\ FLAP}}} + \Delta C_{D_{RUDDER}} + \Delta C_{D_{\substack{SPEED \\ BRAKE}}}$$

$$+ \Delta C_{D_{FLEX}} + \Delta C_{D_{\substack{LANDING \\ GEAR}}} + \Delta C_{D_{\substack{GROUND \\ EFFECT}}} + \Delta C_{D_{\substack{SILTS \\ POD}}}$$

where,

$C_{D_{BASIC}}$ = Basic, full-scale, freestream, rigid body drag force coefficient. (Figures 4.1.2.2-1 through -6)

NOTE: 1. All control surfaces neutral *except* $\delta_{SB} = 25°$.

* Refer to Appendix D when using digitized data.

$\Delta C_{D_{ELEVATOR}}$ = Change in drag force coefficient due to elevon (elevator) deflection, δ_e. (Figures 4.1.2.2-7 through -35)

$\Delta C_{D_{AILERON}}$ = Change in drag force coefficient due to aileron deflection, δ_a.

$$= \frac{1}{2}(\Delta C_{D_{e_{\delta_e=\delta_{e_L}}}} + \Delta C_{D_{e_{\delta_e=\delta_{e_R}}}}) - \Delta C_{D_{e_{\delta_e=\delta_{e_{TRIM}}}}}$$

$\Delta C_{D_{BODY\ FLAP}}$ = Change in drag force coefficient due to body flap deflection, δ_{BF}. (Figures 4.1.2.2-36 through -65)

$\Delta C_{D_{RUDDER}}$ = Change in drag force coefficient due to rudder deflection, δ_r. (Assume zero)

$\Delta C_{D_{SPEED\ BRAKE}}$ = Change in drag force coefficient due to speed brake deflection, δ_{SB}. (Figures 4.1.2.2-66 through -92)

$\Delta C_{D_{FLEX}}$ = Change in drag force coefficient due to aeroelastic deformation.

$$= C_D^F - C_D^R$$

C_D^F corresponds to a rigid body value at an elevon setting corresponding to the flexible elevon hinge moment

$$\Delta C_{D_{FLEX}} = \Delta C^F_{D_{\bar{q}_{REF}=300psf}} \cdot \bar{q}/300$$

$C_{D_{\bar{q}_{REF}=300psf}}$ = Change in drag coefficient due to aeroelastic deformation for a dynamic pressure of 300 psf. (Figures 4.1.2.2-93 through-117)

NOTE: 1. Detailed discussion of aeroelasticity may be obtained from Appendix A.

$\Delta C_{D_{LANDING\ GEAR}}$ = Change in drag force coefficient due to extension of landing gear. (Figure 4.1.2.2-118)

NOTE: 1. Drag ratio for partial gear deployment. (Figure 4.1.2.2-119)

$\Delta C_{D_{GROUND\ EFFECT}}$ = Change in drag force coefficient due to proximity of ground f(h/b). (Figures 4.1.2.2-120 through -124)

$\Delta C_{D_{\substack{SILTS \\ POD}}}$ = Change in drag force coefficient due to addition of SILTS pod.

= $-0.00046471 + 0.000790212\,M - 0.000125976\,M^2$ for $M \leq 6.0$

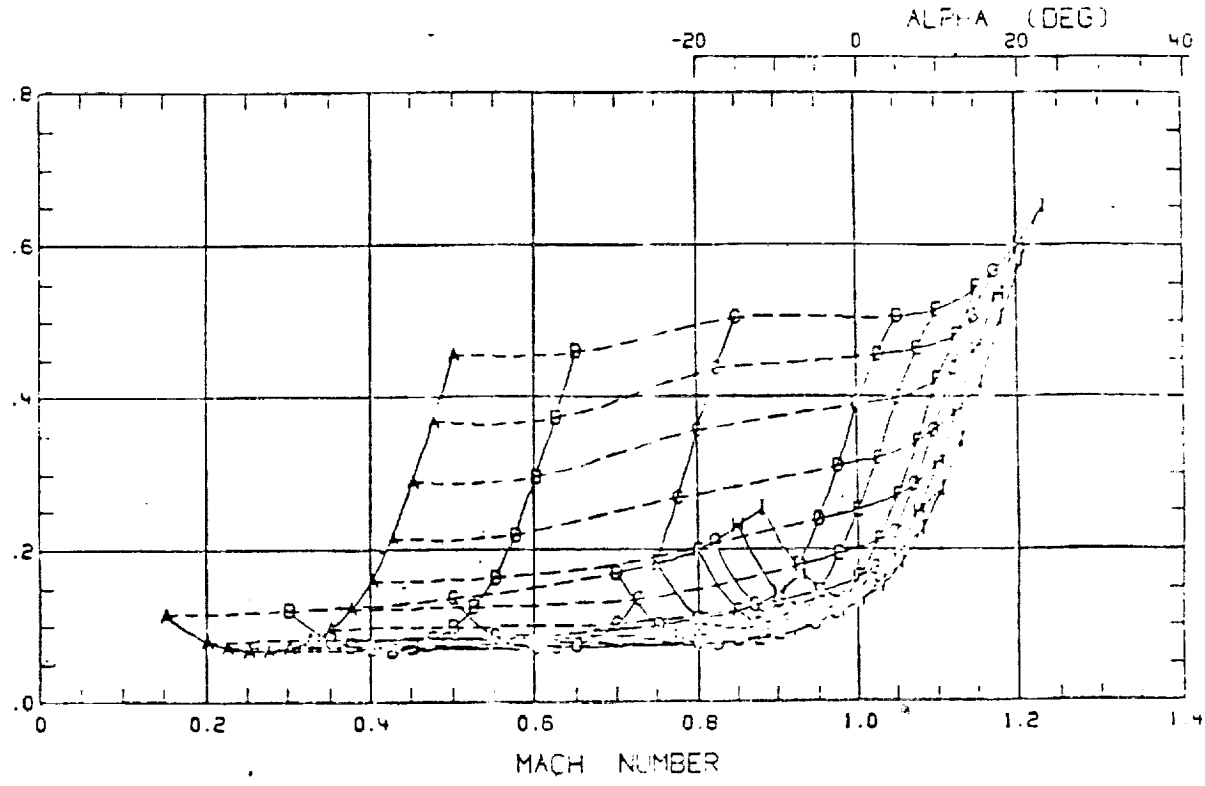
= zero for $M > 6.0$

To obtain the RCS flow field interaction effect on the drag force:

$$D_{RCS} = (N_{RCS} \sin \alpha + A_{RCS} \cos \alpha) - lb$$

where N_{RCS} and A_{RCS} are obtained from Sections 4.1.1.1 and 4.1.1.2, respectively.

* Refer to Appendix D when using digitized data.



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

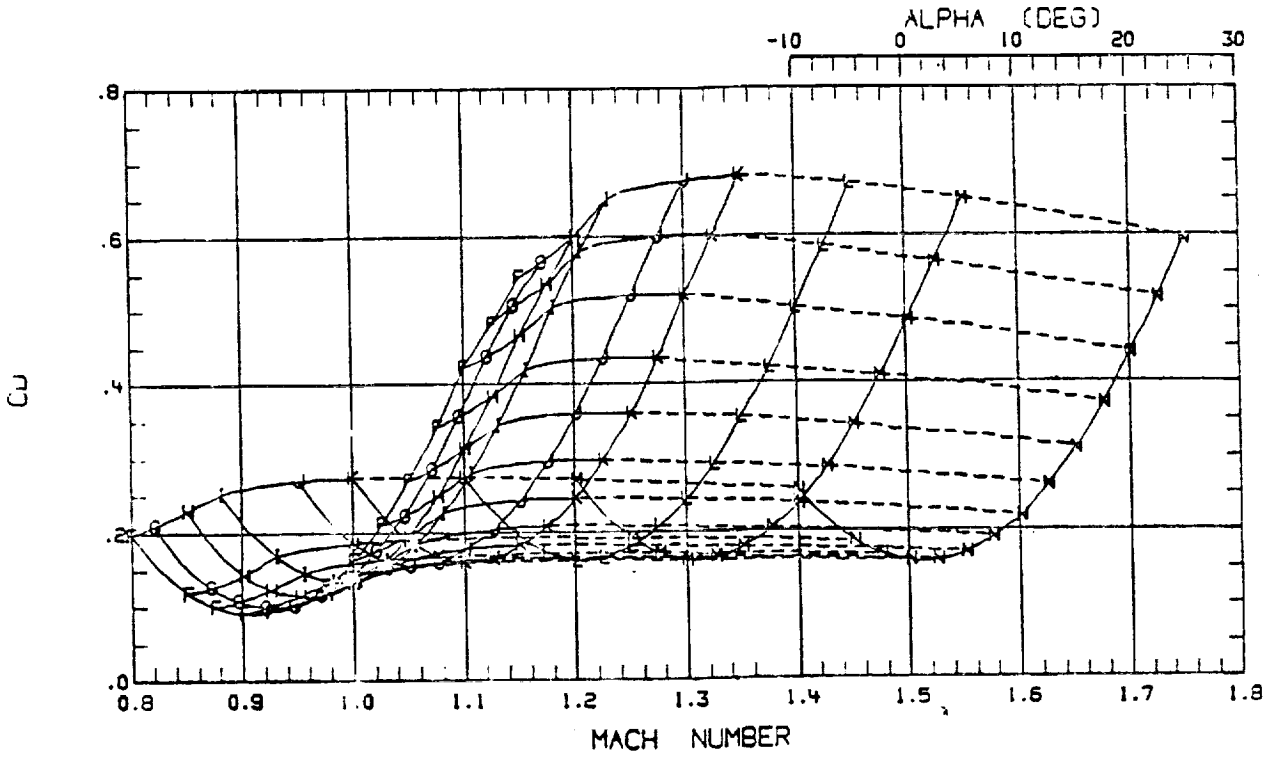
WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C CW = 39.560 FT.
BODY LENGTH LB = 1291.3 IN.

DRAG COEFFICIENT

ALPHA (DEG)	MACH NUMBER 0.350 A	0.400 B	0.600 C	0.800 D	0.850 E	0.900 F	0.950 G	0.980 H	0.9... I
-10.000	0.11425	0.11975	0.13921	0.16357	0.16854	0.19703	0.20667	0.21989	0.2...
-5.000	0.07585	0.08119	0.08489	0.09953	0.10788	0.11831	0.12552	0.14227	0.1...
-2.500	0.07170	0.07263	0.07517	0.08323	0.08875	0.09887	0.10710	0.12269	0.1...
0.0	0.06740	0.06810	0.07020	0.07630	0.08030	0.09070	0.09960	0.11450	0.1...
2.500	0.06687	0.05747	0.07011	0.07557	0.08018	0.09309	0.10180	0.11702	0.1...
5.000	0.07338	0.07096	0.07250	0.08175	0.08916	0.10574	0.11519	0.13127	0.1...
7.500	0.08056	0.08145	0.08464	0.10038	0.10980	0.12750	0.13806	0.15696	0.1...
10.000	0.09599	0.09775	0.10146	0.13188	0.14389	0.16155	0.17477	0.19689	0.2...
12.500	0.11125	0.12444	0.13381	0.17827	0.19190	0.21031	0.22196	0.24823	0.2...
15.000	0.16784	0.16278	0.18832	0.23803	0.25455	0.27066	0.28350	0.31191	0.3...
17.500	0.21346	0.21758	0.26537	0.30939	0.31973	0.34168	0.35577	0.38262	0.4...
20.000	0.28369	0.28389	0.35519	0.38957	0.39759	0.42137	0.43584	0.46456	0.4...
22.500	0.36851	0.37144	0.43592	0.45493	0.46103	0.46172	0.50467	0.53313	0.5...
25.000	0.46537	0.45790	0.50401	0.50539	0.51175	0.54316	0.56346	0.59974	0.6...
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.1.2.2 -1
BASIC DRAG COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

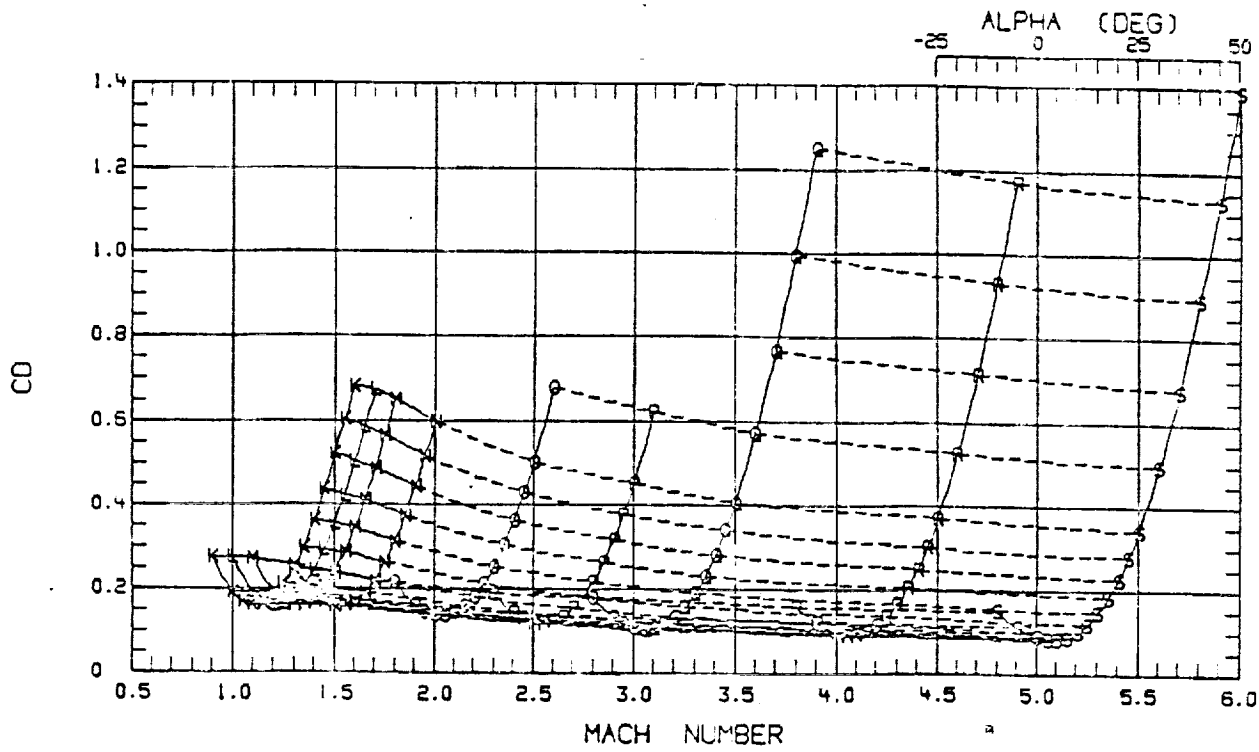
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	0.900 F	0.920 G	0.950 H	0.980 I	1.050 J	1.100 K	1.200 L	1.300 M	1.500 N
ALPHA (DEG)	DRAG COEFFICIENT								
-10.000	0.19703	0.20867	0.22925	0.25227	0.26933	0.27358	0.27477	0.27037	0.25326
-5.000	0.11831	0.12552	0.14223	0.16817	0.18470	0.18942	0.19259	0.19067	0.18445
-2.500	0.09887	0.10710	0.12269	0.14461	0.16251	0.16647	0.17013	0.16958	0.16572
0.0	0 09070	0.09900	0.11450	0.13460	0.15410	0.15840	0.16140	0.16110	0.15770
2.500	0.09309	0.10180	0.11702	0.13644	0.15935	0.16376	0.16502	0.16395	0.15862
5.000	0.10574	0.11515	0.13127	0.15286	0.17724	0.18173	0.18139	0.17783	0.16938
7.500	0.12750	0.13806	0.15696	0.18221	0.20398	0.20794	0.20709	0.20226	0.18964
10.000	0.16156	0.17477	0.19588	0.22487	0.24256	0.24495	0.24298	0.23613	0.21755
12.500	0.21031	0.22196	0.24823	0.27902	0.29479	0.29645	0.29055	0.28325	0.25989
15.000	0.27066	0.28350	0.31191	0.34259	0.35909	0.35895	0.35301	0.34037	0.30958
17.500	0.34168	0.35577	0.38252	0.41746	0.43401	0.43355	0.42081	0.40809	0.37008
20.000	0.42137	0.43584	0.46452	0.50331	0.51932	0.52016	0.50090	0.48367	0.43922
22.500	0.48172	0.50467	0.53313	0.57864	0.59902	0.59994	0.58377	0.56200	0.51308
25.000	0.54316	0.56348	0.59974	0.65071	0.67457	0.67979	0.67010	0.64751	0.59368
30.000									
35.000									
40.000									
45.000									
50.000									

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.2.2 -2
BASIC DRAG COEFFICIENT



CONFIGURATION

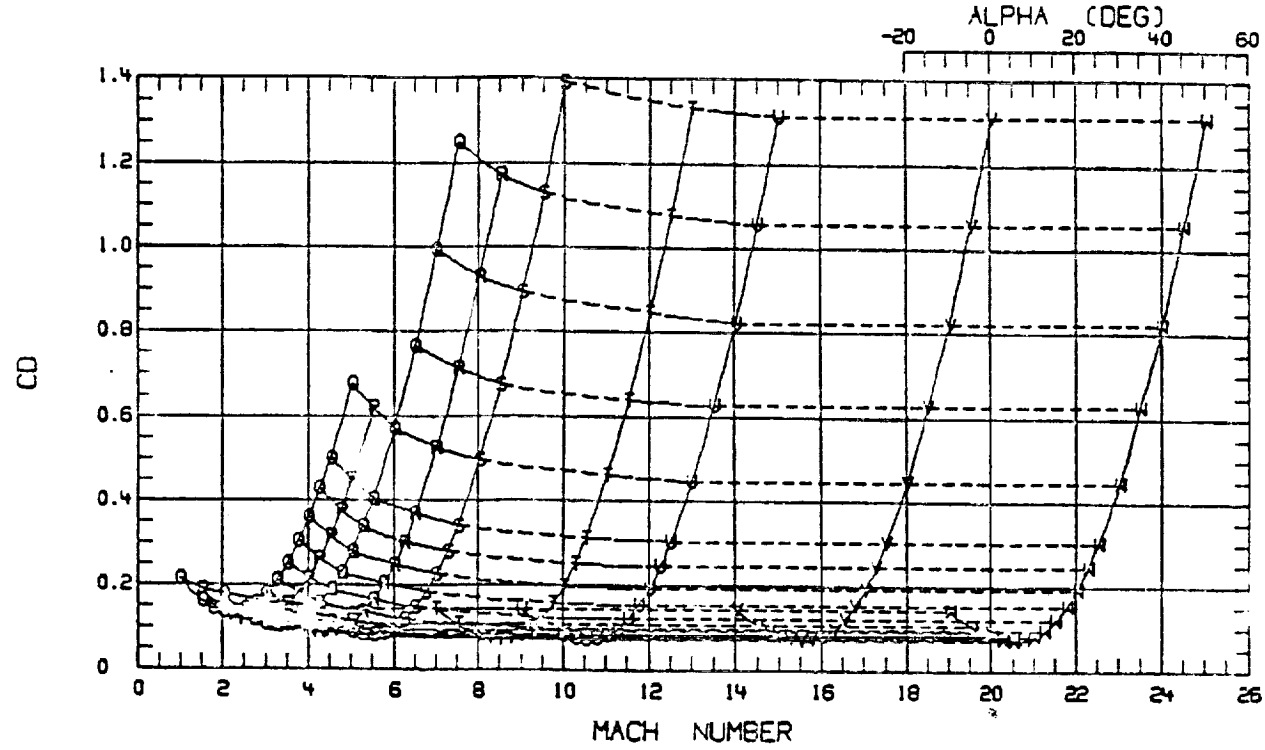
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	REFERENCE DIMENSIONS	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	1.100	1.200	1.300	1.500	2.000	2.500	3.000	4.000	5.000
ALPHA (DEG)	K	L	M	N	O	P	Q	R	S
	DRAG COEFFICIENT								
-10.000	0.27358	0.27477	0.27037	0.25326	0.21167	0.18859	0.17640	0.15782	0.14843
-5.000	0.18942	0.19259	0.19067	0.18445	0.15837	0.14100	0.13105	0.11936	0.11165
-2.500	0.16647	0.17013	0.16958	0.16572	0.14245	0.12698	0.11599	0.10538	0.09795
0.0	0.15840	0.16140	0.16110	0.15770	0.13490	0.11860	0.10580	0.09430	0.08760
2.500	0.16376	0.16502	0.16395	0.15852	0.13500	0.11632	0.10399	0.08937	0.08226
5.000	0.18173	0.18139	0.17763	0.16938	0.14189	0.12068	0.10700	0.09063	0.08096
7.500	0.20794	0.20709	0.20226	0.18964	0.15579	0.13301	0.11677	0.09815	0.08634
10.000	0.24485	0.24298	0.23613	0.21755	0.17850	0.15244	0.13324	0.11238	0.09853
12.500	0.29645	0.29055	0.28325	0.25989	0.20958	0.17951	0.15649	0.13380	0.11760
15.000	0.35895	0.35301	0.34037	0.30958	0.24932	0.21476	0.18711	0.16342	0.14482
17.500	0.43356	0.42081	0.40809	0.37008	0.30079	0.25990	0.22679	0.20107	0.18106
20.000	0.52016	0.50090	0.48367	0.43922	0.35911	0.31286	0.27582	0.24672	0.22523
22.500	0.59994	0.58377	0.56200	0.51308	0.42462	0.37320	0.33639	0.29758	0.27765
25.000	0.67979	0.67010	0.64751	0.59368	0.49836	0.44700	0.40275	0.36614	0.33893
30.000	•••••••	•••••••	•••••••	•••••••	0.67501	0.61723	0.56977	0.52265	0.49216
35.000	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	0.76472	0.70975	0.67287
40.000	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	0.99301	0.92759	0.89062
45.000	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	1.24741	1.16885	1.12550
50.000	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	•••••••	1.38996

ENGINEER [illegible]
DATE 10-3-78

FIGURE 4.1.2.2 - 3
BASIC DRAG COEFFICIENT



CONFIGURATION

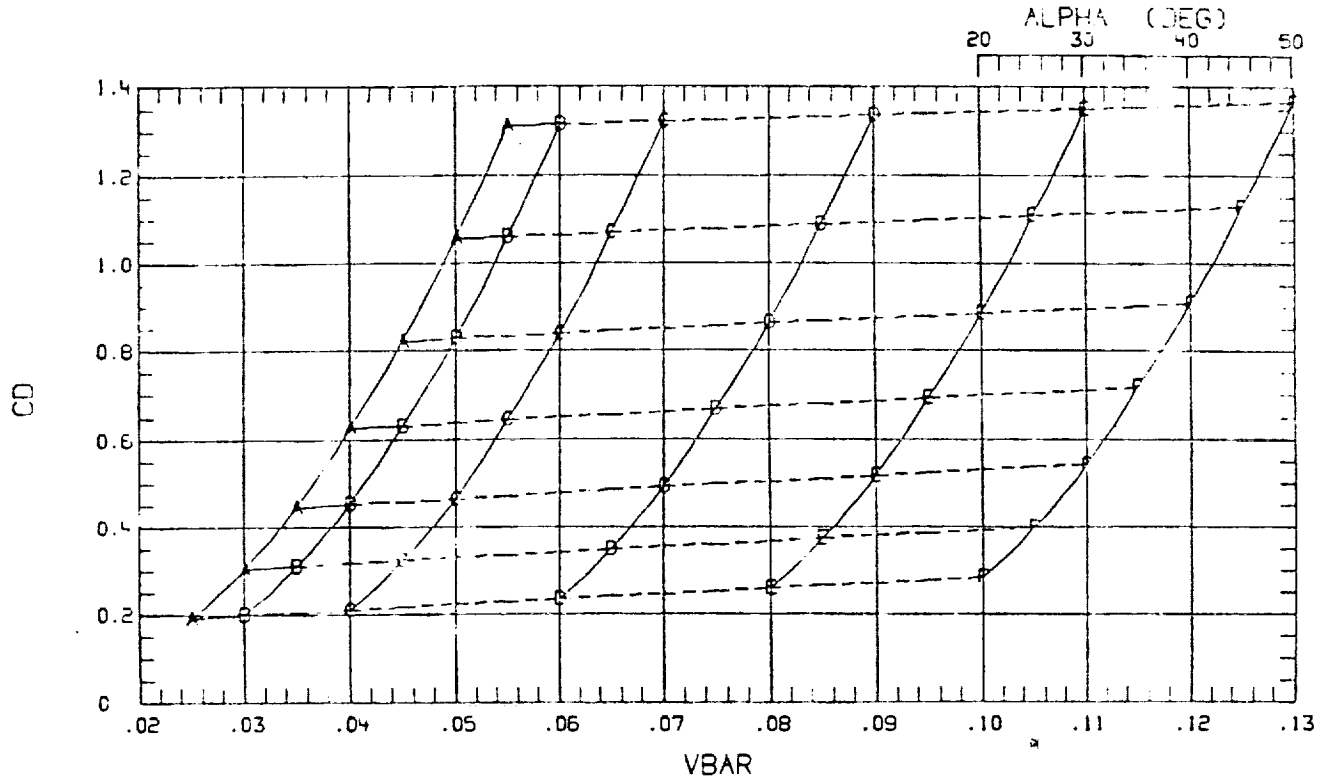
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.		REFERENCE DIMENSIONS	
OR	YO = BL 0.0 IN.		WING AREA	SW = 2690.00 SQ.FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		WING SPAN	BW = 78.056 FT.
			M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	2.000	2.500	3.000	4.000	5.000	8.000	10.000	15.000	20.000
	Q	P	O	R	S	T	U	V	W
ALPHA (DEG)	DRAG COEFFICIENT								
-10.000	0.21167	0.18859	0.17640	0.15782	0.14843	0.14122	0.14122	0.14122	0.14122
-5.000	0.15837	0.14100	0.13105	0.11936	0.11165	0.10501	0.10501	0.10501	0.10501
-2.500	0.14245	0.12698	0.11599	0.10538	0.09795	0.09067	0.09067	0.09067	0.09067
0.0	0.13490	0.11860	0.10680	0.09430	0.08760	0.08000	0.08000	0.08000	0.08000
2.500	0.13500	0.11632	0.10399	0.08937	0.08226	0.07359	0.07359	0.07359	0.07359
5.000	0.14189	0.12068	0.10700	0.09063	0.08096	0.07142	0.07140	0.07140	0.07140
7.500	0.15579	0.13301	0.11677	0.09815	0.08634	0.07402	0.07348	0.07348	0.07348
10.000	0.17850	0.15244	0.13324	0.11238	0.09853	0.08216	0.08059	0.08059	0.08059
12.500	0.20958	0.17951	0.15649	0.13380	0.11760	0.09780	0.09544	0.09544	0.09544
15.000	0.24932	0.21476	0.18711	0.16342	0.14482	0.12245	0.11931	0.11931	0.11931
17.500	0.30078	0.25990	0.22679	0.20107	0.18106	0.15697	0.15302	0.15302	0.15302
20.000	0.35911	0.31286	0.27582	0.24672	0.22523	0.19614	0.19178	0.19178	0.19178
22.500	0.42462	0.37320	0.33639	0.29758	0.27765	0.24878	0.24394	0.24394	0.24394
25.000	0.49836	0.44700	0.40275	0.36614	0.33893	0.30876	0.30372	0.30372	0.30372
30.000	0.67501	0.61723	0.56977	0.52265	0.49216	0.45821	0.44343	0.44343	0.44343
35.000	**********	**********	0.76472	0.70975	0.67287	0.63575	0.62404	0.62404	0.62404
40.000	**********	**********	0.99301	0.92759	0.89062	0.84440	0.82113	0.82113	0.82113
45.000	**********	**********	1.24741	1.16885	1.12550	1.07445	1.05430	1.05430	1.05430
50.000	**********	**********	**********	**********	1.38996	1.33019	1.31104	1.31104	1.31104

ENGINEER DSD
DATE 10-3-78

FIGURE 4.1.2.2 -4
BASIC DRAG COEFFICIENT



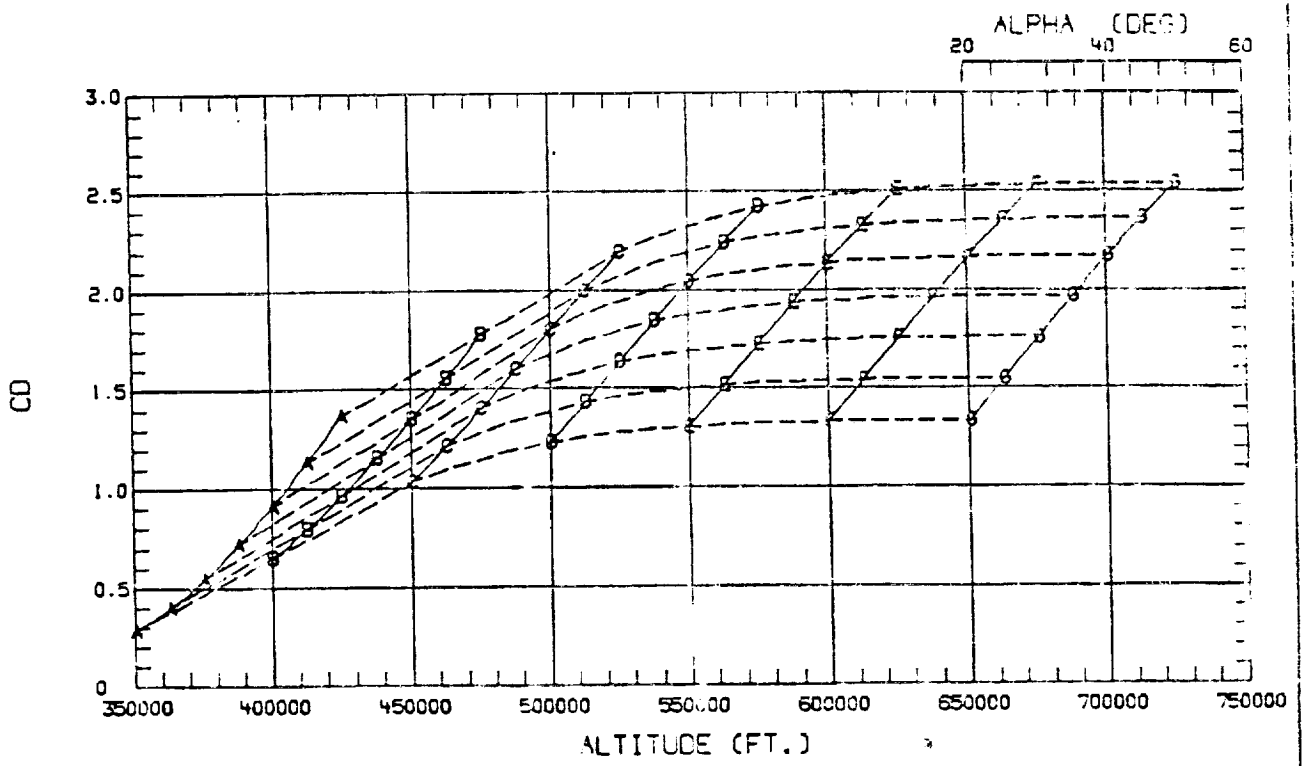
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005	0.010	0.020	0.040	0.060	0.080
	A	B	C	D	E	F
ALPHA (DEG)	VISCOUS DRAG COEFFICIENT					
20.000	0.19178	0.19769	0.21010	0.23454	0.25897	0.28340
25.000	0.30372	0.30998	0.32257	0.34768	0.37287	0.39798
30.000	0.44343	0.45002	0.46309	0.48925	0.51540	0.54155
35.000	0.62404	0.63034	0.64271	0.66745	0.69219	0.71693
40.000	0.82113	0.82696	0.83860	0.86196	0.88525	0.90862
45.000	1.05430	1.05910	1.06865	1.08781	1.10690	1.12607
50.000	1.31104	1.31464	1.32196	1.33655	1.35108	1.36612

ENGINEER NASA
DATE

FIGURE 4.1.2.2-5
BASIC DRAG COEFFICIENT

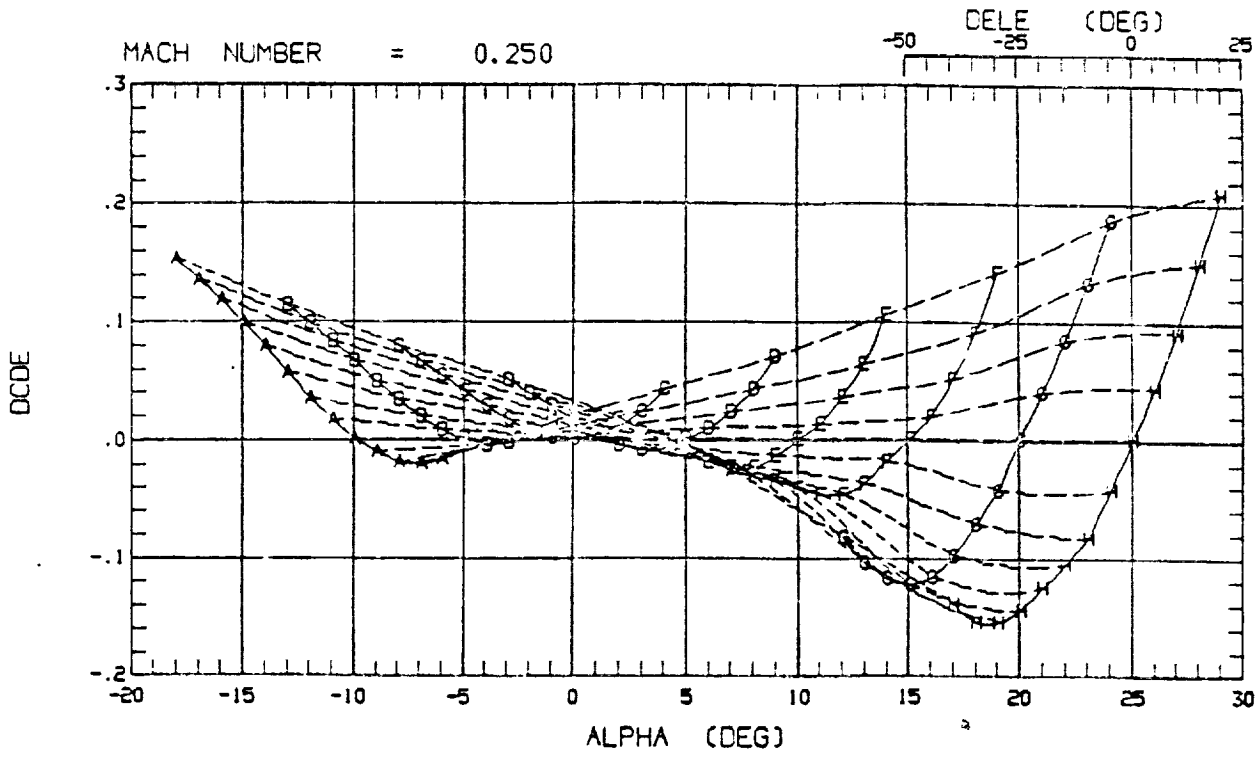


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE DRAG COEFFICIENT						
20.000	0.28340	0.64706	1.02612	1.22886	1.30559	1.32984	1.33384
25.000	0.39798	0.79518	1.20913	1.43058	1.51441	1.54093	1.54499
30.000	0.54155	0.96169	1.39974	1.63398	1.72258	1.75067	1.75496
35.000	0.71693	1.14872	1.59886	1.83961	1.93071	1.95952	1.96402
40.000	0.90862	1.34510	1.80019	2.04362	2.13565	2.16481	2.16930
45.000	1.12607	1.55259	1.99729	2.23516	2.32511	2.35360	2.35806
50.000	1.36612	1.77066	2.19139	2.41794	2.50327	2.53024	2.53444

ENGINEER NASA
DATE

FIGURE 4.1.2.2 -6
BASIC DRAG COEFFICIENT



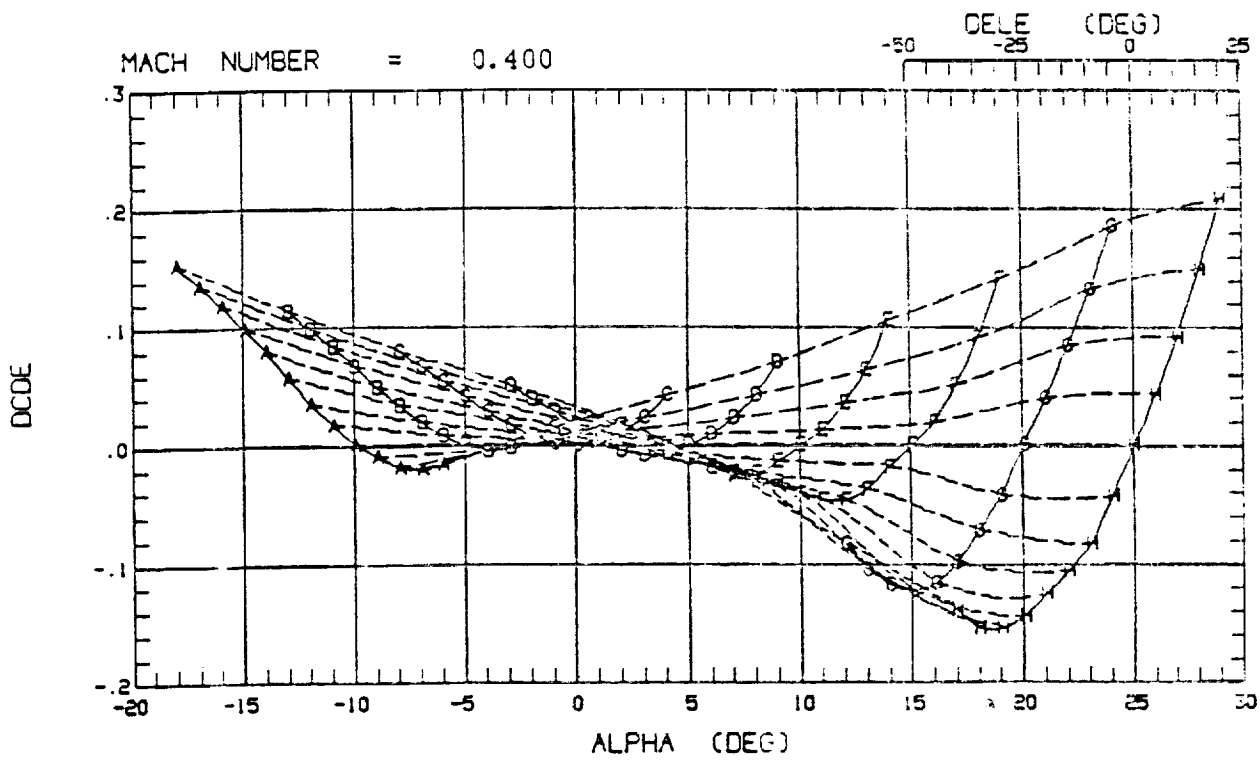
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.15260	0.11340	0.07960	0.04990	0.01760	-0.02620	-0.08370	-0.13910
-35.000	0.13560	0.09800	0.06700	0.03900	0.00800	-0.03100	-0.10440	-0.15370
-30.000	0.11870	0.08300	0.05400	0.02800	-0.00200	-0.03500	-0.11700	-0.15460
-25.000	0.09880	0.06700	0.04100	0.01700	-0.01100	-0.04100	-0.12200	-0.14380
-20.000	0.07830	0.04900	0.02800	0.00500	-0.01900	-0.04600	-0.11630	-0.12540
-15.000	0.05670	0.03400	0.01700	-0.00400	-0.02400	-0.04600	-0.09840	-0.10550
-10.000	0.03450	0.01900	0.00700	-0.00900	-0.02400	-0.03700	-0.07240	-0.08300
-5.000	0.01730	0.00800	0.00200	-0.00700	-0.01400	-0.01800	-0.04230	-0.04230
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00950	-0.00400	0.00400	0.00900	0.01300	0.02000	0.03970	0.04230
10.000	-0.01910	-0.00200	0.01200	0.02300	0.03600	0.05100	0.08400	0.09110
15.000	-0.02000	0.00400	0.02300	0.04200	0.06400	0.09000	0.13240	0.14920
20.000	-0.01650	0.01500	0.04200	0.07000	0.10600	0.14100	0.18530	0.20820

ENGINEER GCO
DATE 9/13/72

FIGURE 4.1.2.2-7
ELEVON DRAG COEFFICIENT INCREMENT



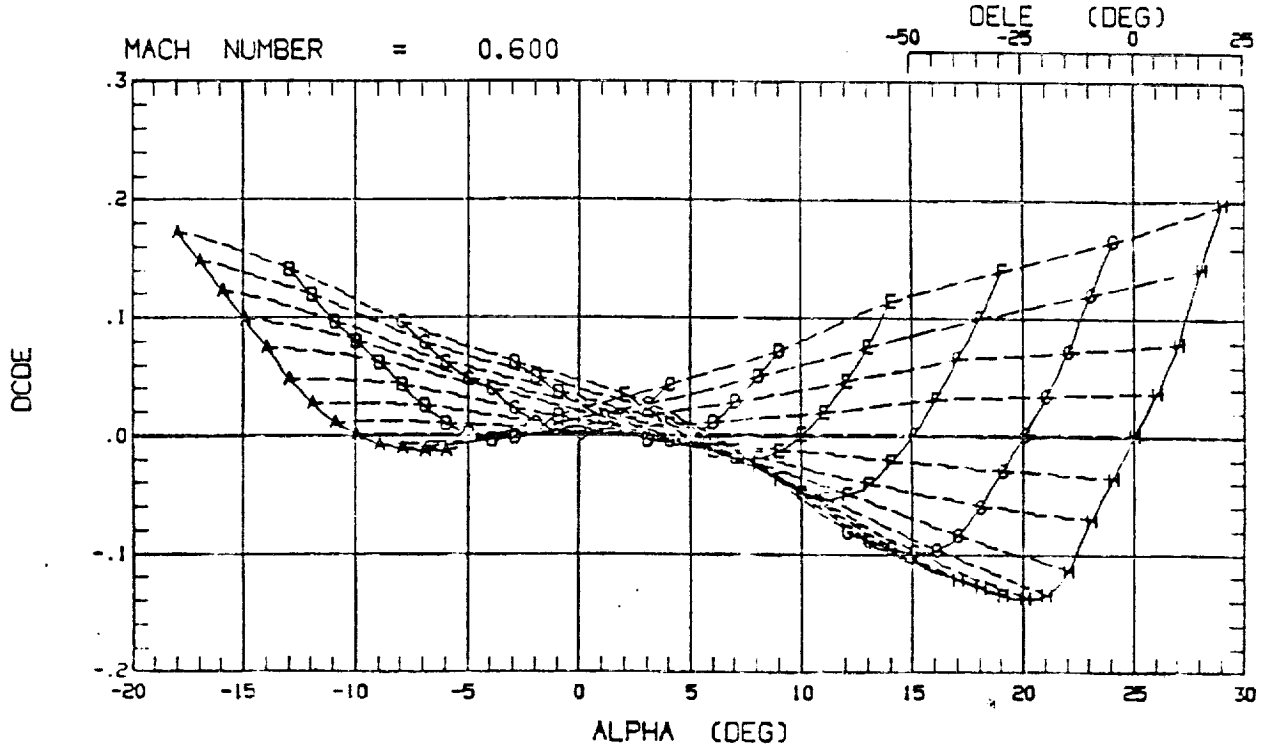
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.15260	0.11340	0.07960	0.04990	0.01760	-0.02620	-0.08370	-0.13910
-35.000	0.13560	0.09800	0.06700	0.03900	0.00800	-0.03100	-0.10440	-0.15370
-30.000	0.11870	0.08300	0.05400	0.02800	-0.00200	-0.03500	-0.11700	-0.15460
-25.000	0.09880	0.06700	0.04100	0.01700	-0.01100	-0.04100	-0.12200	-0.14380
-20.000	0.07890	0.04900	0.02800	0.00500	-0.01900	-0.04600	-0.11630	-0.12540
-15.000	0.05670	0.03400	0.01700	-0.00400	-0.02400	-0.04600	-0.09840	-0.10550
-10 000	0.03450	0.01900	0.00700	-0.00900	-0.02400	-0.03700	-0.07240	-0.08300
-5.000	0.01730	0.00800	0.00200	-0.00700	-0.01400	-0.01800	-0.04230	-0.04230
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00950	-0.00400	0.00400	0.00900	0.01300	0.02000	0.03970	0.04230
10.000	-0.01910	-0.00200	0.01200	0.02300	0.03600	0.05100	0.08400	0.09110
15.000	-0.02000	0.00400	0.02300	0.04200	0.06400	0.09000	0.13240	0.14920
20.000	-0.01650	0.01500	0.04200	0.07000	0.10600	0.14100	0.19530	0.20820

ENGINEER QCD
DATE 7/13/78

FIGURE 4.1.2.2-8
ELEVON DRAG COEFFICIENT INCREMENT



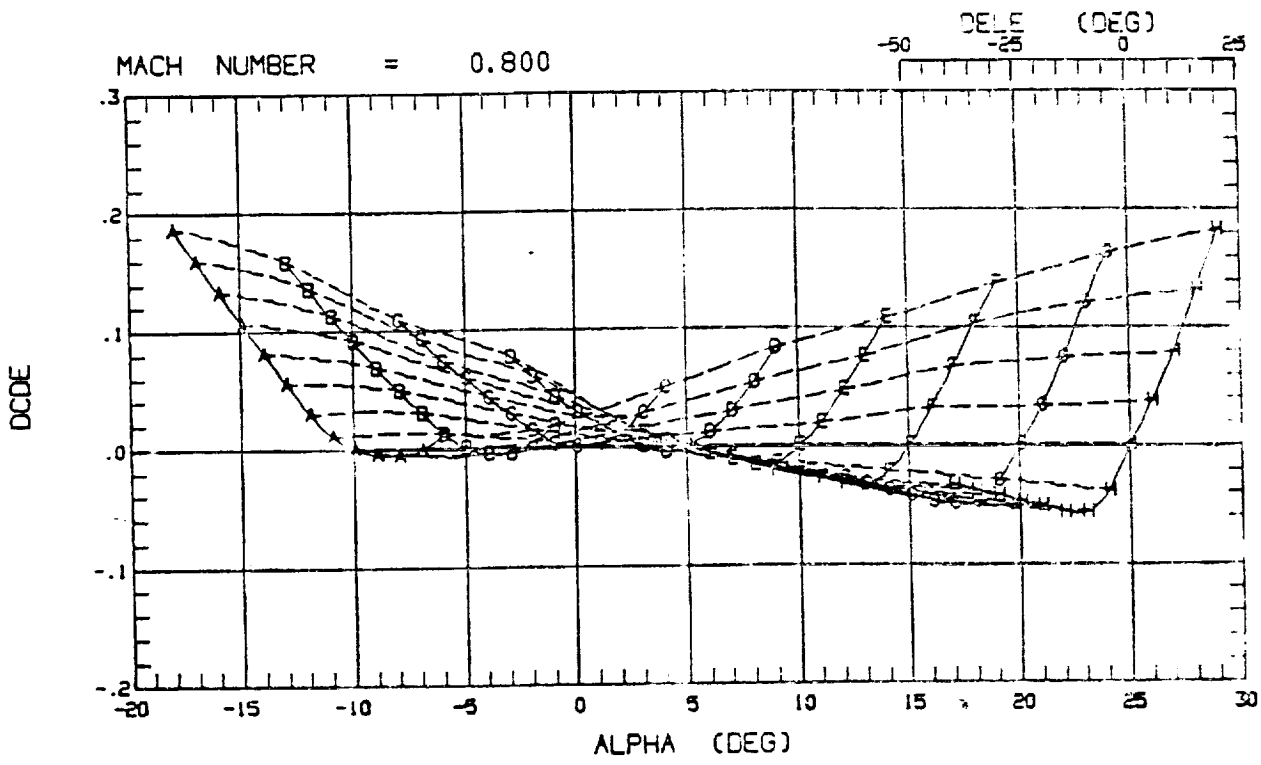
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.17170	0.14020	0.09560	0.06100	0.03400	-0.01300	-0.08190	-0.12270
-35.000	0.14710	0.11800	0.07800	0.04900	0.02100	-0.02570	-0.08900	-0.12930
-30.000	0.12260	0.09600	0.06100	0.03600	0.00800	-0.03750	-0.09600	-0.13590
-25.000	0.09830	0.07900	0.04800	0.02450	-0.00450	-0.04850	-0.09900	-0.13800
-20.000	0.07400	0.06200	0.03800	0.01400	-0.01370	-0.05400	-0.09700	-0.13530
-15.000	0.04800	0.04200	0.02200	0.00380	-0.01900	-0.05050	-0.08500	-0.11500
-10.000	0.02700	0.02400	0.01000	-0.00400	-0.02000	-0.04150	-0.06000	-0.07160
-5.000	0.01100	0.01000	0.00250	-0.00500	-0.01300	-0.02200	-0.03000	-0.03580
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00780	-0.00400	0.00400	0.01100	0.02000	0.03100	0.03400	0.03600
10.000	-0.01150	-0.00200	0.01300	0.02600	0.04600	0.06500	0.07100	0.07840
15.000	-0.01350	0.00600	0.02600	0.04950	0.07600	0.09900	0.12000	0.14200
20.000	-0.01400	0.01600	0.04300	0.07200	0.11400	0.14050	0.16500	0.19750

ENGINEER CCO
DATE 9/13/78

FIGURE 4.1.2.2-9
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

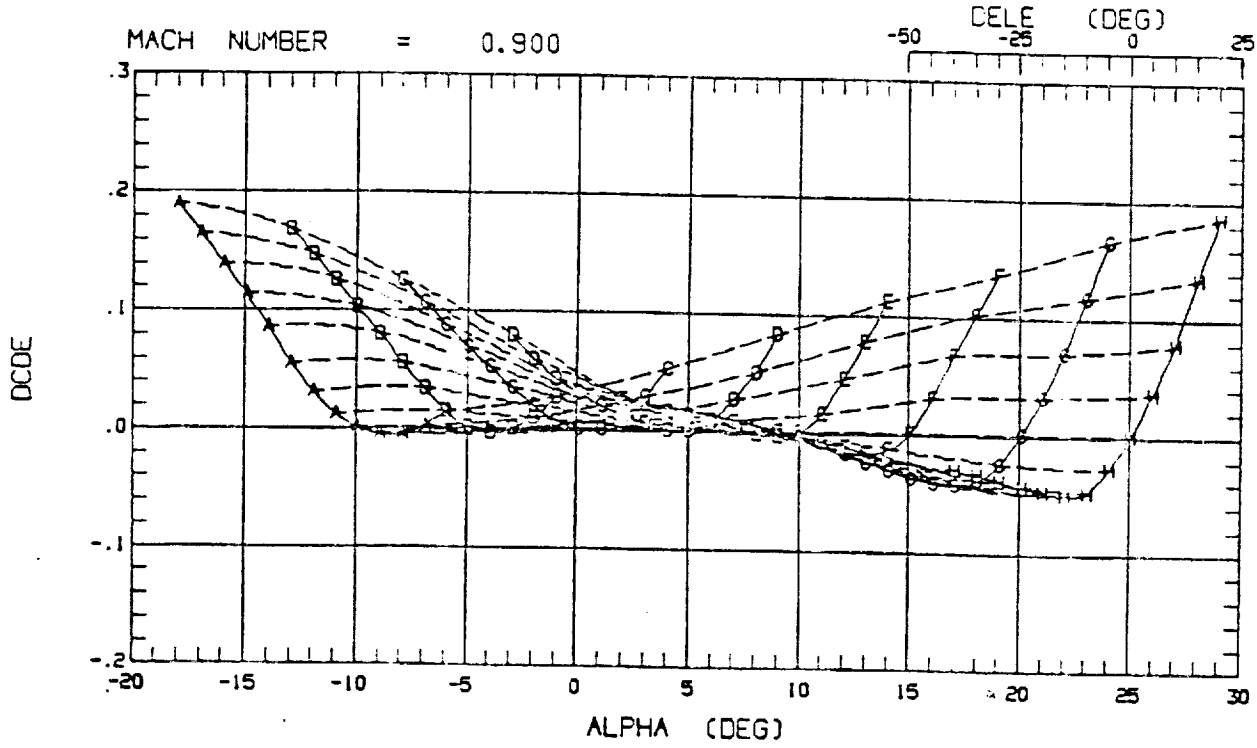
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT
BODY LENGTH LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON DRAG INCREMENT							
-40.000	0.18600	0.15800	0.10850	0.07700	0.02000	-0.00600	-0.02700	-0.03410
-35.000	0.15900	0.13550	0.09150	0.06050	0.01130	-0.01620	-0.03240	-0.03850
-30.000	0.13260	0.11200	0.07300	0.04300	0.00400	-0.02100	-0.03730	-0.04290
-25.000	0.10640	0.09000	0.05850	0.03000	-0.00050	-0.02550	-0.04220	-0.04730
-20.000	0.08030	0.06800	0.04300	0.02000	-0.00600	-0.02800	-0.04760	-0.05170
-15.000	0.05510	0.04650	0.02800	0.00900	-0.01150	-0.03300	-0.04950	-0.05660
-10.000	0.02950	0.03000	0.01500	0.0	-0.01600	-0.03350	-0.04780	-0.05690
-5.000	0.01110	0.01200	0.00350	-0.00500	-0.01450	-0.02200	-0.03050	-0.03910
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00490	-0.00500	0.00300	0.01200	0.01900	0.03200	0.03300	0.03710
10.000	-0.00560	-0.00400	0.01300	0.03000	0.04700	0.06700	0.07360	0.07810
15.000	-0.00100	0.00450	0.02850	0.05400	0.07600	0.10300	0.12080	0.13100
20.000	0.01170	0.01800	0.05000	0.08300	0.10800	0.13700	0.16240	0.18260

ENGINEER DCD
DATE 9/13/78

FIGURE 4.1.2.2-10
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.18970	0.16830	0.12500	0.07900	0.02620	0.00800	-0.01740	-0.03000
-35.000	0.16400	0.14650	0.10600	0.05950	0.02150	0.00400	-0.02460	-0.03420
-30.000	0.13840	0.12500	0.08700	0.04300	0.01600	0.0	-0.03130	-0.03890
-25.000	0.11290	0.10150	0.06950	0.03100	0.01200	-0.00500	-0.03700	-0.04360
-20.000	0.08600	0.07980	0.05200	0.02000	0.00780	-0.00800	-0.04110	-0.04770
-15.000	0.05490	0.05450	0.03500	0.01200	0.00300	-0.01250	-0.04280	-0.05040
-10.000	0.03040	0.03350	0.01900	0.00500	-0.00250	-0.01700	-0.03930	-0.04750
-5.000	0.01180	0.01400	0.00700	0.00050	-0.00350	-0.01400	-0.02470	-0.02780
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00480	-0.00370	0.00100	0.00810	0.01600	0.03100	0.03240	0.03640
10.000	-0.00490	0.0	0.00970	0.02700	0.04600	0.06800	0.07000	0.07730
15.000	0.00190	0.01000	0.02800	0.05050	0.07800	0.10200	0.11700	0.13390
20.000	0.01470	0.02700	0.05300	0.08300	0.11200	0.13600	0.16500	0.18570

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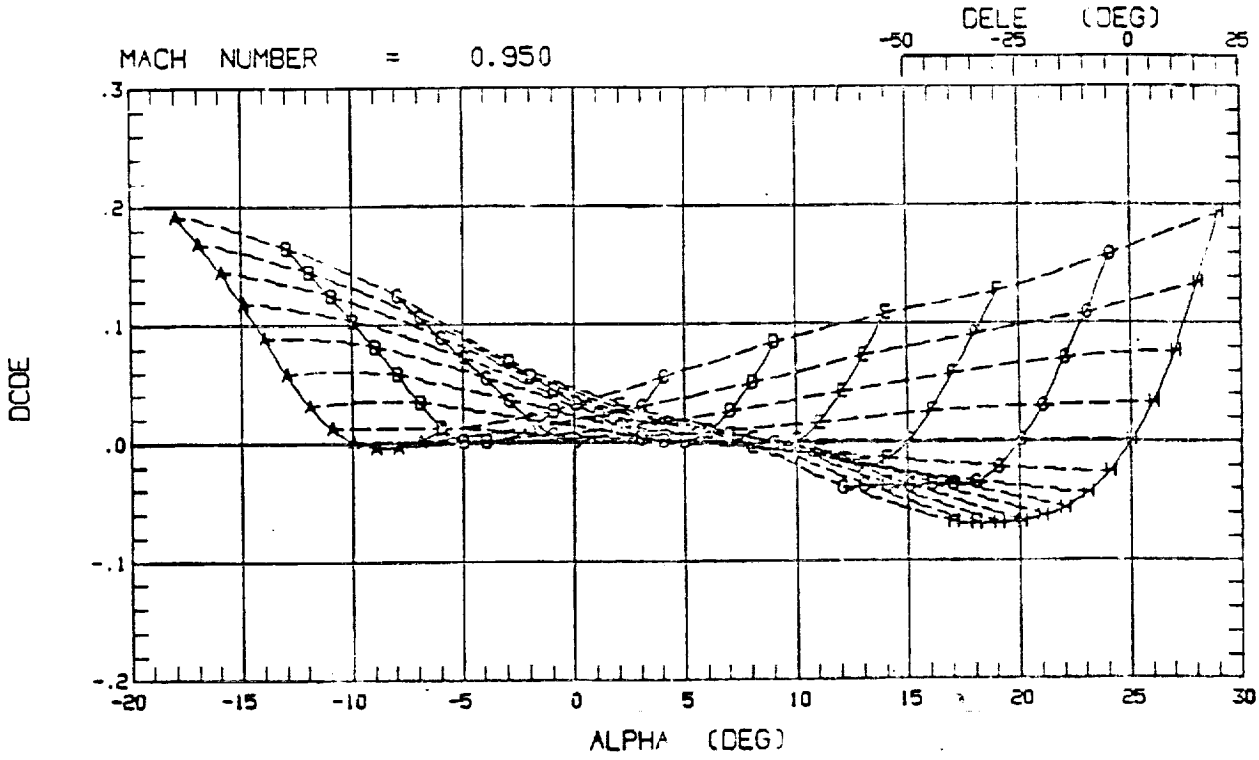
DATE 9/13/78

FIGURE 4.1.2.2-11
ELEVON DRAG COEFFICIENT INCREMENT



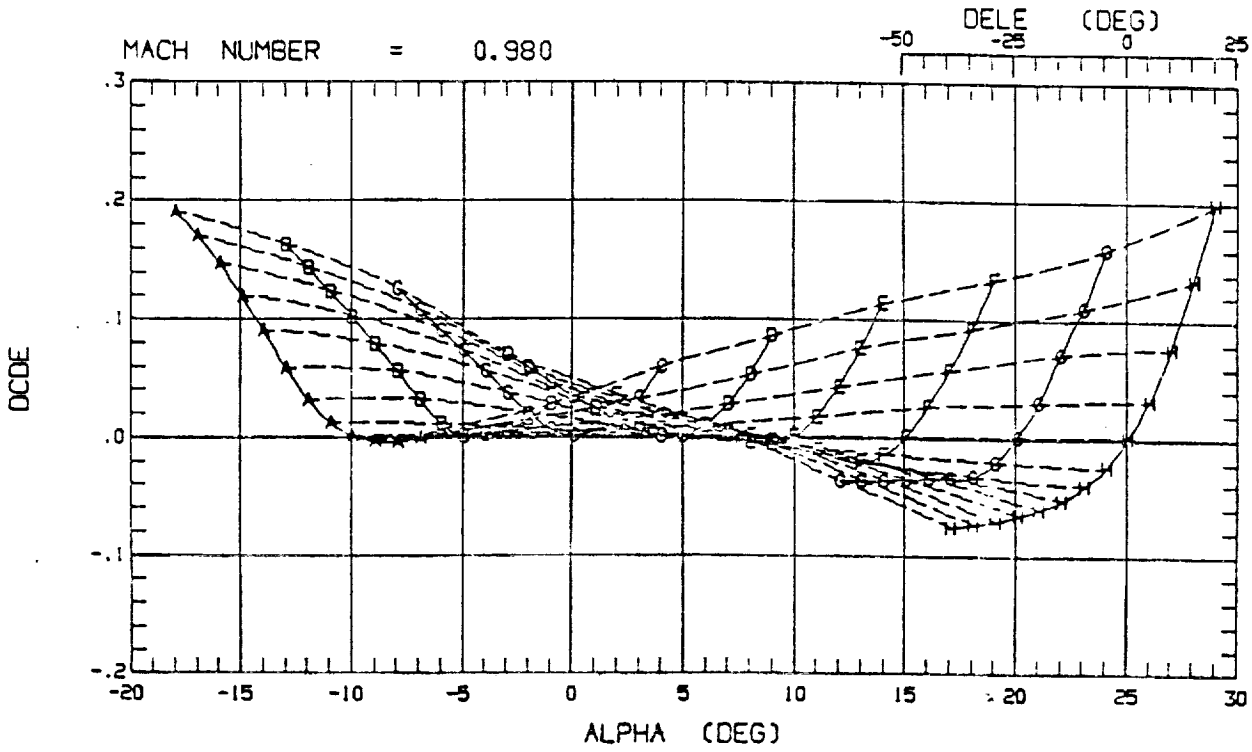
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.19060	0.16400	0.12350	0.06750	0.03150	0.00560	-0.03840	-0.06860
-35.000	0.16810	0.14350	0.10600	0.05550	0.02200	0.00200	-0.03810	-0.06930
-30.000	0.14350	0.12350	0.08800	0.04400	0.01450	-0.00200	-0.03780	-0.06900
-25.000	0.11680	0.10200	0.07100	0.03220	0.01200	-0.00500	-0.03750	-0.06760
-20.000	0.08860	0.08000	0.05400	0.02200	0.00800	-0.00850	-0.03660	-0.06310
-15.000	0.05770	0.05700	0.03500	0.01200	0.00170	-0.01620	-0.03630	-0.05600
-10.000	0.03100	0.03350	0.01800	0.00300	-0.00450	-0.02100	-0.03550	-0.04380
-5.000	0.01180	0.01150	0.00550	0.0	-0.00750	-0.01500	-0.02210	-0.02630
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00400	0.0	0.00400	0.00850	0.01600	0.02600	0.02990	0.03250
10.000	-0.00400	0.00300	0.01200	0.02600	0.04200	0.05800	0.07080	0.07600
15.000	0.00100	0.01250	0.02950	0.05000	0.07300	0.09100	0.10900	0.13400
20.000	0.01120	0.02600	0.05500	0.08400	0.10800	0.12700	0.15800	0.19350

ENGINEER [illegible]
DATE 9/13/78

FIGURE 4.1.2.2- 12
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.18986	0.16173	0.12514	0.06887	0.03489	0.00464	-0.03720	-0.07655
-35.000	0.16952	0.14232	0.10748	0.05702	0.02511	0.00091	-0.03709	-0.07407
-30.000	0.14603	0.12276	0.08950	0.04539	0.01705	-0.00342	-0.03693	-0.07120
-25.000	0.11906	0.10139	0.07223	0.03362	0.01277	-0.00663	-0.03652	-0.06711
-20.000	0.08941	0.07797	0.05509	0.02342	0.00803	-0.01036	-0.03542	-0.06129
-15.000	0.05779	0.05464	0.03615	0.01326	0.00122	-0.01791	-0.03529	-0.05399
-10.000	0.03124	0.03109	0.01882	0.00418	-0.00507	-0.02164	-0.03392	-0.04169
-5.000	0.01189	0.01016	0.00536	0.0	-0.00641	-0.01512	-0.02152	-0.02541
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00370	0.00151	0.00111	0.00985	0.01746	0.02572	0.02914	0.03153
10.000	-0.00400	0.00469	0.01337	0.02730	0.04292	0.05694	0.07054	0.07542
15.000	-0.00033	0.01420	0.03170	0.05210	0.07558	0.09210	0.10944	0.13403
20.000	0.00719	0.02656	0.05948	0.08606	0.11351	0.13336	0.15896	0.19816

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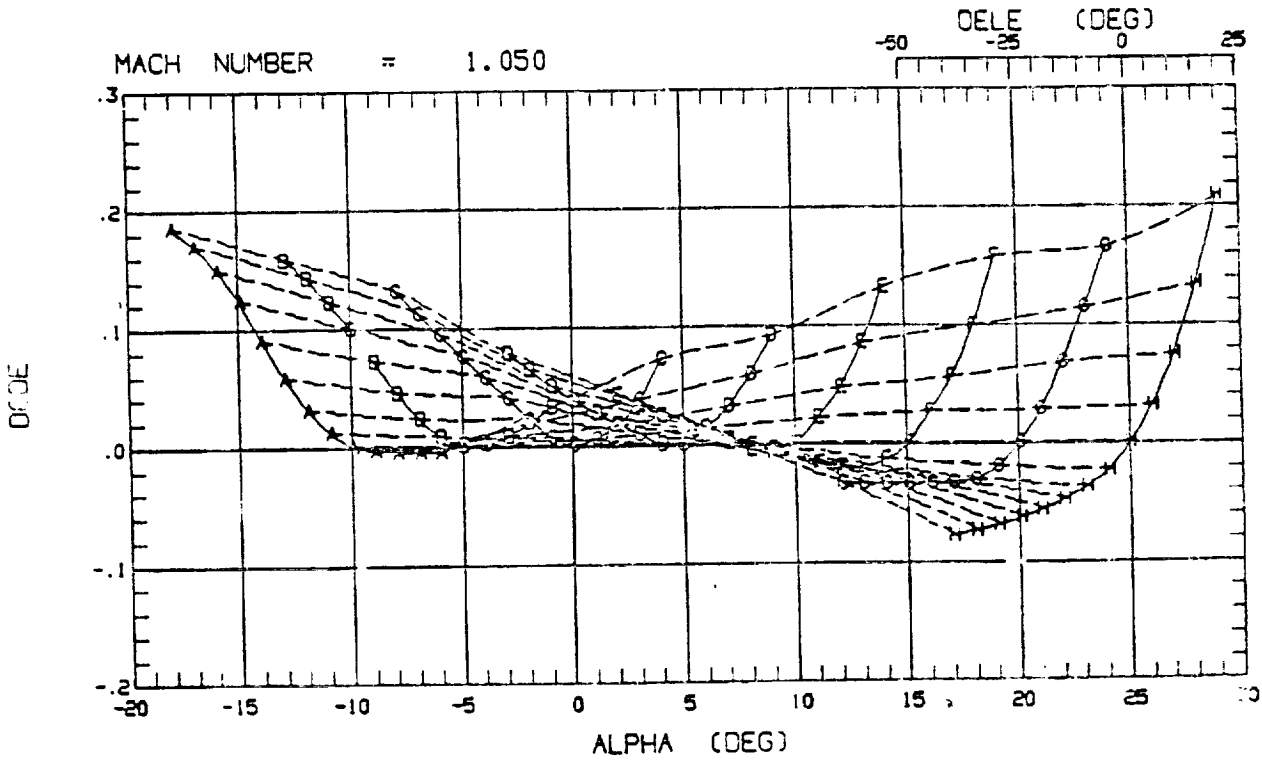
DATE 9/13/78

FIGURE 4.1.2.2-13
ELEVON DRAG COEFFICIENT INCREMENT



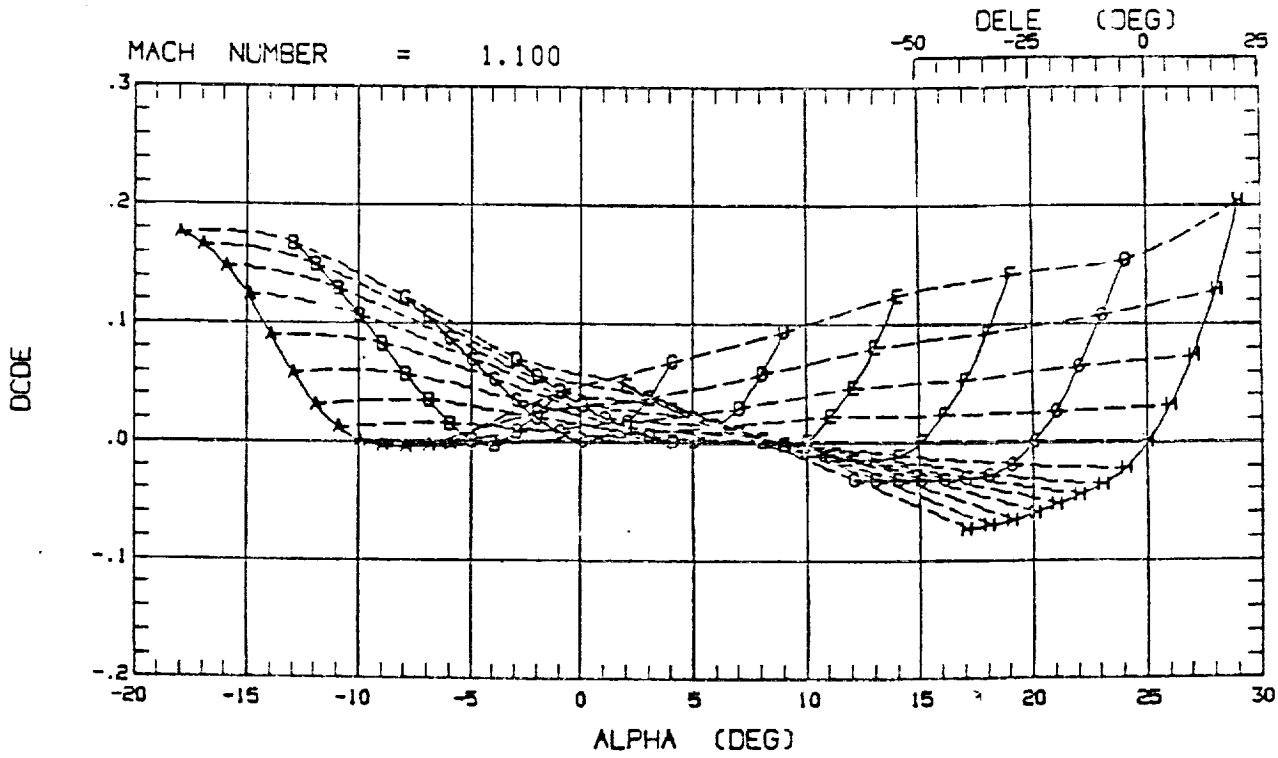
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.18400	0.15820	0.13150	0.07800	0.04300	0.00430	-0.03410	-0.07820
-35.000	0.16930	0.14250	0.11250	0.06400	0.03400	-0.00100	-0.03420	-0.07380
-30.000	0.14960	0.12200	0.09400	0.04950	0.02430	-0.00700	-0.03430	-0.06940
-25.000	0.12390	0.09900	0.07550	0.03770	0.01600	-0.01200	-0.03400	-0.06350
-20.000	0.08970	0.07100	0.05700	0.02700	0.00800	-0.01620	-0.03360	-0.05660
-15.000	0.05750	0.04550	0.04000	0.01750	0.00150	-0.01950	-0.03320	-0.04770
-10.000	0.03130	0.02300	0.02200	0.00900	-0.00400	-0.01900	-0.03080	-0.03730
-5.000	0.01220	0.00800	0.00630	0.0	-0.00380	-0.01400	-0.02040	-0.02340
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00350	0.00200	0.00600	0.01400	0.02200	0.02700	0.02780	0.03100
10.000	-0.00400	0.00800	0.01650	0.03200	0.04700	0.05650	0.06780	0.07420
15.000	-0.00420	0.01900	0.03800	0.05900	0.08600	0.10000	0.11440	0.13390
20.000	-0.00400	0.03220	0.07300	0.09200	0.13300	0.15800	0.16530	0.20890

ENGINEER GCD
DATE 9/13/78

FIGURE 4.1.2.2-14
ELEVON DRAG COEFFICIENT INCREMENT



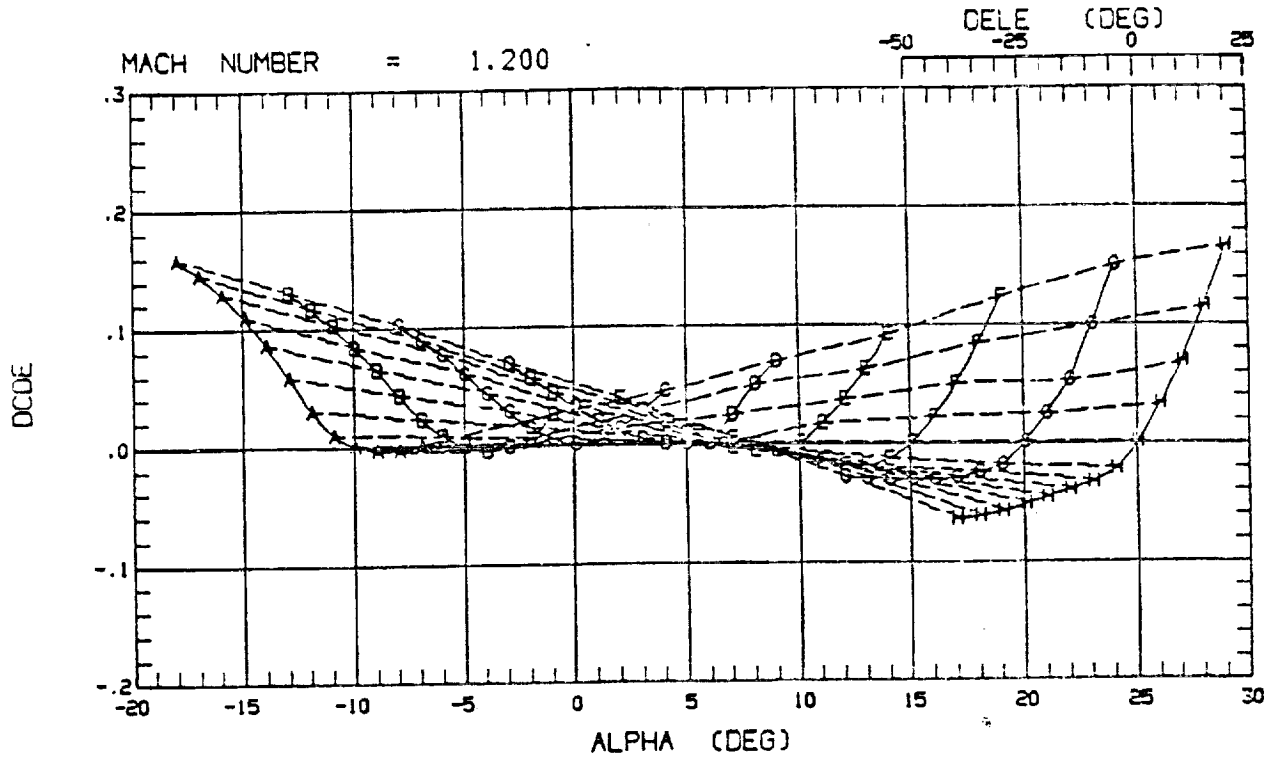
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.17560	0.16700	0.12100	0.06900	0.04700	0.00700	-0.03220	-0.07430
-35.000	0.16530	0.14950	0.10400	0.05550	0.03700	0.00200	-0.03270	-0.07110
-30.000	0.14770	0.12900	0.08630	0.04250	0.02750	-0.00380	-0.03310	-0.06690
-25.000	0.12330	0.10600	0.06900	0.03100	0.01900	-0.00800	-0.03250	-0.06060
-20.000	0.08900	0.08200	0.05200	0.02000	0.01150	-0.01200	-0.03250	-0.05320
-15.000	0.05800	0.05650	0.03450	0.01180	0.00500	-0.01450	-0.03140	-0.04540
-10.000	0.03050	0.03450	0.01900	0.00450	0.0	-0.01450	-0.02870	-0.03600
-5.000	0.01150	0.01500	0.00750	0.0	-0.00200	-0.01200	-0.01930	-0.02290
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00380	-0.00300	0.00550	0.01300	0.02200	0.02300	0.02600	0.03120
10.000	-0.00400	0.00750	0.01700	0.02900	0.04600	0.05300	0.06400	0.07290
15.000	-0.00330	0.02400	0.03750	0.05700	0.08000	0.09250	0.10680	0.12900
20.000	-0.00200	0.04200	0.06800	0.09300	0.12400	0.14200	0.15450	0.20340

ENGINEER GCO
DATE 9/13/78

FIGURE 4.1.2.2-15
ELEVON DRAG COEFFICIENT INCREMENT



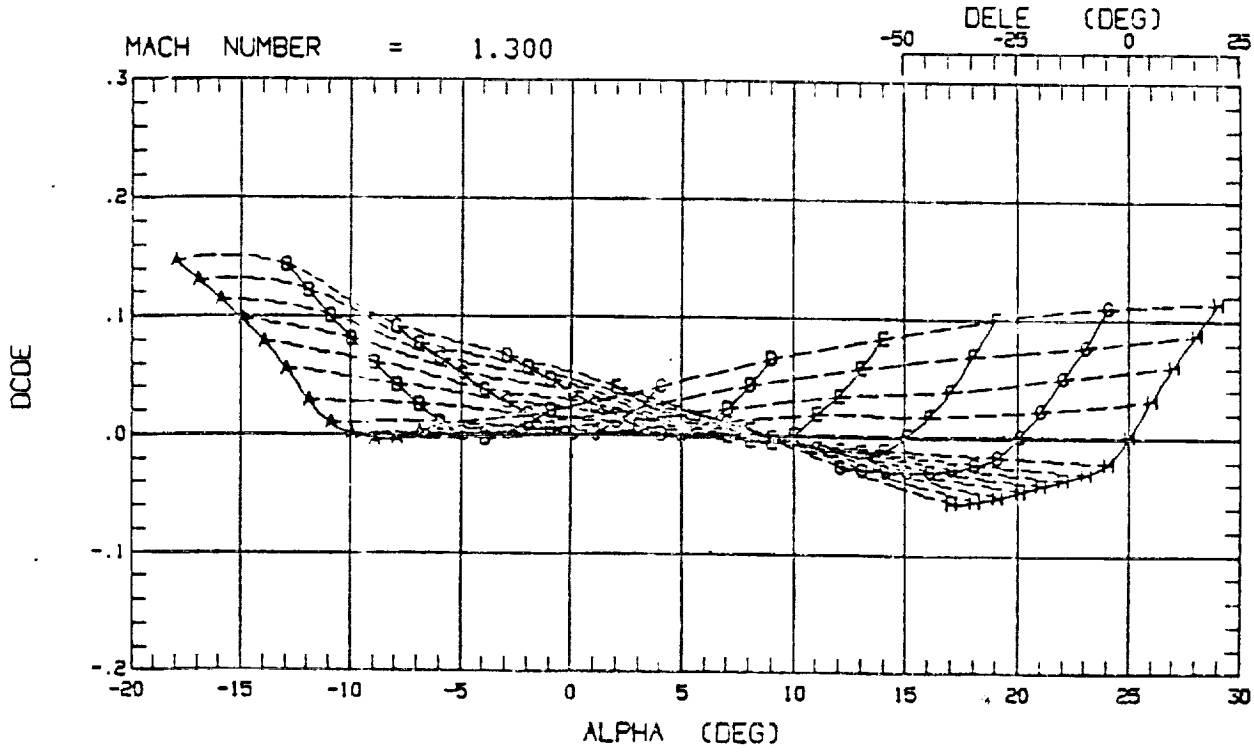
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.15810	0.13000	0.10150	0.06900	0.03850	0.00410	-0.02880	-0.06430
-35.000	0.14480	0.11600	0.08900	0.05600	0.02800	-0.00100	-0.03000	-0.06200
-30.000	0.12900	0.10200	0.07700	0.04400	0.01800	-0.00600	-0.03100	-0.05750
-25.000	0.10910	0.08300	0.06000	0.03200	0.01000	-0.01100	-0.03100	-0.05200
-20.000	0.09520	0.06400	0.04400	0.02000	0.00300	-0.01500	-0.03100	-0.04600
-15.000	0.05770	0.04200	0.02800	0.01100	-0.00300	-0.01800	-0.03000	-0.04000
-10.000	0.03000	0.02200	0.01500	0.00400	-0.00600	-0.01900	-0.02500	-0.03350
-5.000	0.01000	0.00780	0.00550	0.00040	-0.00600	-0.01300	-0.01800	-0.02270
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00320	-0.00400	0.00300	0.0	0.01700	0.02200	0.02500	0.03200
10.000	-0.00330	-0.00100	0.01350	0.02500	0.03700	0.05030	0.05280	0.06730
15.000	0.0	0.00600	0.02800	0.05000	0.06300	0.08450	0.10000	0.11500
20.000	0.00590	0.02600	0.04450	0.06950	0.09200	0.12350	0.15000	0.16500

ENGINEER SCO
DATE 9/13/72

FIGURE 4.1.2.2-16
ELEVON DRAG COEFFICIENT INCREMENT



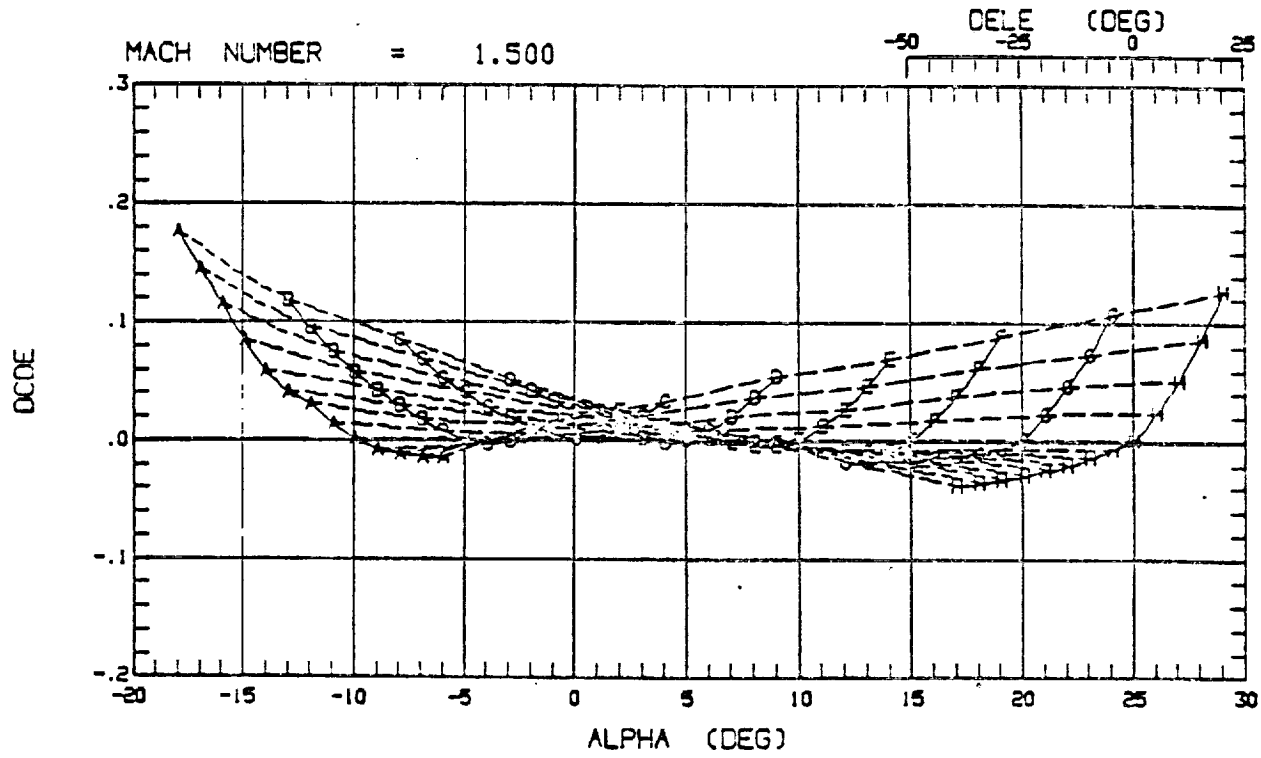
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.14650	0.14250	0.09000	0.06620	0.04000	0.00900	-0.02650	-0.05710
-35.000	0.12970	0.12150	0.07650	0.05600	0.02900	0.00390	-0.02820	-0.05530
-30.000	0.11390	0.10000	0.06400	0.04600	0.01900	-0.00200	-0.02950	-0.05130
-25.000	0.09660	0.08000	0.05100	0.03530	0.01030	-0.00600	-0.02970	-0.04680
-20.000	0.07820	0.06000	0.03750	0.02420	0.00250	-0.01100	-0.02940	-0.04180
-15.000	0.05570	0.04150	0.02750	0.01550	-0.00100	-0.01250	-0.02750	-0.03630
-10.000	0.02790	0.02500	0.01650	0.00650	-0.00400	-0.01350	-0.02400	-0.03080
-5.000	0.00900	0.01000	0.00450	0.0	-0.00600	-0.01250	-0.01670	-0.02190
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00400	-0.00270	0.00100	0.00980	0.01780	0.01700	0.02240	0.03120
10.000	-0.00350	0.00200	0.01100	0.02200	0.03380	0.03850	0.04980	0.05980
15.000	0.00140	0.00900	0.02250	0.04200	0.05750	0.06850	0.07620	0.08740
20.000	0.00890	0.01980	0.04100	0.06500	0.08330	0.10000	0.11000	0.11350

ENGINEER GEO
DATE 9/13/78

FIGURE 4.1.2.2-17
ELEVON DRAG COEFFICIENT INCREMENT



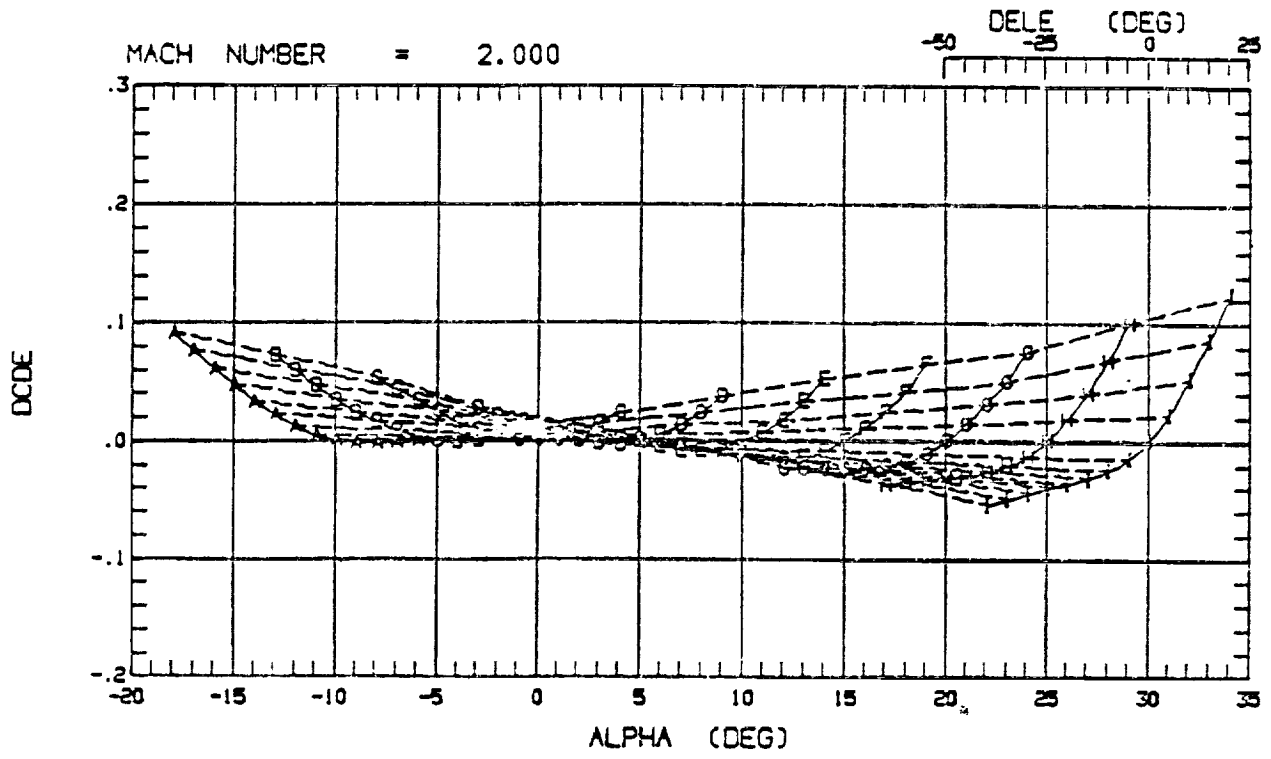
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.17592	0.11679	0.08467	0.05023	0.02420	0.00337	-0.01815	-0.03836
-35.000	0.14411	0.09473	0.06803	0.04072	0.01807	-0.00141	-0.01807	-0.03660
-30.000	0.11488	0.07398	0.05140	0.03176	0.01240	-0.00215	-0.01758	-0.03324
-25.000	0.08462	0.05687	0.03948	0.02340	0.00752	-0.00488	-0.01707	-0.02992
-20.000	0.05822	0.04156	0.02660	0.01654	0.00162	-0.00688	-0.01463	-0.02546
-15.000	0.04044	0.02836	0.01814	0.00845	-0.00166	-0.00885	-0.01319	-0.02066
-10.000	0.02960	0.01654	0.01123	0.00218	-0.00512	-0.00967	-0.01028	-0.01490
-5.000	0.01369	0.00656	0.00470	-0.00170	-0.00489	-0.00810	-0.00650	-0.00784
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00785	-0.00387	0.00249	0.00823	0.01189	0.01733	0.02214	0.02344
10.000	-0.01195	-0.00060	0.00913	0.01982	0.02579	0.03745	0.04565	0.05016
15.000	-0.01412	0.00648	0.02046	0.03607	0.04591	0.06127	0.07321	0.08601
20.000	-0.01480	0.01518	0.03274	0.05399	0.06917	0.08830	0.10700	0.12551

ENGINEER CCO
DATE 9/13/78

FIGURE 4.1.2.2-18
ELEVON DRAG COEFFICIENT INCREMENT



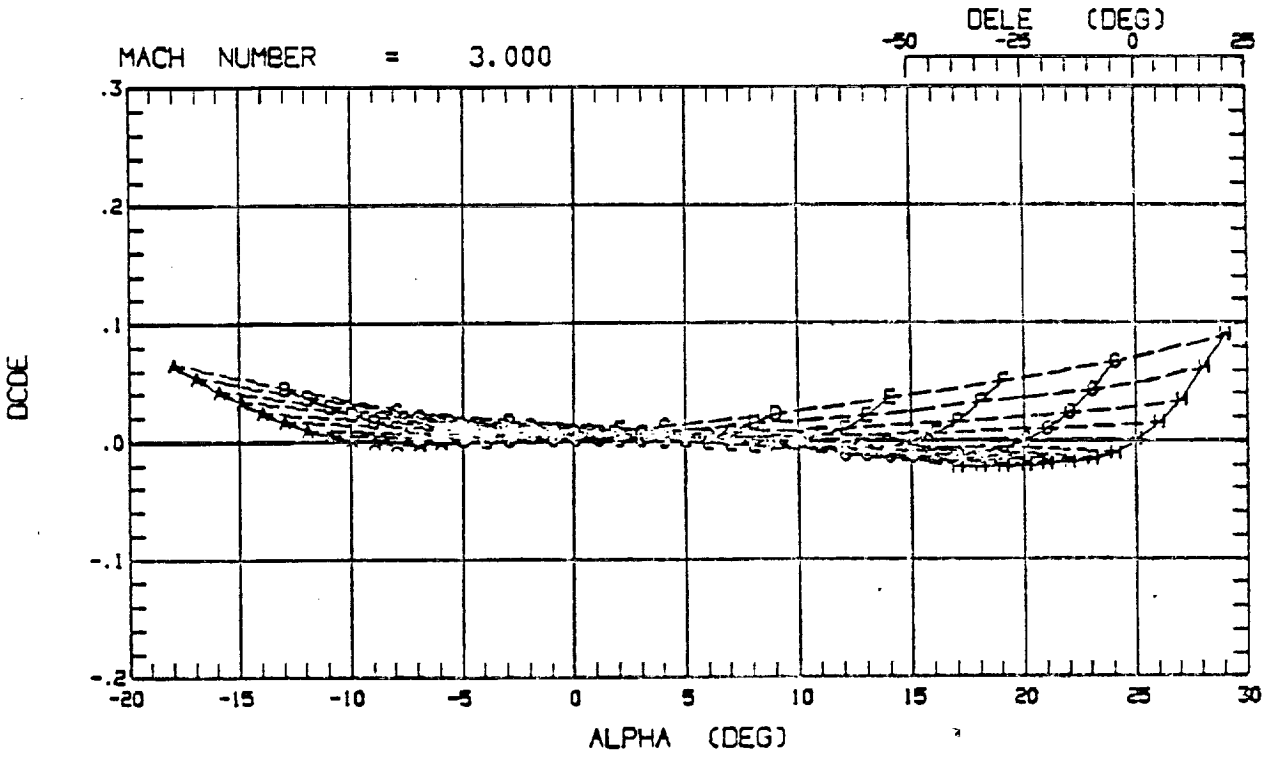
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	ELEVON DRAG INCREMENT								
-40.000	0.09050	0.07180	0.05310	0.02700	0.01200	-0.00500	-0.02300	-0.03740	-0.05500
-35.000	0.07560	0.05900	0.04300	0.02050	0.00750	-0.00800	-0.02400	-0.03540	-0.05000
-30.000	0.06070	0.04600	0.03300	0.01400	0.00200	-0.01000	-0.02400	-0.03350	-0.04500
-25.000	0.04680	0.03400	0.02400	0.01000	-0.00100	-0.01300	-0.02400	-0.03130	-0.04000
-20.000	0.03280	0.02300	0.01500	0.00600	-0.00400	-0.01500	-0.02300	-0.03000	-0.03600
-15.000	0.02230	0.01600	0.01000	0.00050	-0.00800	-0.01600	-0.02100	-0.02600	-0.03200
-10.000	0.01190	0.00800	0.00500	-0.00200	-0.00900	-0.01400	-0.01800	-0.02150	-0.02500
-5.000	0.00450	0.00300	0.00100	-0.00300	-0.00700	-0.00900	-0.01100	-0.01400	-0.01500
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00210	-0.00050	0.0	0.00500	0.00700	0.01100	0.01400	0.01800	0.02200
10.000	-0.00200	0.00110	0.00600	0.01300	0.01700	0.02400	0.03100	0.04000	0.05200
15.000	-0.00040	0.00620	0.01500	0.02300	0.03300	0.04100	0.05000	0.06800	0.08600
20.000	0.00020	0.01200	0.02300	0.03700	0.05200	0.06500	0.07600	0.10000	0.12300

ENGINEER GCO
DATE 9/13/78

FIGURE 4.1.2.2-19
ELEVON DRAG COEFFICIENT INCREMENT



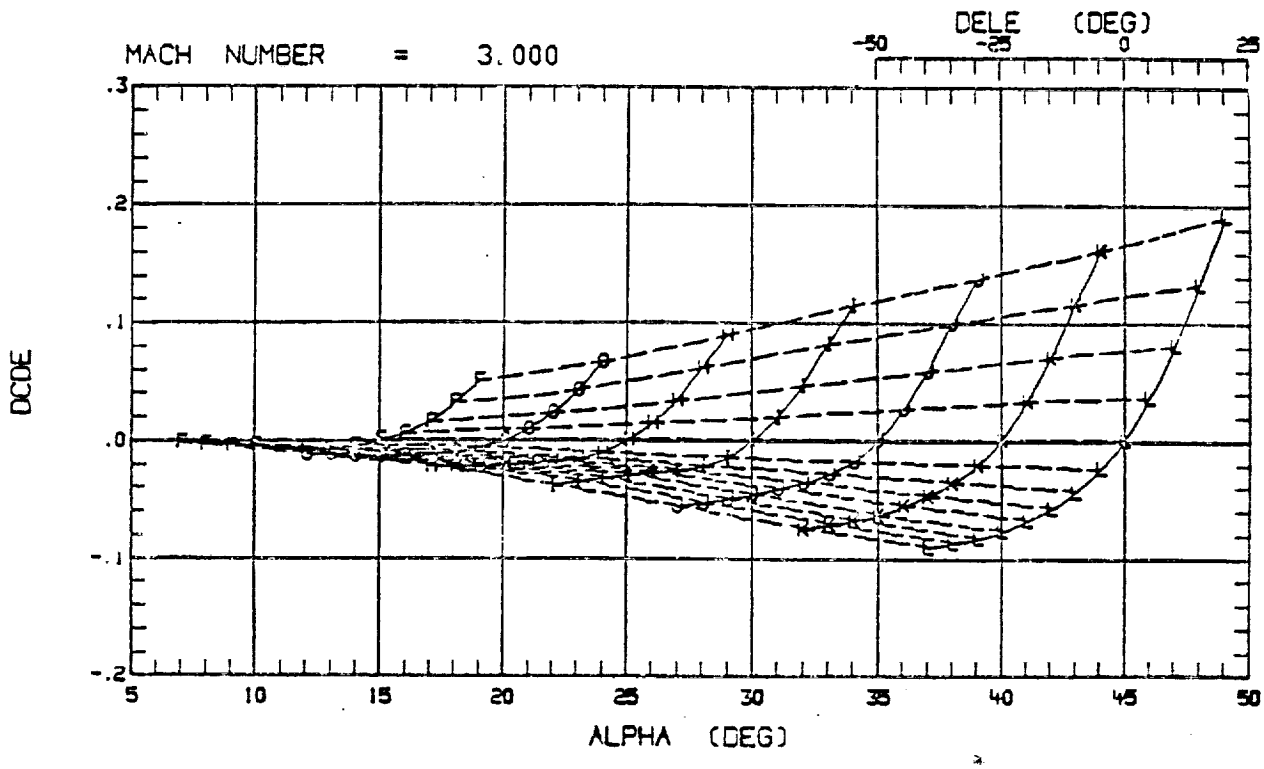
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.06340	0.04410	0.02500	0.01600	0.01000	-0.00200	-0.01170	-0.02200
-35.000	0.05240	0.03600	0.02000	0.01200	0.00600	-0.00300	-0.01200	-0.02250
-30.000	0.04150	0.02800	0.01550	0.00850	0.00200	-0.00400	-0.01300	-0.02200
-25.000	0.03230	0.02200	0.01150	0.00600	0.0	-0.00500	-0.01300	-0.02150
-20.000	0.02300	0.01600	0.00800	0.00300	-0.00200	-0.00600	-0.01300	-0.02000
-15.000	0.01570	0.01100	0.00400	0.00100	-0.00300	-0.00700	-0.01200	-0.01800
-10.000	0.00830	0.00600	0.00300	0.0	-0.00400	-0.00700	-0.01000	-0.01600
-5.000	0.00410	0.00300	0.00100	-0.00100	-0.00200	-0.00500	-0.00600	-0.01100
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00170	-0.00100	0.00100	0.00250	0.00400	0.00600	0.01000	0.01500
10.000	-0.00330	0.0	0.00300	0.00700	0.01000	0.01600	0.02300	0.03300
15.000	-0.00280	0.00300	0.00600	0.01400	0.02100	0.03200	0.04200	0.06160
20.000	-0.00230	0.00400	0.01200	0.02200	0.03600	0.05000	0.06700	0.08900

ENGINEER GO
DATE 9/13/78

FIGURE 4.1.2.2- 20
ELEVON DRAG COEFFICIENT INCREMENT



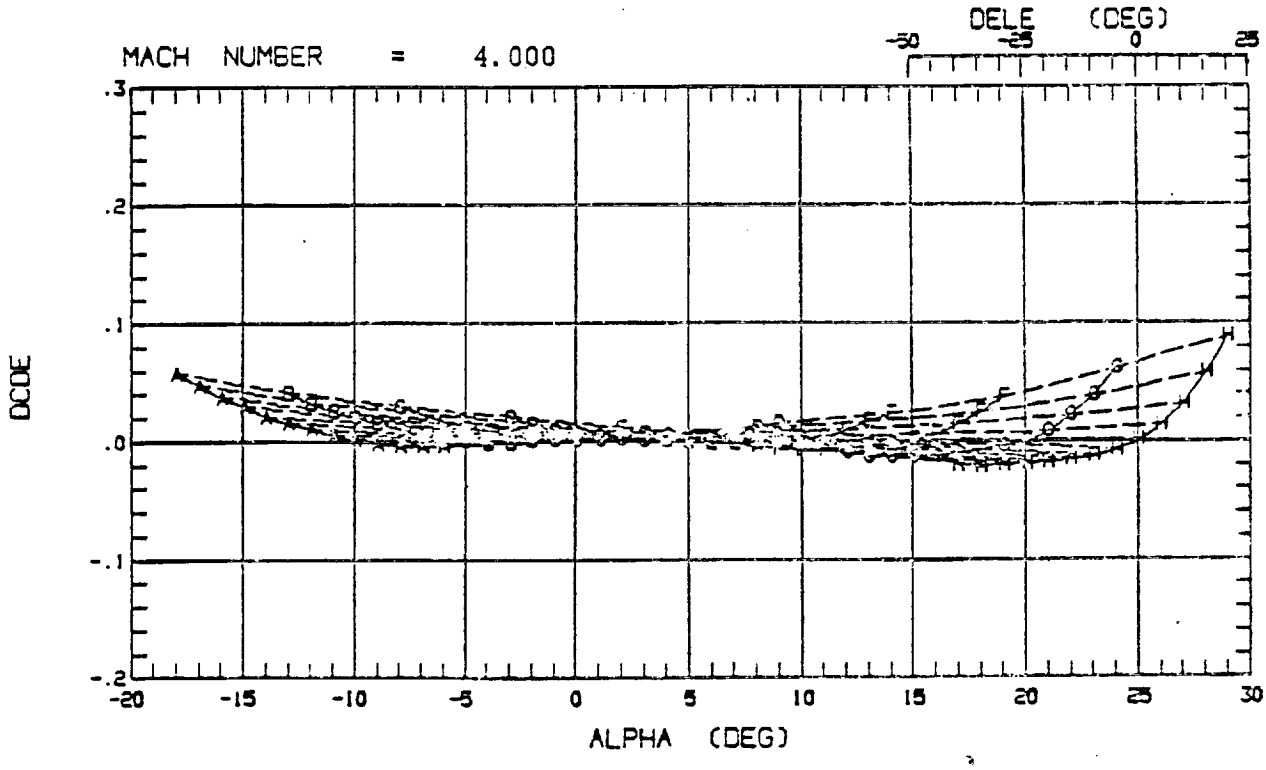
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)						
	15.000	20.000	25.000	30.000	35.000	40.000	45.000
	F	G	H	I	J	K	L
DELE (DEG)	ELEVON DRAG INCREMENT						
-40.000	-0.00200	-0.01170	-0.02200	-0.03890	-0.05720	-0.07550	-0.09110
-35.000	-0.00300	-0.01200	-0.02250	-0.03520	-0.05355	-0.07190	-0.08717
-30.000	-0.00400	-0.01300	-0.02200	-0.03250	-0.05040	-0.06830	-0.08312
-25.000	-0.00500	-0.01300	-0.02150	-0.03000	-0.04700	-0.06400	-0.07721
-20.000	-0.00600	-0.01300	-0.02000	-0.02800	-0.04185	-0.05570	-0.06824
-15.000	-0.00700	-0.01200	-0.01800	-0.02600	-0.03675	-0.04750	-0.05825
-10.000	-0.00700	-0.01000	-0.01600	-0.02200	-0.02882	-0.03600	-0.04337
-5.000	-0.00500	-0.00600	-0.01100	-0.01500	-0.01815	-0.02100	-0.02370
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00600	0.01000	0.01500	0.02000	0.02685	0.03310	0.03620
10.000	0.01600	0.02300	0.03300	0.04600	0.05876	0.07090	0.08042
15.000	0.03200	0.04200	0.05160	0.08110	0.09928	0.11640	0.13266
20.000	0.05000	0.06700	0.08900	0.11420	0.13800	0.16180	0.19032

ENGINEER SCO
DATE 9/13/78

FIGURE 4.1.2.2-21
ELEVON DRAG COEFFICIENT INCREMENT



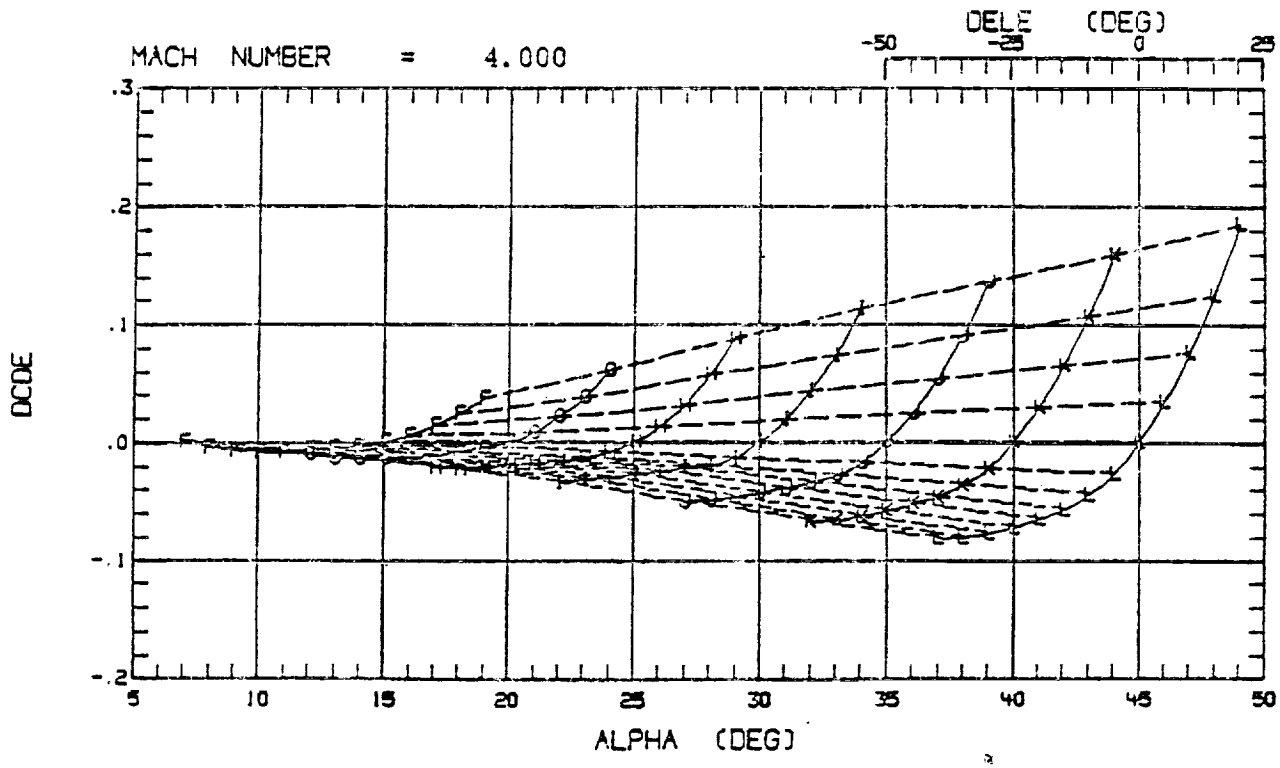
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.05650	0.04000	0.02840	0.01940	0.01010	0.0	-0.00920	-0.02080
-35.000	0.04650	0.03150	0.02270	0.01300	0.00430	-0.00400	-0.01300	-0.02200
-30.000	0.03650	0.02450	0.01600	0.00800	0.00120	-0.00650	-0.01370	-0.02080
-25.000	0.02830	0.01900	0.01200	0.00550	-0.00080	-0.00780	-0.01400	-0.01950
-20.000	0.02010	0.01400	0.00800	0.00300	-0.00200	-0.00800	-0.01300	-0.01820
-15.000	0.01450	0.00880	0.00450	0.00210	-0.00250	-0.00600	-0.01050	-0.01600
-10.000	0.00890	0.00500	0.00200	0.0	-0.00250	-0.00500	-0.00800	-0.01350
-5.000	0.00450	0.00200	0.00050	0.0	-0.00200	-0.00300	-0.00400	-0.00820
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00320	-0.00200	0.0	0.00200	0.00350	0.00600	0.00800	0.01300
10.000	-0.00440	-0.00200	0.00200	0.00620	0.00900	0.01440	0.02160	0.03150
15.000	-0.00500	0.0	0.00500	0.01050	0.01640	0.02450	0.03850	0.05700
20.000	-0.00500	0.00150	0.00400	0.01490	0.02310	0.03740	0.06160	0.08860

ENGINEER DCO
DATE 9/13/78

FIGURE 4.1.2.2-22
ELEVON DRAG COEFFICIENT INCREMENT



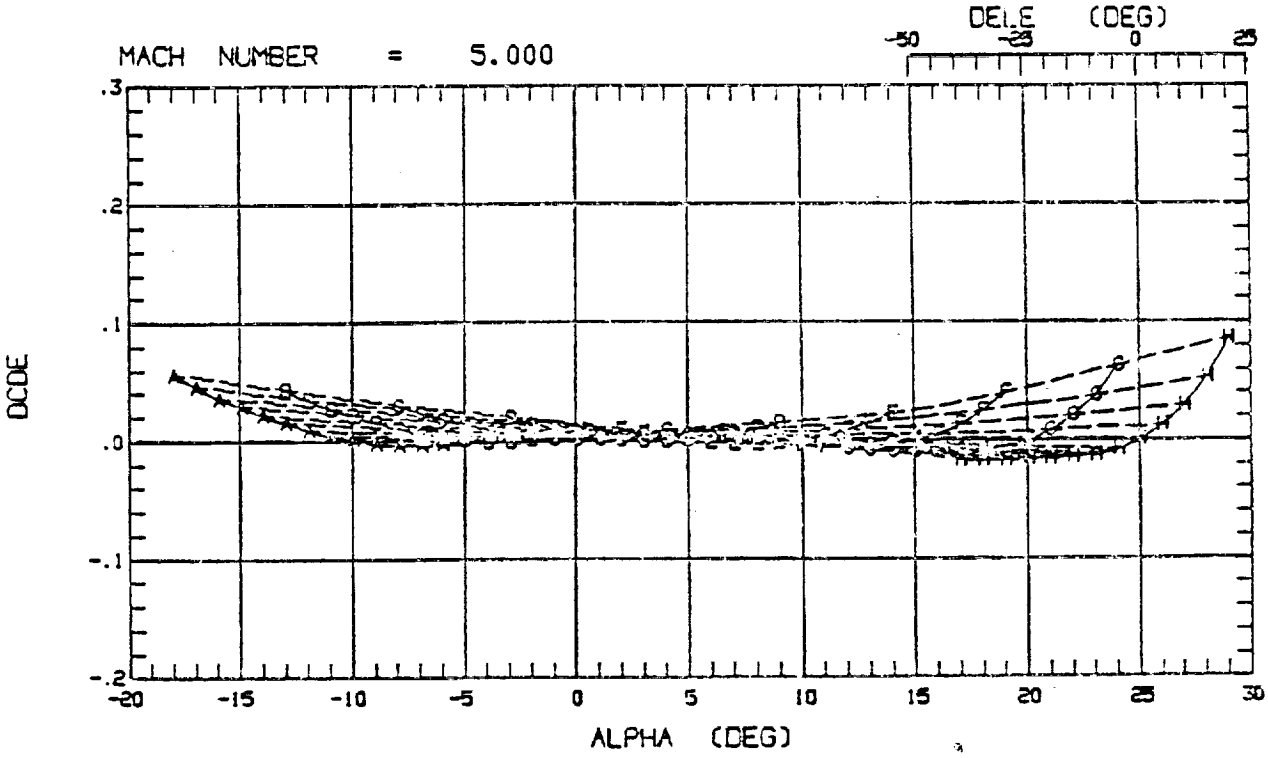
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000	20.000	25.000	30.000	35.000	40.000	45.000
	F	G	H	I	J	K	L
DELE (DEG)	ELEVON DRAG INCREMENT						
-40.000	0.0	-0.00920	-0.02080	-0.03350	-0.04935	-0.06640	-0.08131
-35.000	-0.00400	-0.01300	-0.02200	-0.03130	-0.04840	-0.06550	-0.08046
-30.000	-0.00650	-0.01370	-0.02080	-0.02950	-0.04600	-0.06250	-0.07694
-25.000	-0.00780	-0.01400	-0.01950	-0.02670	-0.04260	-0.05850	-0.07222
-20.000	-0.00800	-0.01300	-0.01820	-0.02440	-0.03825	-0.05210	-0.06467
-15.000	-0.00600	-0.01050	-0.01600	-0.02170	-0.03385	-0.04600	-0.05691
-10.000	-0.00500	-0.00800	-0.01350	-0.01980	-0.02790	-0.03600	-0.04384
-5.000	-0.00300	-0.00400	-0.00820	-0.01300	-0.01778	-0.02250	-0.02512
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00600	0.00800	0.01300	0.01900	0.02473	0.03000	0.03437
10.000	0.01440	0.02160	0.03150	0.04360	0.05430	0.06500	0.07622
15.000	0.02450	0.03850	0.05700	0.07400	0.09050	0.10700	0.12462
20.000	0.03740	0.06160	0.08860	0.11350	0.13610	0.15870	0.18516

ENGINEER [illegible]
DATE 9/13/78

FIGURE 4.1.2.2-23
ELEVON DRAG COEFFICIENT INCREMENT



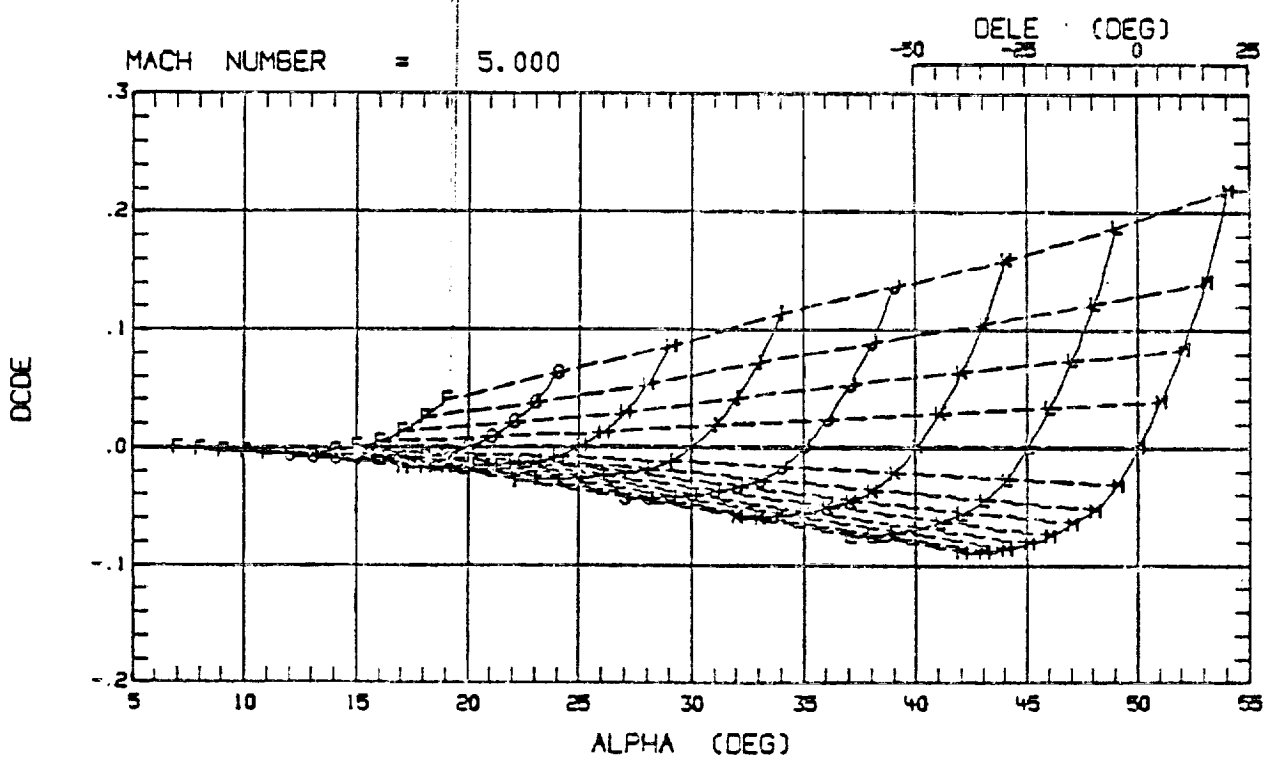
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.05560	0.04190	0.02830	0.01860	0.00850	-0.00040	-0.00770	-0.01770
-35.000	0.04540	0.03320	0.02270	0.01250	0.00510	-0.00200	-0.00860	-0.01740
-30.000	0.03530	0.02650	0.01710	0.00880	0.00170	-0.00360	-0.00950	-0.01700
-25.000	0.02790	0.02030	0.01250	0.00500	-0.00010	-0.00470	-0.00980	-0.01640
-20.000	0.02050	0.01410	0.00790	0.00220	-0.00180	-0.00580	-0.01010	-0.01590
-15.000	0.01440	0.00930	0.00420	0.0	-0.00300	-0.00580	-0.00940	-0.01430
-10.000	0.00820	0.00450	0.00120	-0.00100	-0.00310	-0.00580	-0.00870	-0.01290
-5.000	0.00320	0.00100	0.00060	-0.00050	-0.00200	-0.00290	-0.00600	-0.00900
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00350	-0.00200	0.00040	0.00210	0.00350	0.00450	0.00800	0.01250
10.000	-0.00450	-0.00200	0.00070	0.00420	0.00860	0.01350	0.02030	0.02990
15.000	-0.00400	0.0	0.00440	0.00950	0.01500	0.02500	0.03750	0.05300
20.000	-0.00390	0.00200	0.00810	0.01480	0.02250	0.03960	0.06280	0.08580

ENGINEER CC
DATE 9/13/78

FIGURE 4.1.2.2-24
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

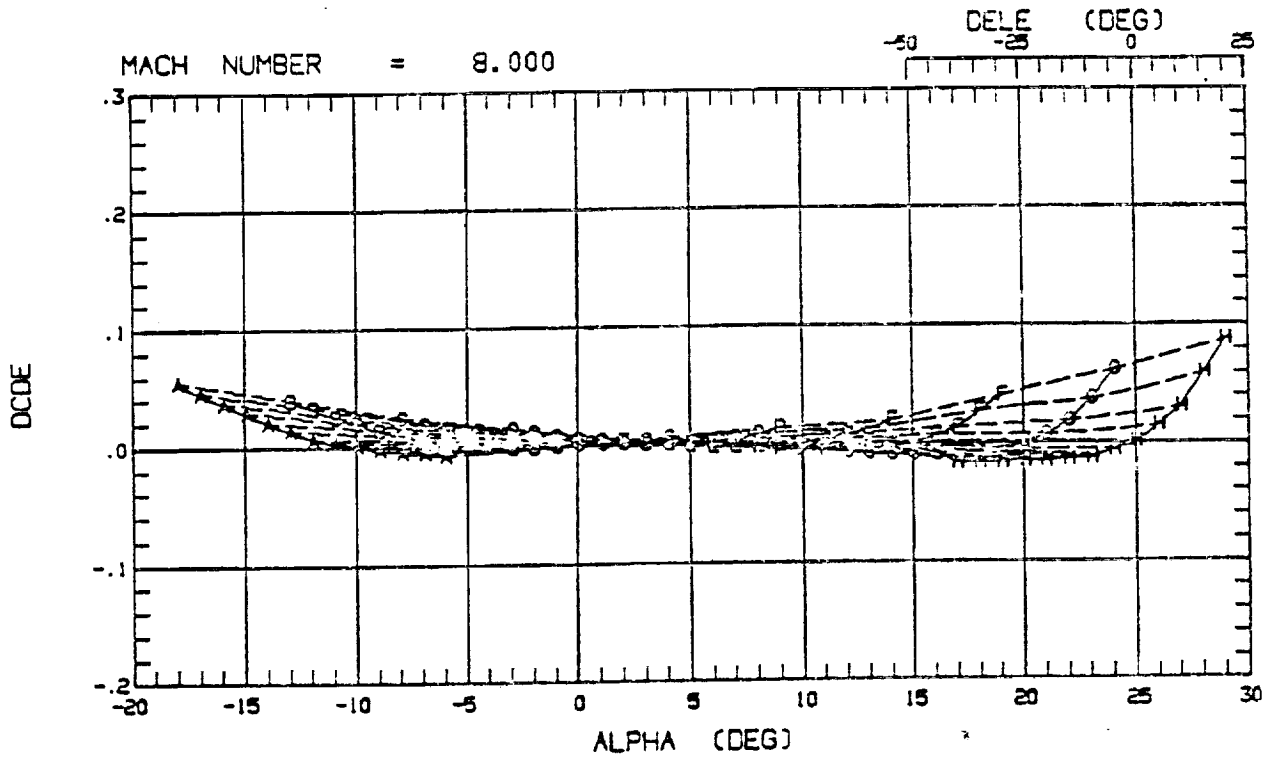
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	REFERENCE DIMENSIONS	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	-0.00040	-0.00770	-0.01770	-0.02830	-0.04400	-0.05970	-0.07502	-0.09010
-35.000	-0.00200	-0.00860	-0.01740	-0.02800	-0.04400	-0.06000	-0.07506	-0.08950
-30.000	-0.00360	-0.00950	-0.01700	-0.02770	-0.04285	-0.05800	-0.07255	-0.08670
-25.000	-0.00470	-0.00980	-0.01640	-0.02630	-0.04115	-0.05600	-0.06965	-0.08250
-20.000	-0.00580	-0.01010	-0.01590	-0.02490	-0.03815	-0.05140	-0.06394	-0.07600
-15.000	-0.00580	-0.00940	-0.01430	-0.02210	-0.03405	-0.04600	-0.05611	-0.06500
-10.000	-0.00580	-0.00870	-0.01290	-0.01920	-0.02815	-0.03710	-0.04567	-0.05400
-5.000	-0.00290	-0.00600	-0.00900	-0.01270	-0.01715	-0.02200	-0.02710	-0.03250
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00450	0.00800	0.01250	0.01800	0.02335	0.02850	0.03337	0.03800
10.000	0.01350	0.02030	0.02890	0.04140	0.05305	0.06380	0.07361	0.08250
15.000	0.02500	0.03750	0.05300	0.07200	0.08850	0.10500	0.12225	0.14000
20.000	0.03960	0.06290	0.08580	0.11350	0.13630	0.15910	0.18689	0.21600

ENGINEER [illegible]
DATE 9/13/78

FIGURE 4.1.2.2-25
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

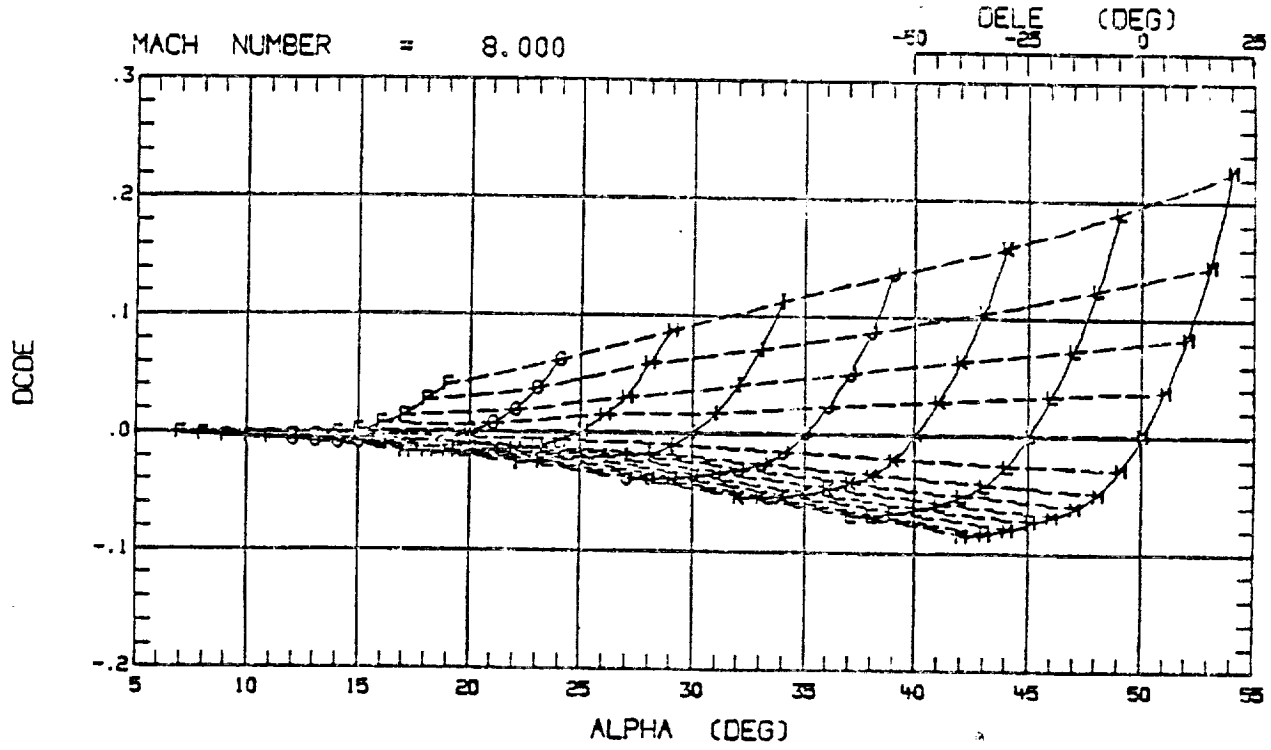
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.05340	0.03860	0.02380	0.01330	0.00280	-0.00230	-0.00730	-0.01670
-35.000	0.04460	0.03170	0.01890	0.01010	0.00140	-0.00360	-0.00850	-0.01670
-30.000	0.03560	0.02490	0.01390	0.00690	-0.00010	-0.00490	-0.00970	-0.01680
-25.000	0.02780	0.01910	0.01050	0.00490	-0.00070	-0.00530	-0.00990	-0.01620
-20.000	0.01970	0.01340	0.00700	0.00280	-0.00140	-0.00570	-0.00950	-0.01570
-15.000	0.01280	0.00890	0.00490	0.00170	-0.00140	-0.00520	-0.00790	-0.01430
-10.000	0.00590	0.00430	0.00280	0.00070	-0.00140	-0.00470	-0.00790	-0.01290
-5.000	0.00290	0.00220	0.00140	0.00030	-0.00070	-0.00230	-0.00500	-0.00650
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00370	-0.00120	0.00030	0.00200	0.00300	0.00650	0.00700	0.01480
10.000	-0.00530	-0.00240	0.00050	0.00390	0.00740	0.01300	0.01860	0.02970
15.000	-0.00570	-0.00170	0.00250	0.00830	0.01250	0.02670	0.03700	0.05840
20.000	-0.00810	-0.00100	0.00610	0.01260	0.01910	0.04030	0.06160	0.08710

ENGINEER DLO
DATE 9/13/88

FIGURE 4.1.2.2-26
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

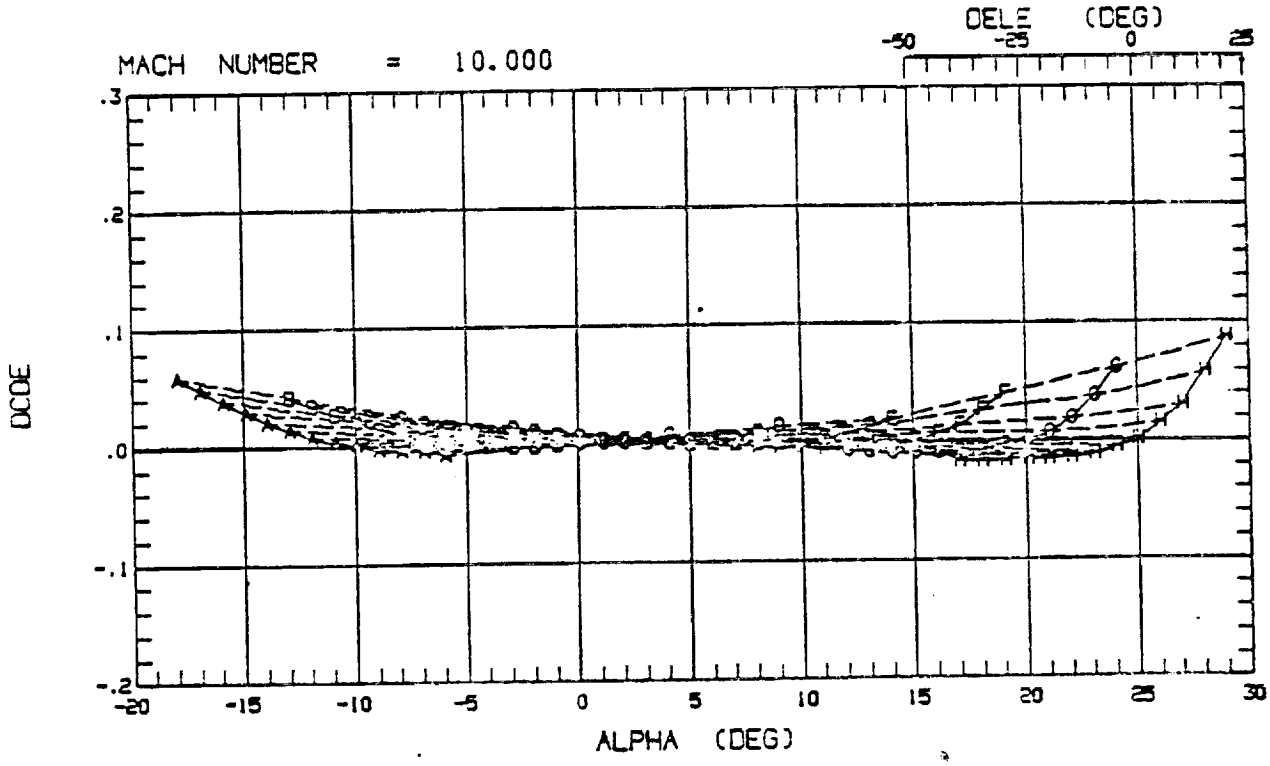
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

REFERENCE DIMENSIONS

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
DELE (DEG)	F	G	H	I	J	K	L	M
	ELEVON DRAG INCREMENT							
-40.000	-0.00230	-0.00730	-0.01670	-0.02600	-0.03927	-0.05390	-0.06916	-0.08530
-35.000	-0.00360	-0.00850	-0.01670	-0.02500	-0.03925	-0.05400	-0.06887	-0.08400
-30.000	-0.00490	-0.00970	-0.01680	-0.02400	-0.03830	-0.05250	-0.06652	-0.08020
-25.000	-0.00530	-0.00990	-0.01620	-0.02260	-0.03665	-0.05070	-0.06332	-0.07500
-20.000	-0.00570	-0.00950	-0.01570	-0.02120	-0.03395	-0.04670	-0.05851	-0.06970
-15.000	-0.00520	-0.00790	-0.01430	-0.01960	-0.03080	-0.04200	-0.05211	-0.06150
-10.000	-0.00470	-0.00790	-0.01290	-0.01800	-0.02940	-0.03480	-0.04252	-0.04980
-5.000	-0.00230	-0.00500	-0.00650	-0.01150	-0.01650	-0.02150	-0.02556	-0.02900
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00650	0.00700	0.01480	0.01700	0.02300	0.02900	0.03369	0.03750
10.000	0.01300	0.01860	0.02970	0.04070	0.05190	0.06310	0.07336	0.08300
15.000	0.02570	0.03700	0.05840	0.07200	0.08711	0.10400	0.12300	0.14400
20.000	0.04030	0.06160	0.08710	0.11250	0.13590	0.15920	0.18955	0.22460

ENGINEER DCD
DATE 9/13/28

FIGURE 4.1.2.2-27
ELEVON DRAG COEFFICIENT INCREMENT



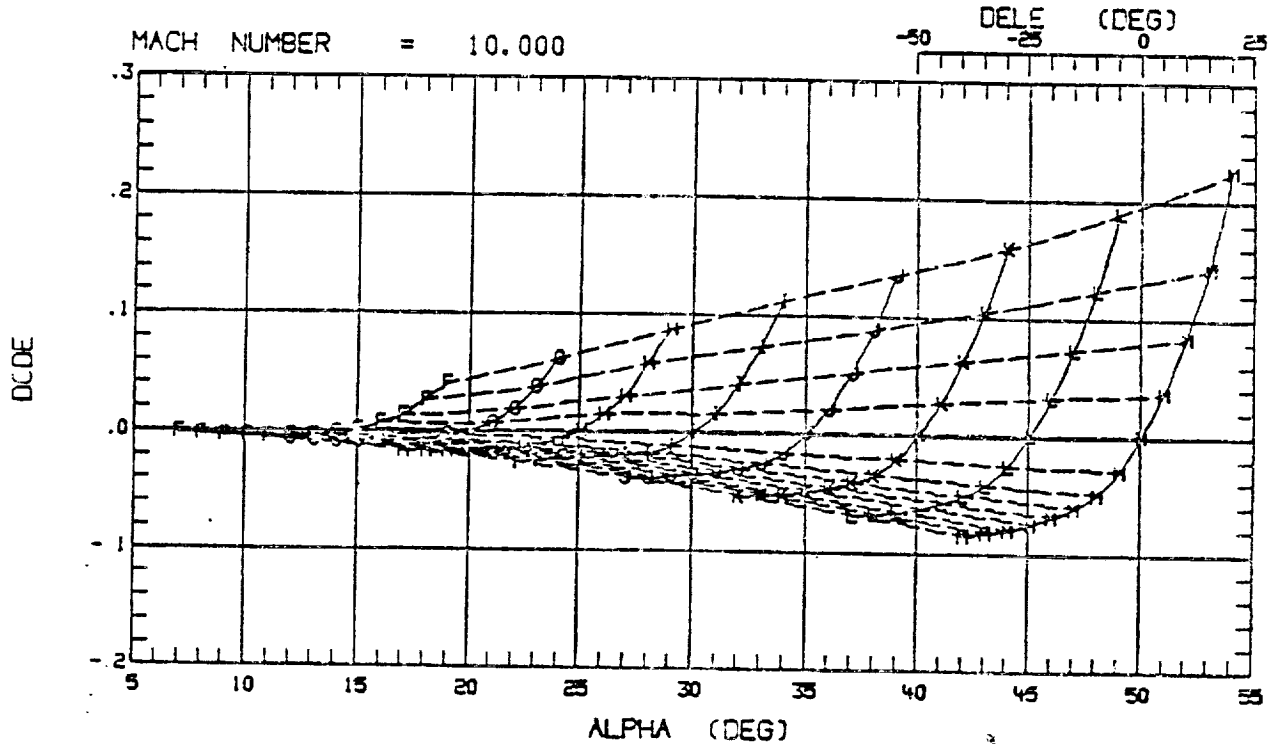
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.05730	0.04060	0.02380	0.01350	0.00310	-0.00200	-0.00720	-0.01670
-35.000	0.04730	0.03310	0.01890	0.01040	0.00190	-0.00330	-0.00850	-0.01670
-30.000	0.03720	0.02560	0.01400	0.00740	0.00070	-0.00460	-0.00990	-0.01670
-25.000	0.02860	0.01960	0.01060	0.00520	-0.00020	-0.00500	-0.00980	-0.01610
-20.000	0.02000	0.01350	0.00710	0.00300	-0.00110	-0.00540	-0.00980	-0.01550
-15.000	0.01340	0.00910	0.00480	0.00180	-0.00120	-0.00500	-0.00870	-0.01420
-10.000	0.00690	0.00470	0.00250	0.00060	-0.00130	-0.00450	-0.00770	-0.01290
-5.000	0.00250	0.00230	0.00120	0.00030	-0.00060	-0.00220	-0.00380	-0.00640
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00350	-0.00120	0.0	0.00170	0.00270	0.00630	0.00700	0.01480
10.000	-0.00480	-0.00240	0.0	0.00340	0.00680	0.01270	0.01860	0.02950
15.000	-0.00500	-0.00160	0.00250	0.00800	0.01290	0.02640	0.03700	0.05810
20.000	-0.00790	-0.00080	0.00630	0.01260	0.01890	0.04010	0.06130	0.08670

ENGINEER CCO
DATE 9/13/72

FIGURE 4.1.2.2-28
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

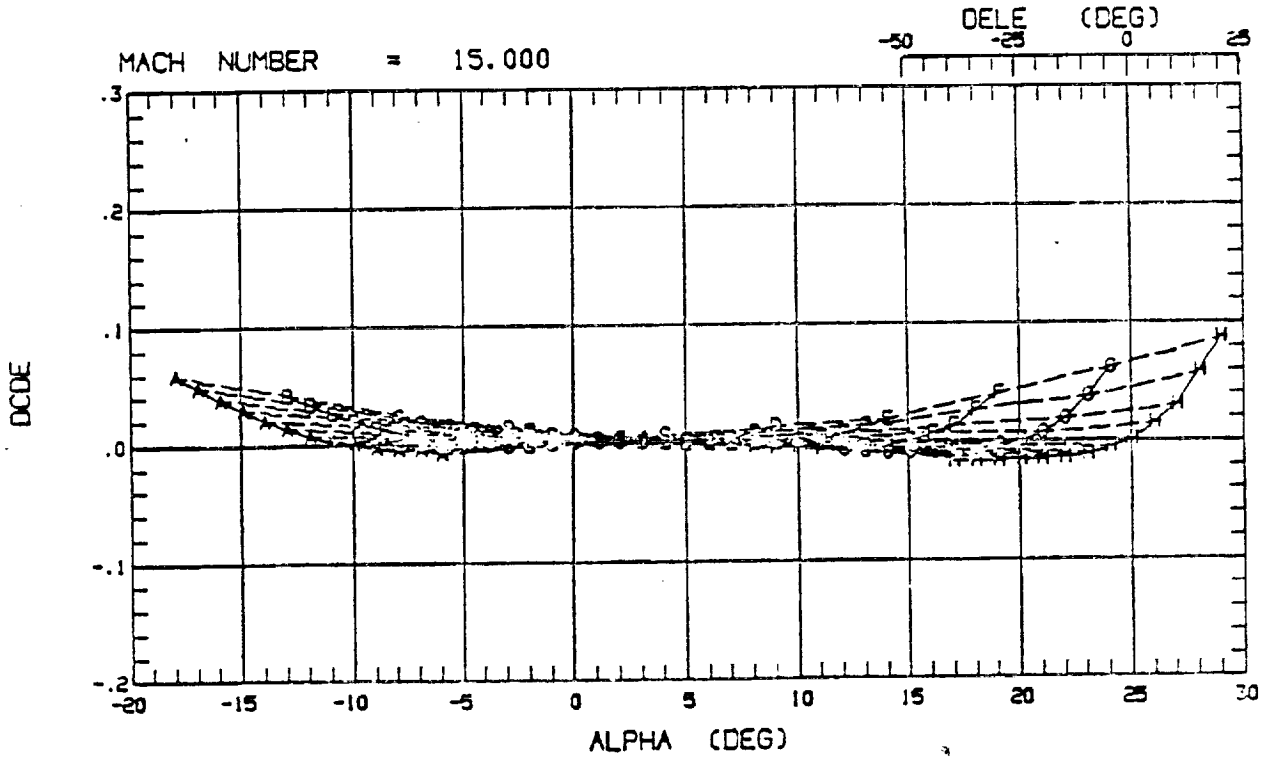
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	REFERENCE DIMENSIONS	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	-0.00200	-0.00720	-0.01670	-0.02630	-0.03944	-0.05400	-0.06627	-0.08650
-35.000	-0.00330	-0.00850	-0.01670	-0.02490	-0.03862	-0.05310	-0.06784	-0.08300
-30.000	-0.00460	-0.00990	-0.01670	-0.02350	-0.03785	-0.05220	-0.06636	-0.08040
-25.000	-0.00500	-0.00980	-0.01610	-0.02250	-0.03590	-0.04930	-0.06233	-0.07510
-20.000	-0.00540	-0.00980	-0.01560	-0.02140	-0.03390	-0.04640	-0.05830	-0.06980
-15.000	-0.00500	-0.00870	-0.01420	-0.01970	-0.03085	-0.04200	-0.05210	-0.06150
-10.000	-0.00450	-0.00770	-0.01280	-0.01790	-0.02845	-0.03500	-0.04272	-0.04990
-5.000	-0.00220	-0.00380	-0.00640	-0.01250	-0.01711	-0.02150	-0.02581	-0.03000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00630	0.00700	0.01460	0.01550	0.02125	0.02700	0.03181	0.03600
10.000	0.01270	0.01860	0.02950	0.04050	0.05175	0.06300	0.07324	0.08280
15.000	0.02640	0.03700	0.05910	0.07300	0.08851	0.10500	0.12325	0.14300
20.000	0.04010	0.06130	0.08670	0.11210	0.13535	0.15860	0.18942	0.22450

ENGINEER SCO
DATE 9/13/22

FIGURE 4.1.2.2-29
ELEVON DRAG COEFFICIENT INCREMENT



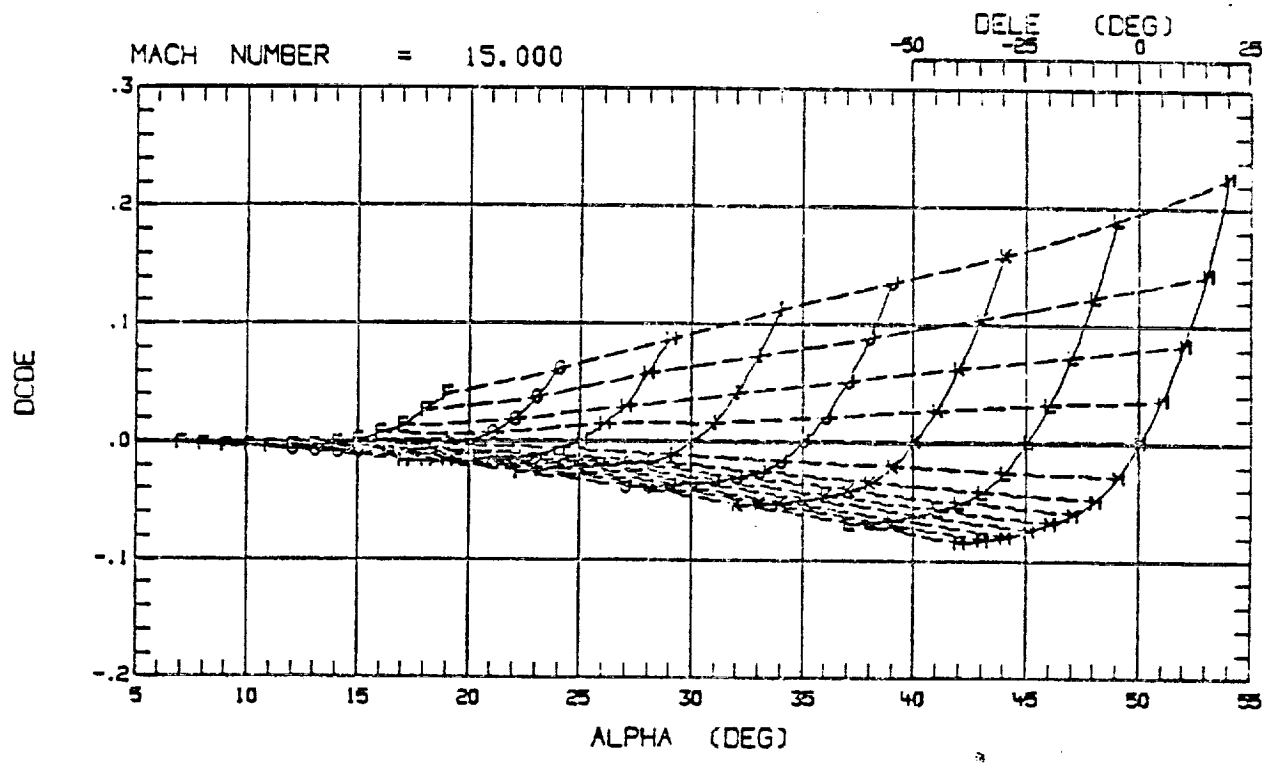
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.05730	0.04060	0.02380	0.01350	0.00310	-0.00200	-0.00720	-0.01670
-35.000	0.04730	0.03310	0.01890	0.01040	0.00190	-0.00330	-0.00850	-0.01670
-30.000	0.03720	0.02560	0.01400	0.00740	0.00070	-0.00460	-0.00990	-0.01670
-25.000	0.02960	0.01960	0.01060	0.00520	-0.00020	-0.00500	-0.00980	-0.01610
-20.000	0.02000	0.01350	0.00710	0.00300	-0.00110	-0.00540	-0.00980	-0.01560
-15.000	0.01340	0.00910	0.00480	0.00180	-0.00120	-0.00500	-0.00870	-0.01420
-10.000	0.00690	0.00470	0.00250	0.00060	-0.00130	-0.00450	-0.00770	-0.01280
-5.000	0.00250	0.00230	0.00120	0.00030	-0.00060	-0.00220	-0.00380	-0.00640
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00350	-0.00120	0.0	0.00170	0.00270	0.00630	0.00700	0.01480
10.000	-0.00480	-0.00240	0.0	0.00340	0.00680	0.01270	0.01860	0.02950
15.000	-0.00500	-0.00160	0.00250	0.00800	0.01290	0.02640	0.03700	0.05810
20.000	-0.00790	-0.00080	0.00630	0.01260	0.01890	0.04010	0.05130	0.08670

ENGINEER CLC
DATE 9/13/78

FIGURE 4.1.2.2-30
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

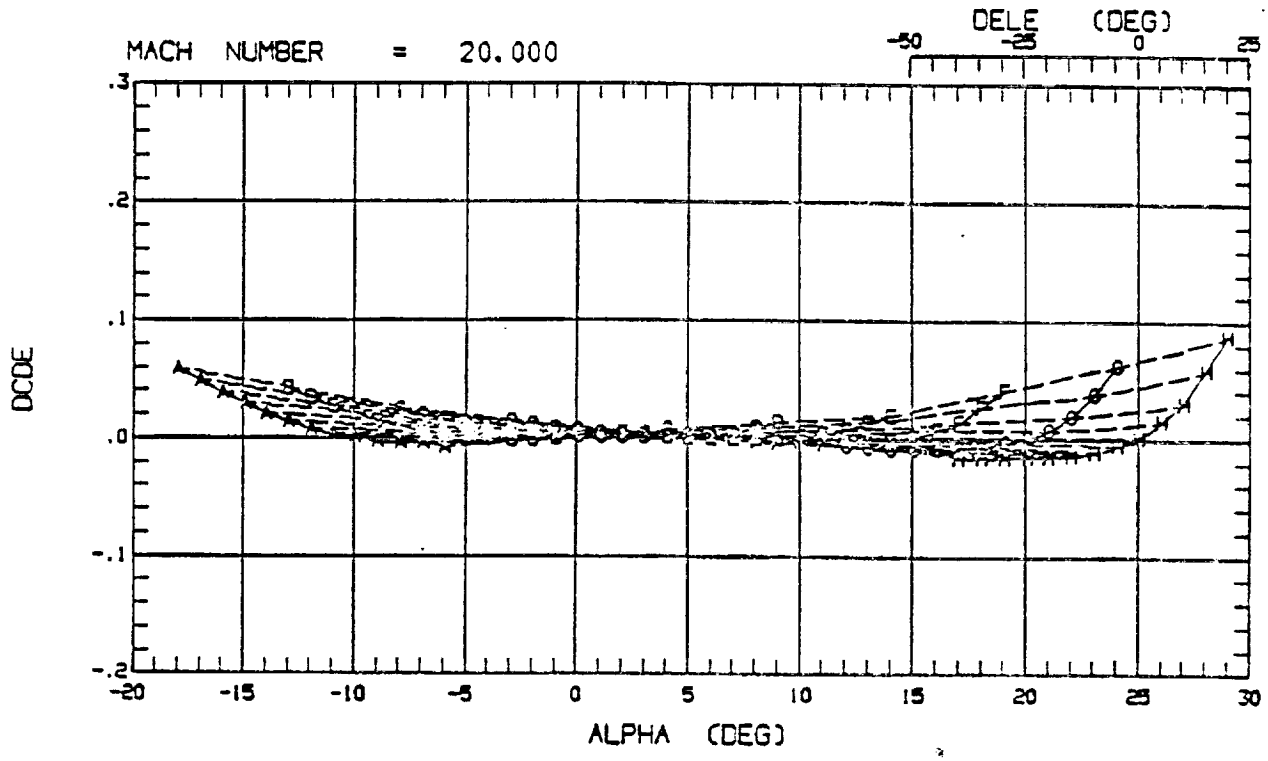
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1078.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.0 IN.	

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	-0.00200	-0.00720	-0.01670	-0.02630	-0.03944	-0.05400	-0.06927	-0.08550
-35.000	-0.00330	-0.00850	-0.01670	-0.02490	-0.03862	-0.05310	-0.06784	-0.08300
-30.000	-0.00460	-0.00990	-0.01670	-0.02350	-0.03785	-0.05220	-0.06638	-0.08040
-25.000	-0.00500	-0.00980	-0.01610	-0.02250	-0.03590	-0.04930	-0.06233	-0.07510
-20.000	-0.00540	-0.00980	-0.01560	-0.02140	-0.03390	-0.04640	-0.05830	-0.06980
-15.000	-0.00500	-0.00870	-0.01420	-0.01970	-0.03085	-0.04200	-0.05210	-0.06150
-10.000	-0.00450	-0.00770	-0.01280	-0.01790	-0.02645	-0.03500	-0.04272	-0.04990
-5.000	-0.00220	-0.00380	-0.00640	-0.01250	-0.01711	-0.02150	-0.02581	-0.03000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00630	0.00700	0.01480	0.01550	0.02125	0.02700	0.03181	0.03600
10.000	0.01270	0.01860	0.02950	0.04050	0.05175	0.06300	0.07324	0.08280
15.000	0.02540	0.03700	0.05810	0.07300	0.08851	0.10500	0.12325	0.14300
20.000	0.04010	0.06130	0.08670	0.11210	0.13535	0.15860	0.18912	0.22450

ENGINEER GCD
DATE 9/13/72

FIGURE 4.1.2.2-31
ELEVON DRAG COEFFICIENT INCREMENT

SD72-SH-0060 IM



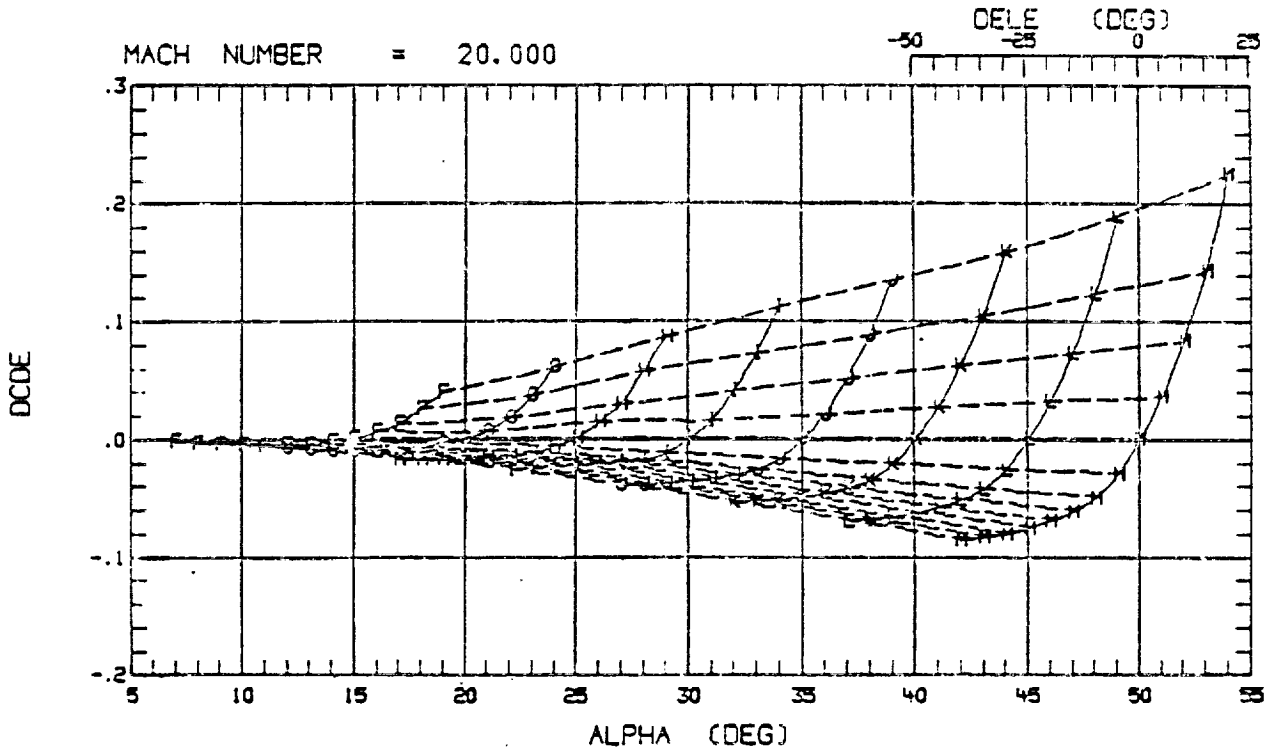
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	0.05730	0.04060	0.02380	0.01350	0.00310	-0.00200	-0.00720	-0.01670
-35.000	0.04730	0.03310	0.01890	0.01040	0.00190	-0.00330	-0.00850	-0.01670
-30.000	0.03720	0.02560	0.01400	0.00740	0.00070	-0.00460	-0.00990	-0.01670
-25.000	0.02960	0.01960	0.01060	0.00520	-0.00020	-0.00500	-0.00980	-0.01610
-20.000	0.02000	0.01350	0.00710	0.00300	-0.00110	-0.00540	-0.00980	-0.01560
-15.000	0.01340	0.00910	0.00480	0.00180	-0.00120	-0.00500	-0.00870	-0.01420
-10.000	0.00690	0.00470	0.00250	0.00060	-0.00130	-0.00450	-0.00770	-0.01280
-5.000	0.00250	0.00230	0.00120	0.00030	-0.00060	-0.00220	-0.00380	-0.00640
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00350	-0.00120	0.0	0.00170	0.00270	0.00630	0.00700	0.01480
10.000	-0.00480	-0.00240	0.0	0.00340	0.00680	0.01270	0.01860	0.02950
15.000	-0.00500	-0.00160	0.00250	0.00800	0.01280	0.02540	0.03700	0.05810
20.000	-0.00790	-0.00080	0.00630	0.01260	0.01890	0.04010	0.06130	0.08670

ENGINEER SCD
DATE 9/13/72

FIGURE 4.1.2.2-32
ELEVON DRAG COEFFICIENT INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE

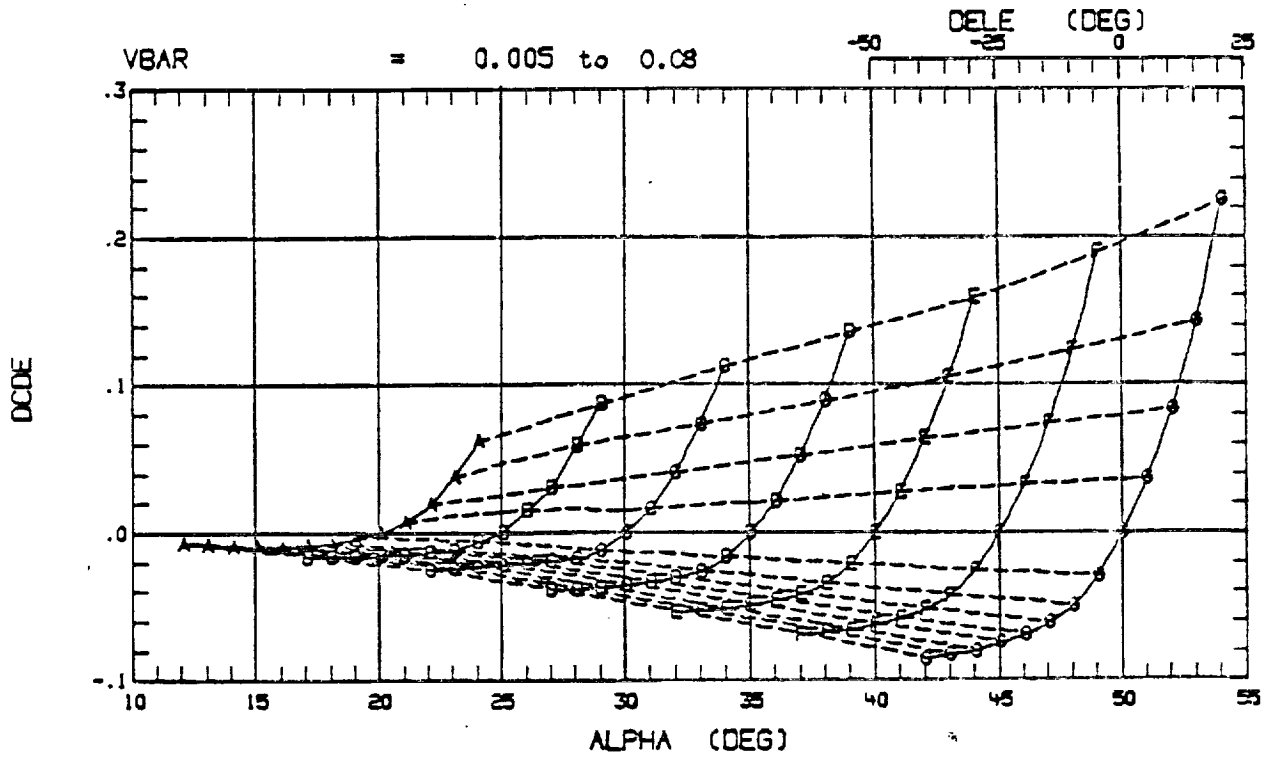
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

REFERENCE DIMENSIONS

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON DRAG INCREMENT							
-40.000	-0.00200	-0.00720	-0.01670	-0.02630	-0.03944	-0.05400	-0.06927	-0.08550
-35.000	-0.00330	-0.00850	-0.01670	-0.02490	-0.03862	-0.05310	-0.06784	-0.08300
-30.000	-0.00460	-0.00980	-0.01670	-0.02350	-0.03785	-0.05220	-0.06636	-0.08040
-25.000	-0.00500	-0.00980	-0.01610	-0.02250	-0.03590	-0.04930	-0.06233	-0.07510
-20.000	-0.00540	-0.00980	-0.01550	-0.02140	-0.03390	-0.04640	-0.05830	-0.06980
-15.000	-0.00500	-0.00870	-0.01420	-0.01970	-0.03085	-0.04200	-0.05210	-0.06150
-10.000	-0.00450	-0.00770	-0.01290	-0.01790	-0.02645	-0.03500	-0.04272	-0.04990
-5.000	-0.00220	-0.00380	-0.00640	-0.01250	-0.01711	-0.02150	-0.02581	-0.03000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00630	0.00700	0.01480	0.01550	0.02125	0.02700	0.03181	0.03600
10.000	0.01270	0.01860	0.02950	0.04050	0.05175	0.06300	0.07324	0.08280
15.000	0.02640	0.03700	0.05810	0.07300	0.08851	0.10500	0.12325	0.14300
20.000	0.04010	0.06130	0.08670	0.11210	0.13535	0.15860	0.18912	0.22450

ENGINEER DCD
DATE 9/13/28

FIGURE 4.1.2.2-33
ELEVON DRAG COEFFICIENT INCREMENT

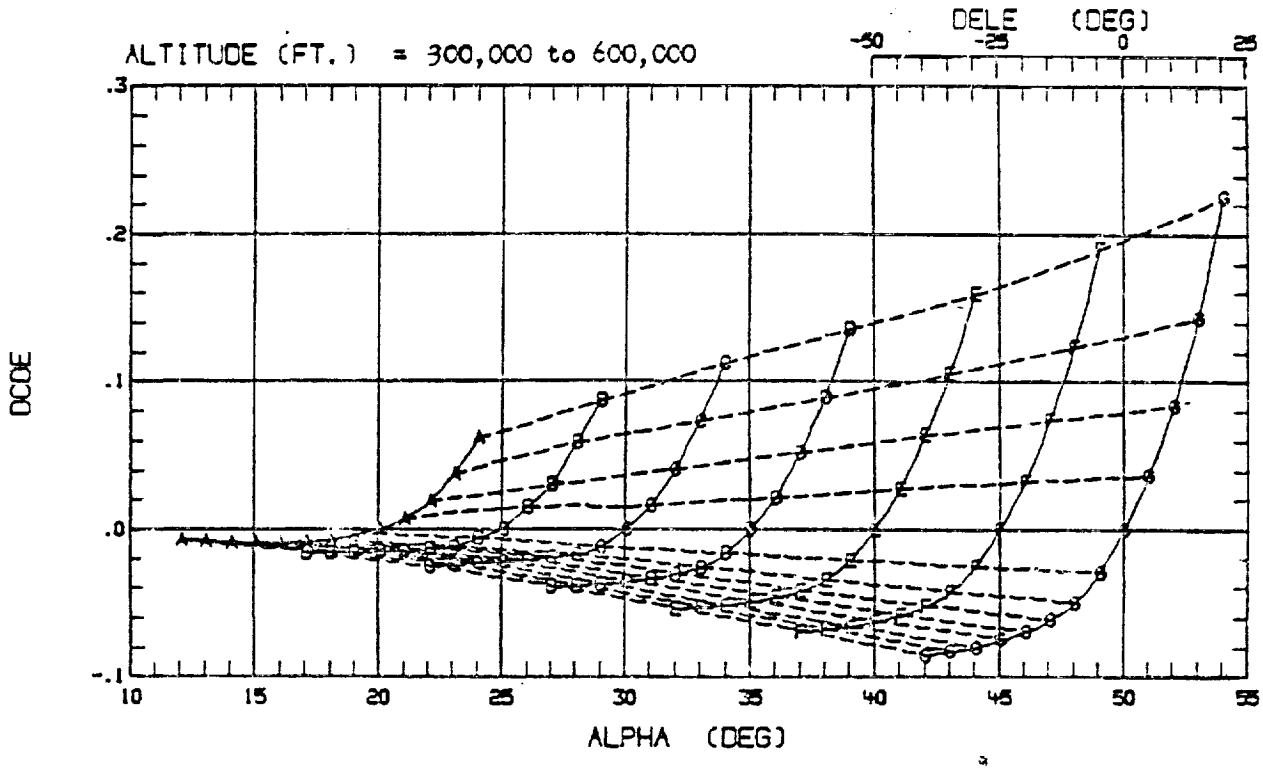


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1250.3 IN.

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELE (DEG)	ELEVON DRAG INCREMENT						
-40.000	-0.00720	-0.01670	-0.02630	-0.03944	-0.05400	-0.06927	-0.08550
-35.000	-0.00850	-0.01670	-0.02490	-0.03862	-0.05310	-0.06784	-0.08300
-30.000	-0.00990	-0.01670	-0.02350	-0.03785	-0.05220	-0.06636	-0.08040
-25.000	-0.00980	-0.01610	-0.02250	-0.03590	-0.04930	-0.06233	-0.07510
-20.000	-0.00980	-0.01560	-0.02140	-0.03390	-0.04640	-0.05830	-0.06980
-15.000	-0.00870	-0.01420	-0.01970	-0.03085	-0.04200	-0.05210	-0.06150
-10.000	-0.00770	-0.01280	-0.01790	-0.02745	-0.03500	-0.04272	-0.04990
-5.000	-0.00380	-0.00640	-0.01250	-0.01711	-0.02150	-0.02581	-0.03000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00700	0.01480	0.01550	0.02125	0.02700	0.03181	0.03600
10.000	0.01860	0.02950	0.04050	0.05175	0.06300	0.07324	0.08290
15.000	0.03700	0.05810	0.07300	0.08851	0.10500	0.12325	0.14300
20.000	0.06130	0.08670	0.11210	0.13535	0.15860	0.18912	0.22450

ENGINEER NASA
DATE

FIGURE 4.1.2.2-34
EFFECT OF ELEVON



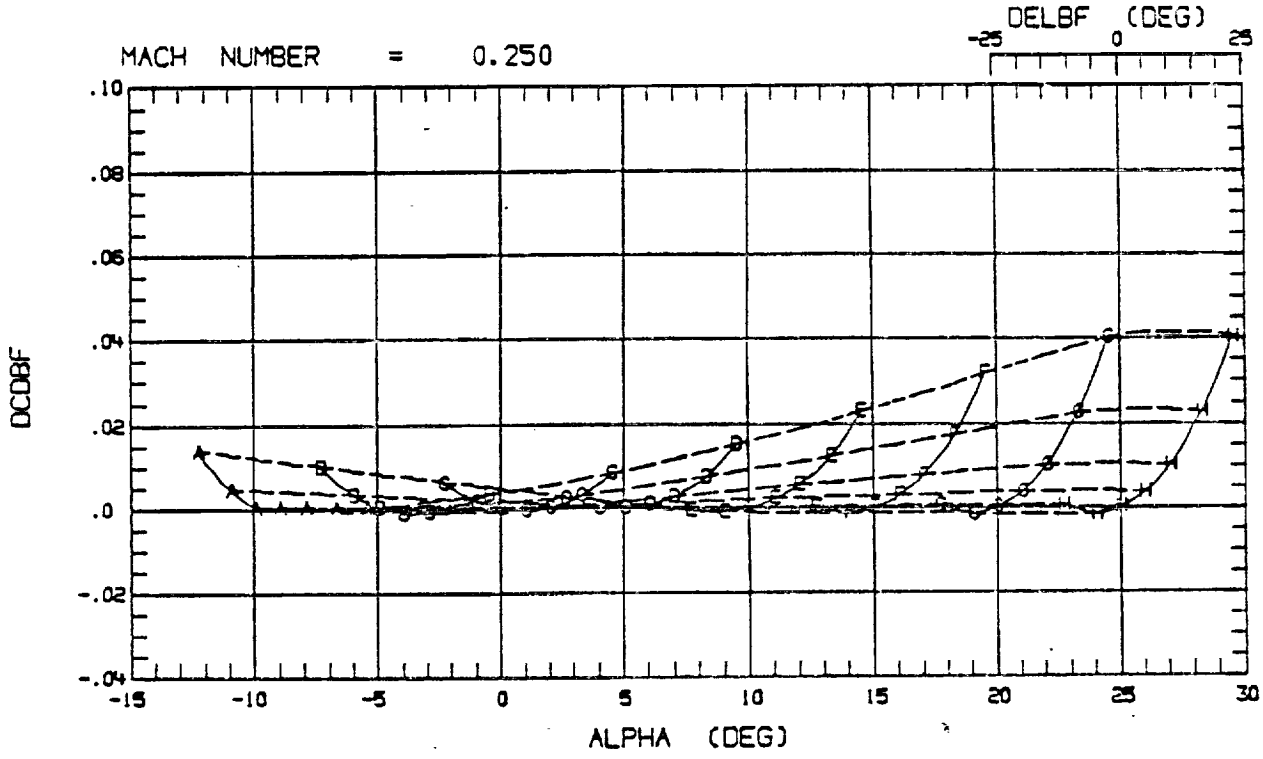
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELE (DEG)	ELEVON DRAG INCREMENT						
-40.000	-0.00720	-0.01670	-0.02630	-0.03944	-0.05400	-0.06927	-0.08550
-35.000	-0.00850	-0.01670	-0.02490	-0.03862	-0.05310	-0.06784	-0.08300
-30.000	-0.00590	-0.01670	-0.02350	-0.03785	-0.05220	-0.06636	-0.08040
-25.000	-0.00980	-0.01610	-0.02250	-0.03590	-0.04930	-0.06233	-0.07510
-20.000	-0.00980	-0.01560	-0.02140	-0.03390	-0.04640	-0.05830	-0.06980
-15.000	-0.00870	-0.01420	-0.01970	-0.03085	-0.04200	-0.05210	-0.06150
-10.000	-0.00770	-0.01280	-0.01790	-0.02845	-0.03500	-0.04272	-0.04990
-5.000	-0.00380	-0.00640	-0.01250	-0.01711	-0.02150	-0.02581	-0.03000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00700	0.01480	0.01550	0.02125	0.02700	0.03181	0.03600
10.000	0.01860	0.02950	0.04050	0.05175	0.06300	0.07324	0.08280
15.000	0.03700	0.05810	0.07300	0.08851	0.10500	0.12325	0.14300
20.000	0.06130	0.08670	0.11210	0.13535	0.15960	0.18912	0.22450

ENGINEER NASA
DATE

FIGURE 4.1.2.2-35
EFFECT OF ELEVON

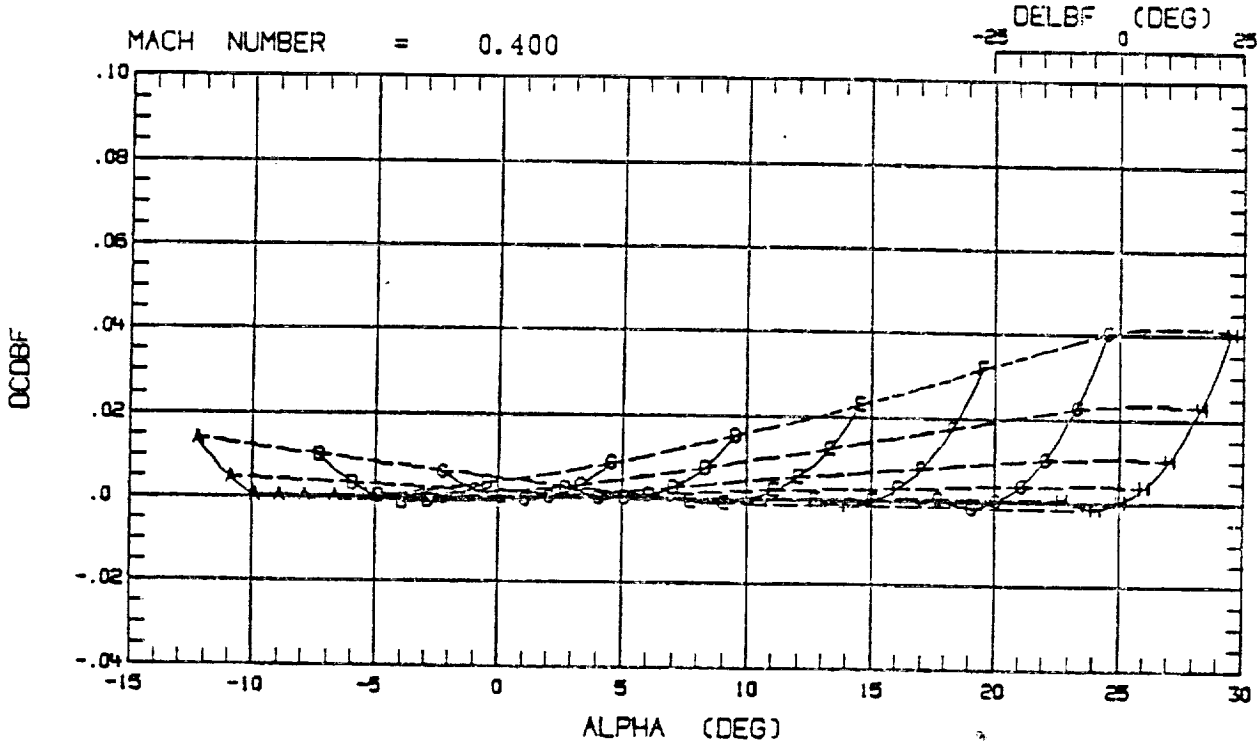


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.01360	0.00959	0.00590	0.00242	-0.00050	0.00005	0.00060	0.00060
-5.000	0.00442	0.00306	0.00170	0.00025	-0.00106	-0.00126	-0.00146	-0.00146
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00116	-0.00054	0.00079	0.00211	0.00294	0.00379	0.00379
10.000	0.0	-0.00083	0.00013	0.00268	0.00536	0.00769	0.01004	0.01004
16.300	0.0	0.00072	0.00300	0.00737	0.01220	0.01735	0.02250	0.02250
22.500	0.0	0.00330	0.00820	0.01499	0.02280	0.03160	0.04040	0.04040

ENGINEER [illegible]
DATE 9-12-74

FIGURE 4.1.2.2-36
EFFECT OF BODY FLAP

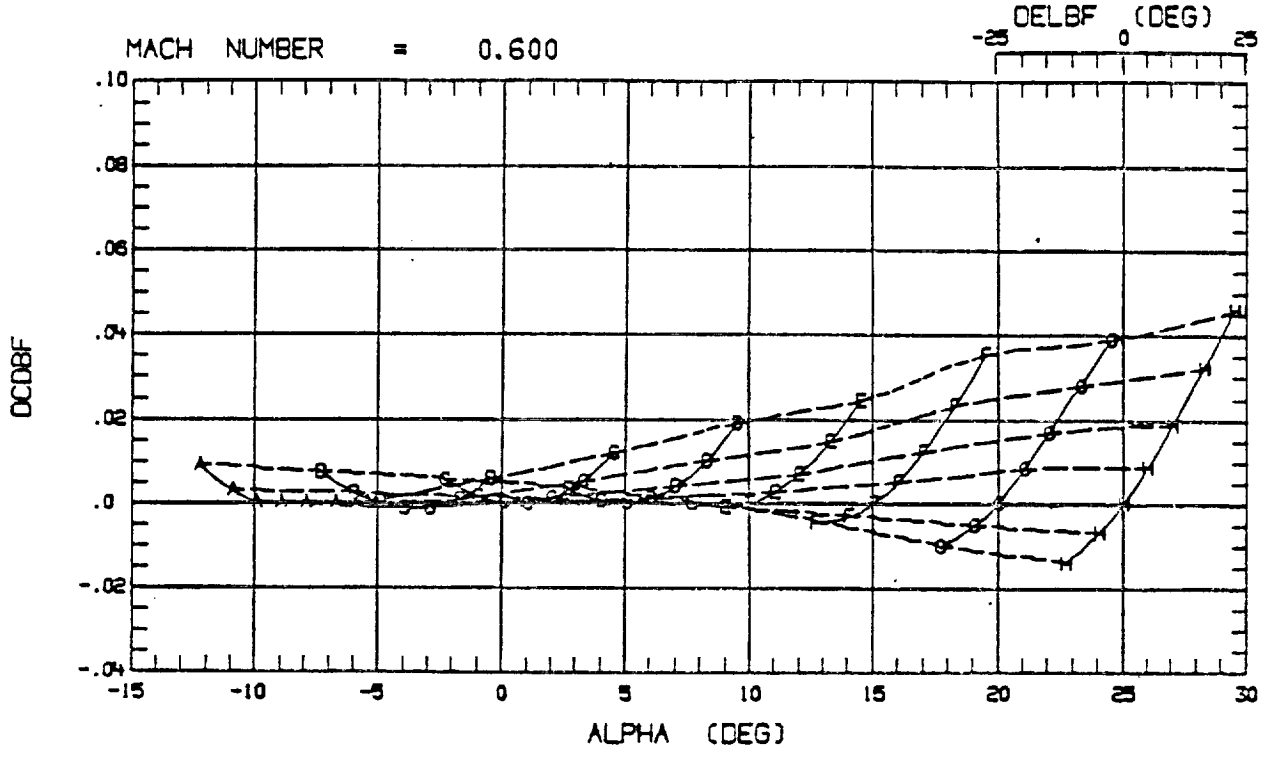


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.01360	0.00959	0.00590	0.00242	-0.00050	0.00005	0.00060	0.00060
-5.000	0.00442	0.00306	0.00170	0.00025	-0.00106	-0.00125	-0.00146	-0.00146
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00116	-0.00054	0.00079	0.00211	0.00294	0.00379	0.00379
10.000	0.0	-0.00083	0.00013	0.00268	0.00536	0.00769	0.01004	0.01004
16.300	0.0	0.00072	0.00300	0.00737	0.01220	0.01735	0.02250	0.02250
22.500	0.0	0.00330	0.00820	0.01499	0.02280	0.03160	0.04040	0.04040

ENGINEER WMZ
DATE 9-29-78

FIGURE 4.1.2.2-37
EFFECT OF BODY FLAP



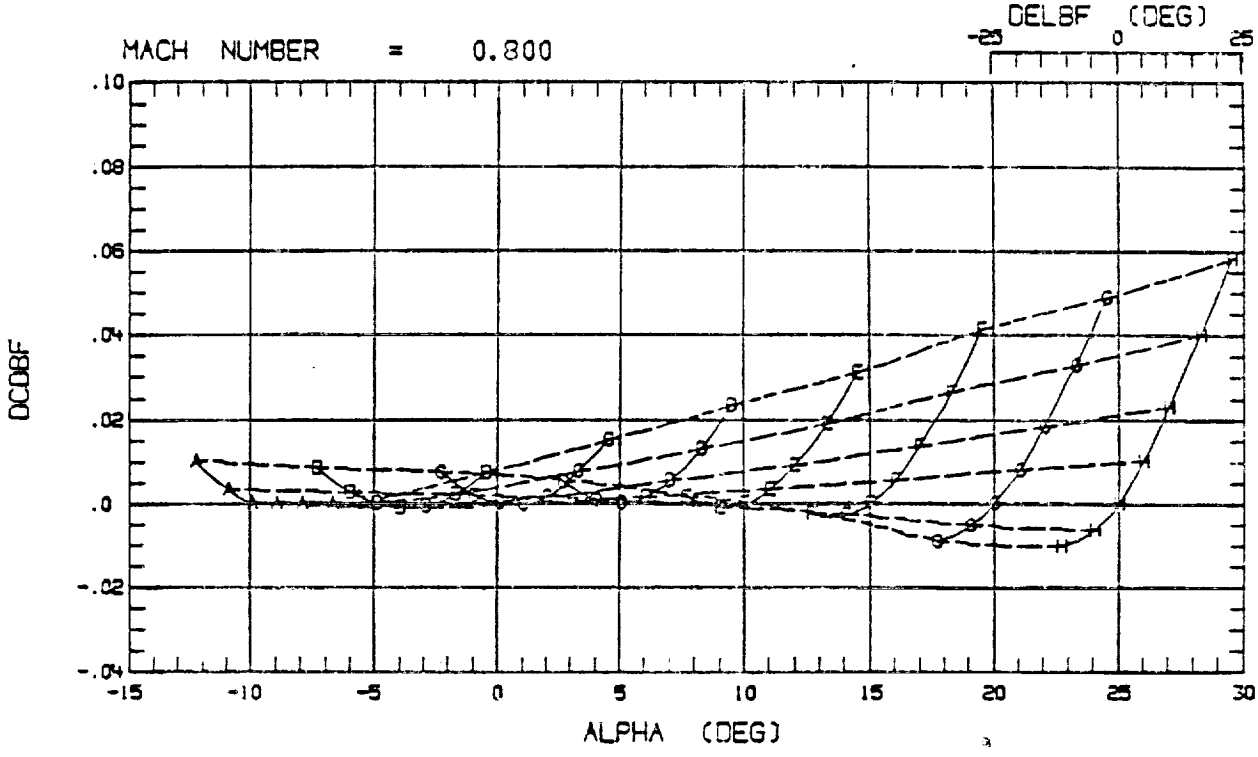
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.00900	0.00725	0.00563	0.00344	0.00026	-0.00447	-0.01000	-0.01400
-5.000	0.00293	0.00230	0.00144	0.00038	-0.00099	-0.00315	-0.00531	-0.00690
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00123	-0.00008	0.00116	0.00268	0.00524	0.00820	0.00866
10.000	0.0	-0.00133	0.00126	0.00392	0.00702	0.01233	0.01693	0.01860
16.300	0.0	0.00081	0.00530	0.01004	0.01484	0.02310	0.02800	0.03200
22.500	0.0	0.00580	0.01202	0.01913	0.02441	0.03950	0.03900	0.04600

ENGINEER WMZ
DATE 9-12-78

FIGURE 4.1.2.2-38
EFFECT OF BODY FLAP



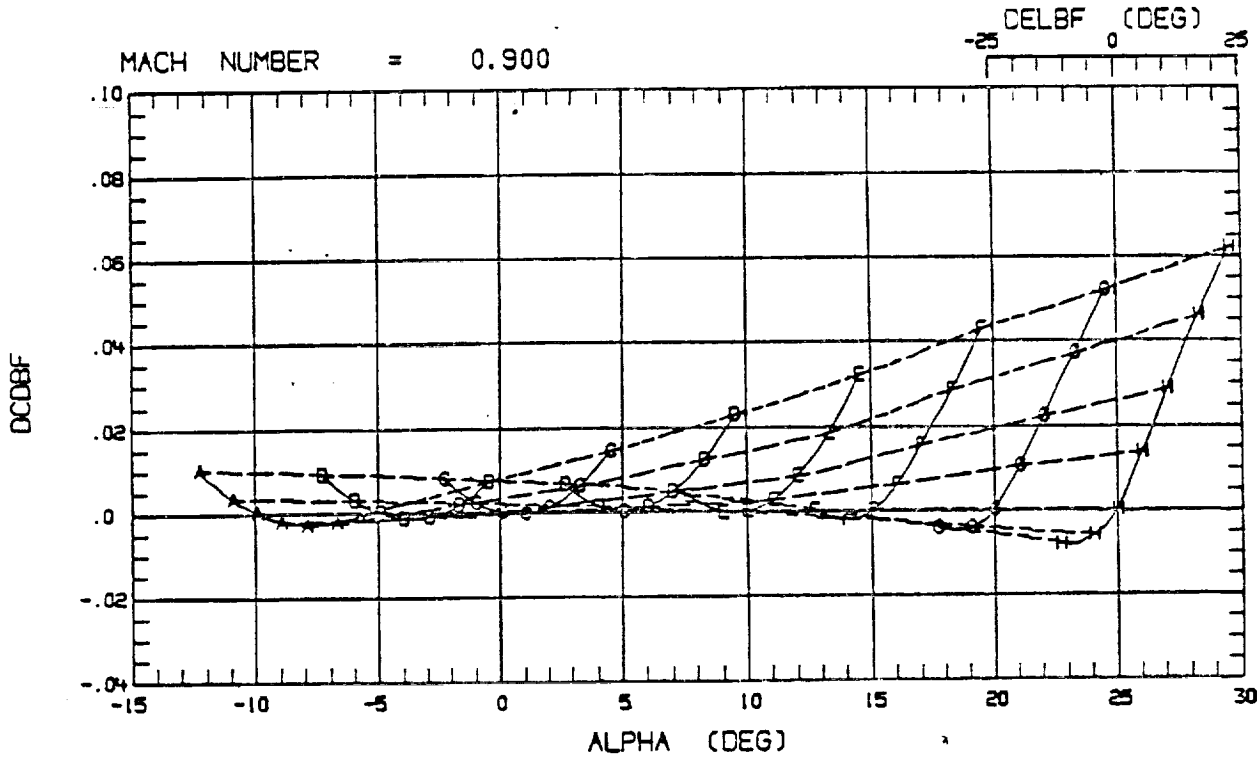
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP DRAG COEFFICIENT INCRE							
-11.700	0.01000	0.00829	0.00735	0.00521	0.00171	-0.00241	-0.00500	-0.01000
-5.000	0.00325	0.00254	0.00200	0.00075	-0.00083	-0.00273	-0.00535	-0.00619
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00105	-0.00020	0.00157	0.00338	0.00560	0.00810	0.01022
10.000	0.0	-0.00061	0.00140	0.00537	0.00911	0.01374	0.01836	0.02286
16.300	0.0	0.00213	0.00750	0.01291	0.01894	0.02650	0.03300	0.04000
22.500	0.0	0.00721	0.01494	0.02319	0.03122	0.04150	0.04900	0.05800

ENGINEER JKD
DATE 10-3-78

FIGURE 4.1.2.2-39
EFFECT OF BODY FLAP



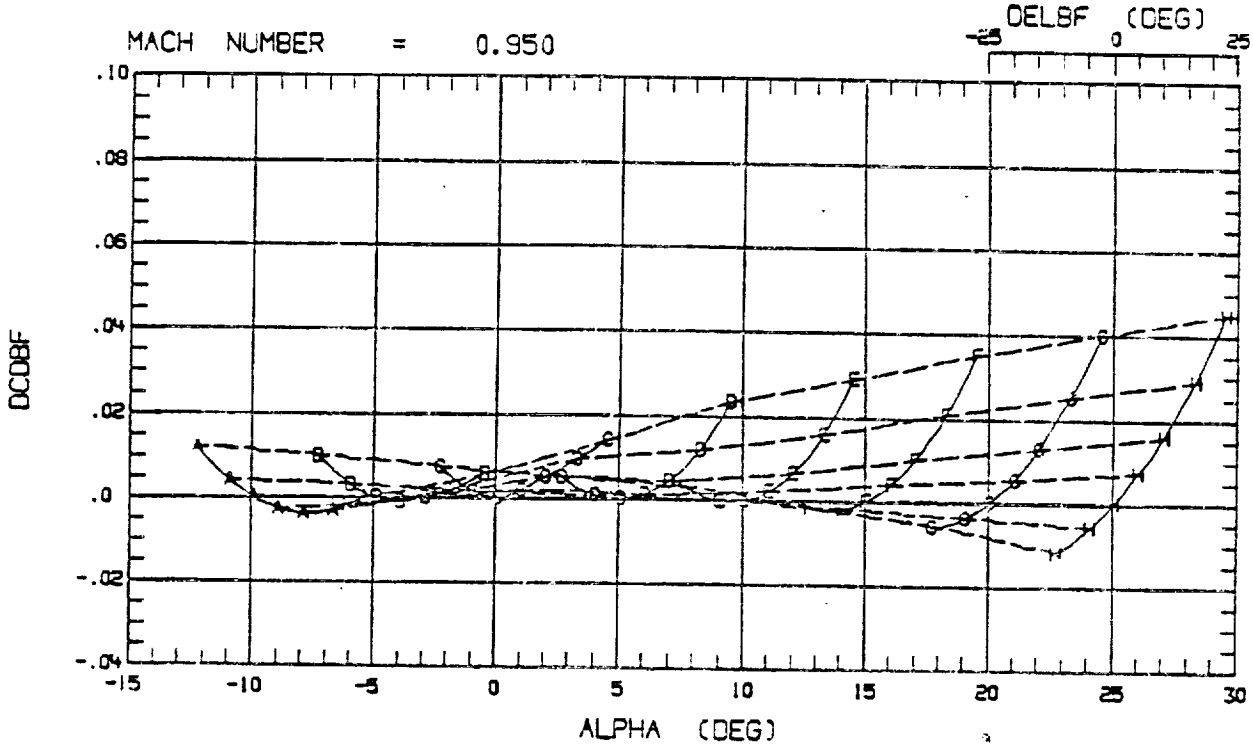
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.01000	0.00916	0.00804	0.00664	0.00385	0.00023	-0.00400	-0.00800
-5.000	0.00340	0.00295	0.00215	0.00127	-0.00010	-0.00201	-0.00402	-0.00598
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00196	-0.00130	-0.00027	0.00115	0.00277	0.00627	0.01035	0.01353
10.000	-0.00260	-0.00101	0.00136	0.00467	0.00816	0.01536	0.02206	0.02845
16.300	-0.00200	0.00179	0.00832	0.01217	0.01839	0.02943	0.03700	0.04600
22.500	0.0	0.00730	0.01443	0.02280	0.03211	0.04279	0.05200	0.06200

ENGINEER Lum
DATE 9-30-78

FIGURE 4.1.2.2-40
EFFECT OF BODY FLAP



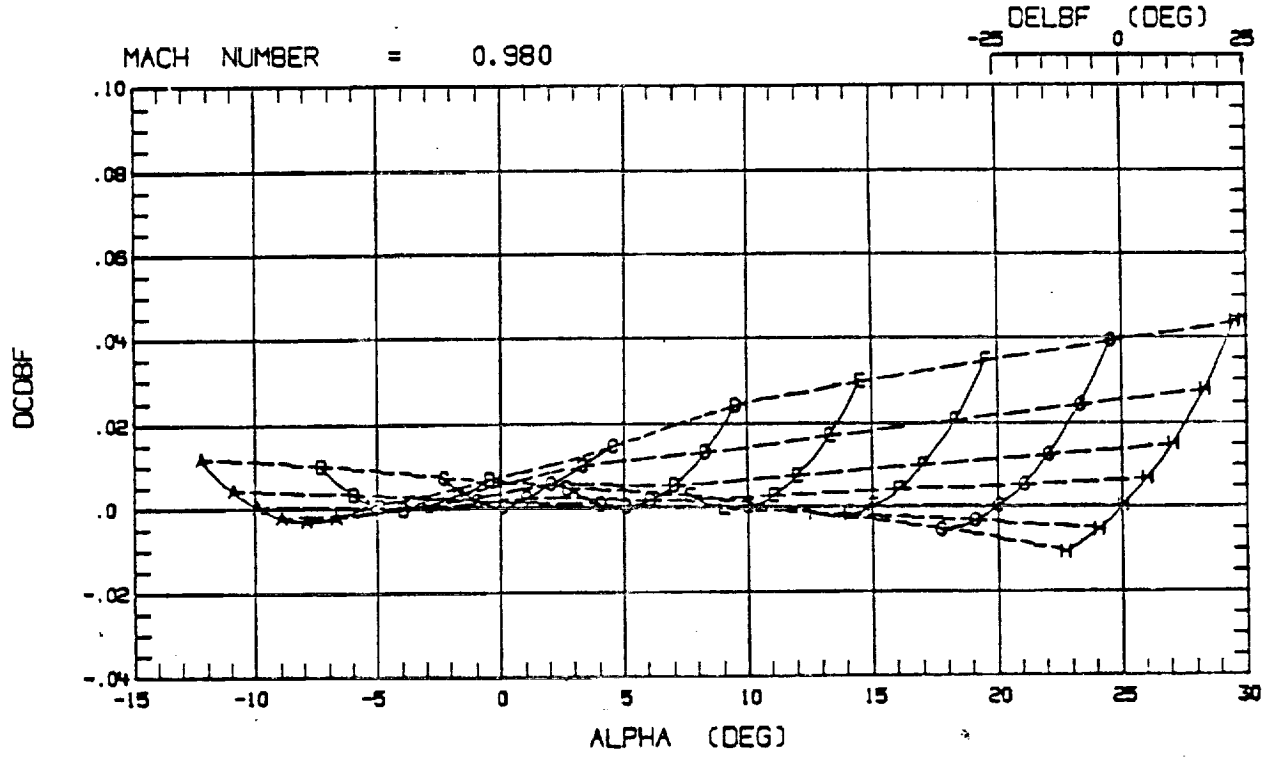
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.01200	0.00983	0.00726	0.00507	0.00297	-0.00160	-0.00600	-0.01200
-5.000	0.00412	0.00302	0.00166	0.00077	-0.00019	-0.00204	-0.00379	-0.00603
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00261	-0.00080	0.00203	0.00121	0.00223	0.00401	0.00556	0.00725
10.000	-0.00372	0.00007	0.00521	0.00447	0.00660	0.01003	0.01293	0.01580
16.300	-0.00300	0.00239	0.00948	0.01196	0.01569	0.02076	0.02500	0.02900
22.500	0.0	0.00580	0.01398	0.02326	0.02885	0.03486	0.04000	0.04500

ENGINEER WMZ
DATE 9-10-78

FIGURE 4.1.2.2-41
EFFECT OF BODY FLAP



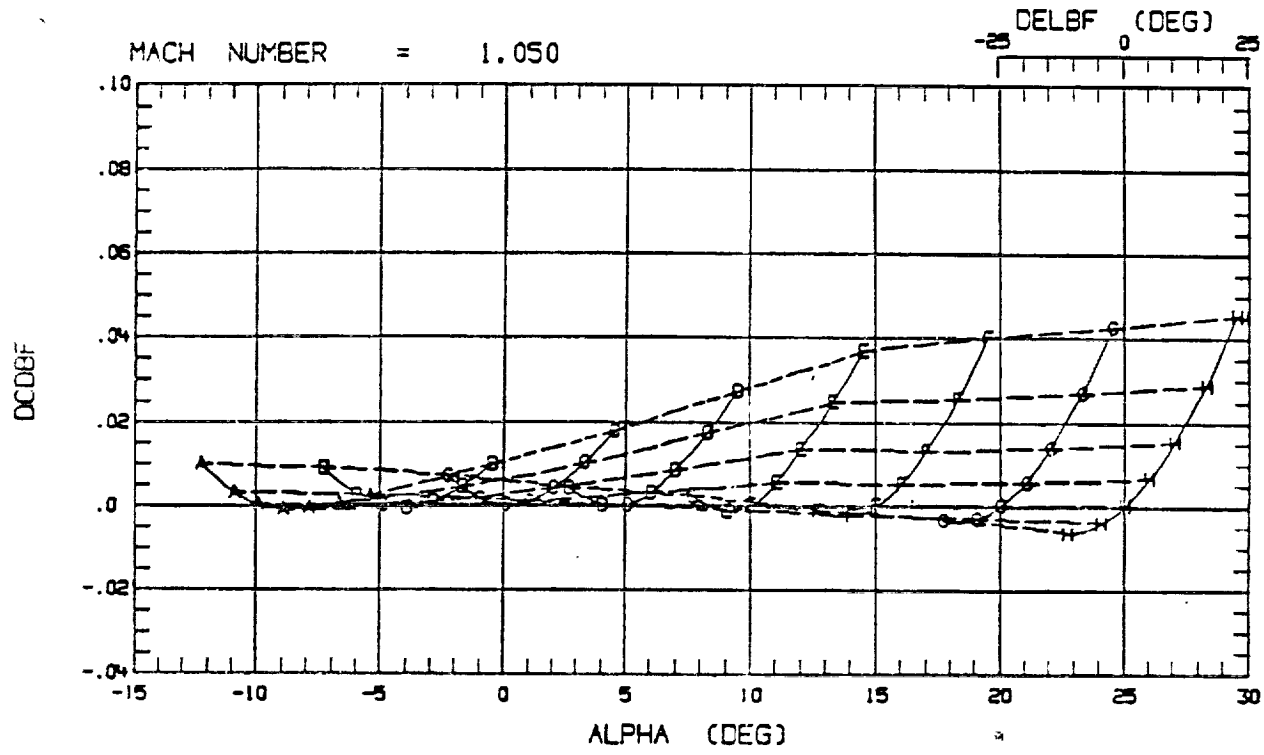
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB. = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.01141	0.00975	0.00698	0.00454	0.00261	-0.00165	-0.00542	-0.0108
-5.000	0.00389	0.00295	0.00154	0.00053	-0.00038	-0.00204	-0.00353	-0.00554
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00235	-0.00055	0.00217	0.00151	0.00257	0.00395	0.00523	0.00672
10.000	-0.00322	0.00057	0.00548	0.00511	0.00737	0.00988	0.01224	0.01470
16.300	-0.00242	0.00302	0.00989	0.01285	0.01672	0.02050	0.02404	0.02750
22.500	0.00036	0.00639	0.01452	0.02407	0.02959	0.03457	0.03911	0.04374

ENGINEER WMZ
DATE 8-30-78

FIGURE 4.1.2.2-42
EFFECT OF BODY FLAP



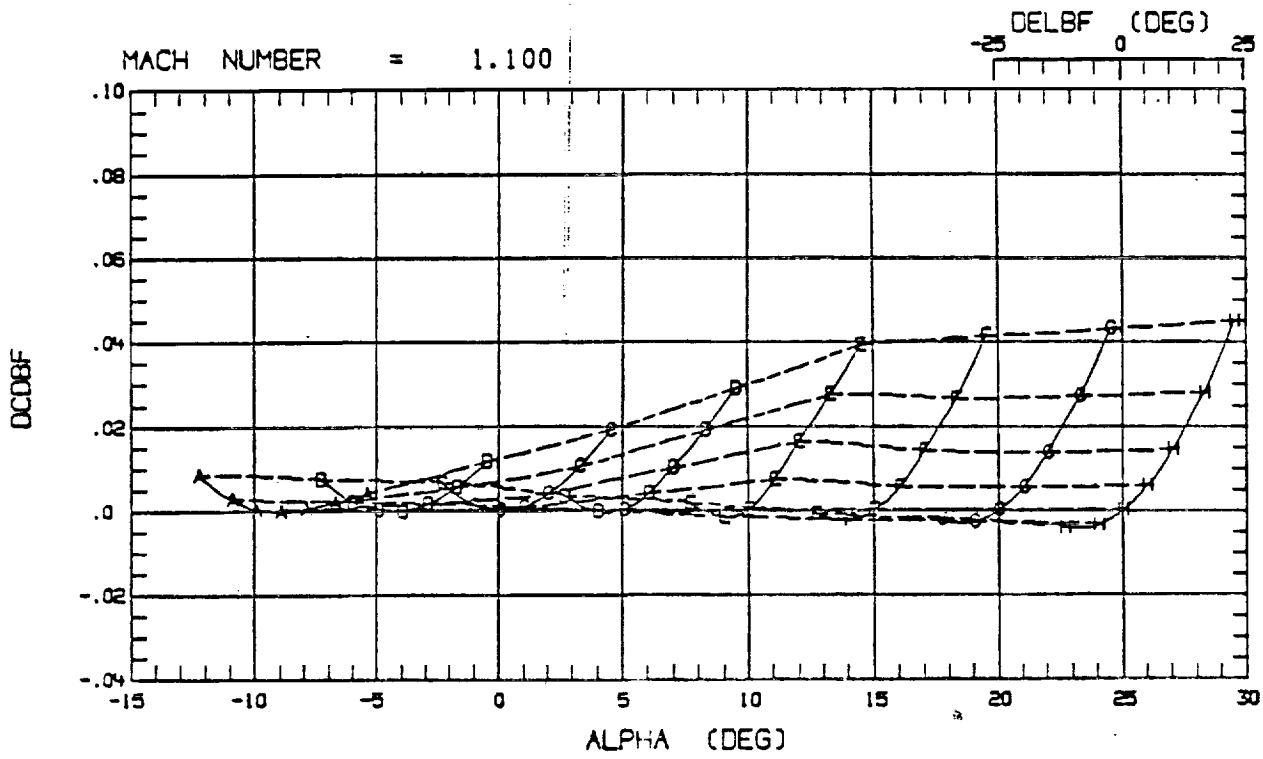
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.00972	0.00854	0.00694	0.00419	0.00214	-0.00123	-0.00327	-0.00654
-5.000	0.00312	0.00245	0.00153	0.00011	-0.00110	-0.00226	-0.00303	-0.00423
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00091	-0.00044	0.00098	0.00301	0.00541	0.00519	0.00565	0.00642
10.000	-0.00054	0.00092	0.00409	0.00843	0.01333	0.01295	0.01376	0.01500
16.300	0.00053	0.00450	0.00996	0.01708	0.02451	0.02530	0.02682	0.02873
22.500	0.00215	0.00987	0.01760	0.02730	0.03664	0.03994	0.04265	0.04538

ENGINEER [illegible]
DATE 9-20-78

FIGURE 4.1.2.2-43
EFFECT OF BODY FLAP

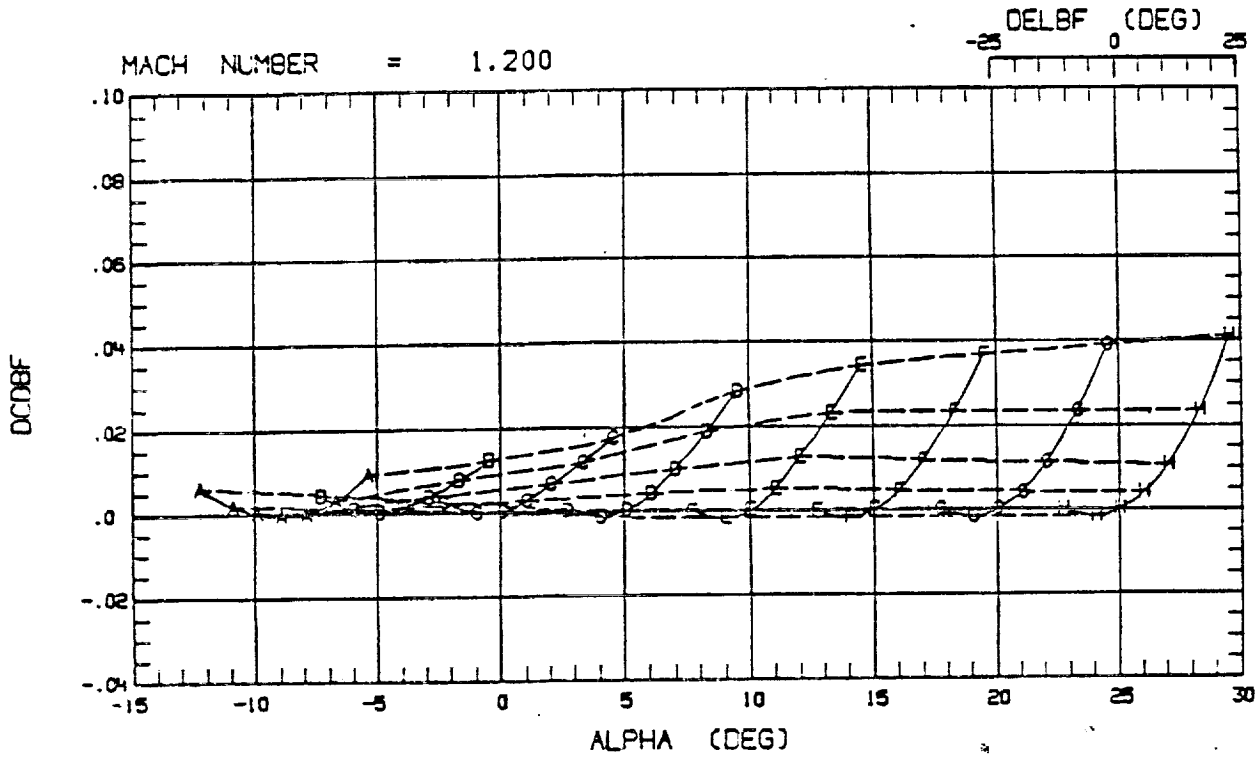


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.00850	0.00733	0.00654	0.00351	0.00162	-0.00090	-0.00200	-0.00400
-5.000	0.00262	0.00198	0.00137	-0.00026	-0.00150	-0.00225	-0.00263	-0.00336
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00037	-0.00011	0.00094	0.00395	0.00725	0.00556	0.00553	0.00588
10.000	0.00046	0.00152	0.00403	0.01015	0.01611	0.01385	0.01373	0.01423
16.300	0.00200	0.00555	0.01031	0.01907	0.02756	0.02661	0.02700	0.02900
22.500	0.00400	0.01150	0.01890	0.02990	0.03922	0.04136	0.04300	0.04500

ENGINEER [illegible]
DATE 9-20-78

FIGURE 4.1.2.2-44
EFFECT OF BODY FLAP



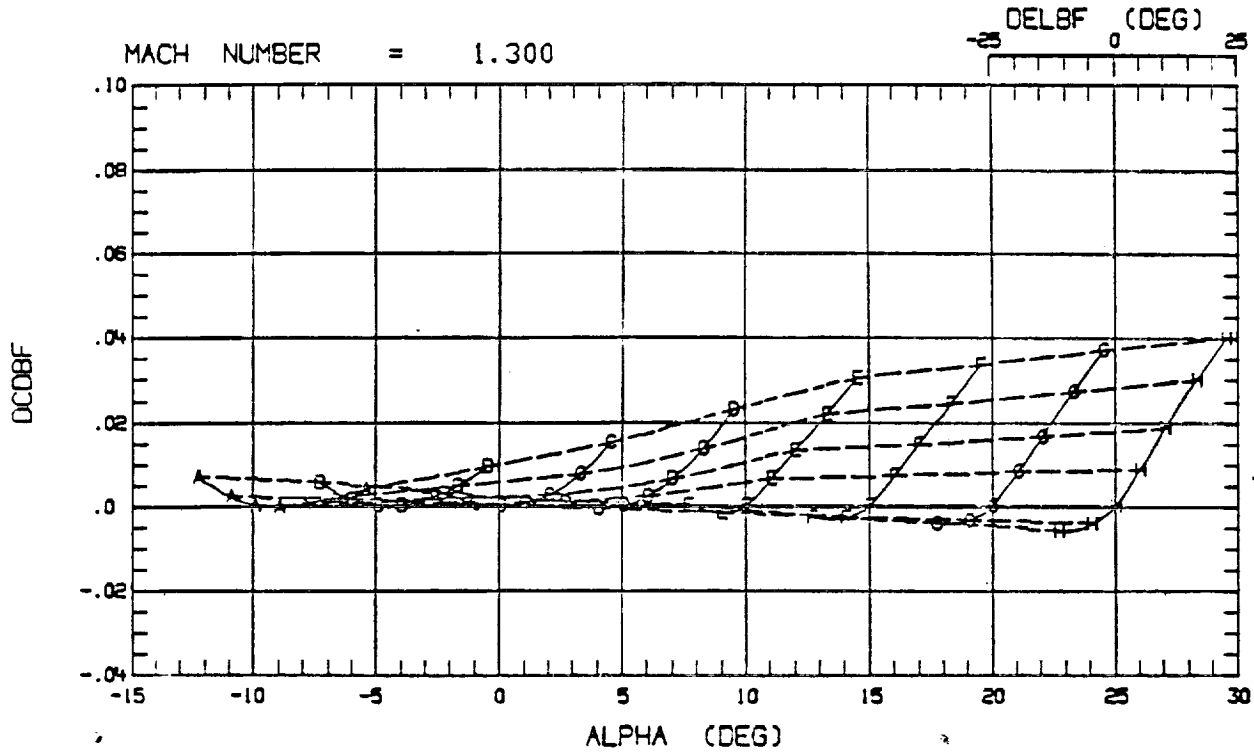
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
CG	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.00600	0.00416	0.00227	0.00018	-0.00024	-0.00011	0.0	0.0
-5.000	0.00173	0.00079	-0.00012	-0.00130	-0.00177	-0.00173	-0.00170	-0.00170
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00062	0.00123	0.00271	0.00396	0.00523	0.00457	0.00423	0.00402
10.000	-0.00006	0.00378	0.00653	0.00983	0.01260	0.01165	0.01099	0.01049
16.300	0.00300	0.00768	0.01168	0.01849	0.02303	0.02312	0.02312	0.02312
22.500	0.00900	0.01216	0.01710	0.02817	0.03434	0.03690	0.03900	0.04100

ENGINEER WMZ
DATE 9-24-78

FIGURE 4.1.2.2-45
EFFECT OF BODY FLAP



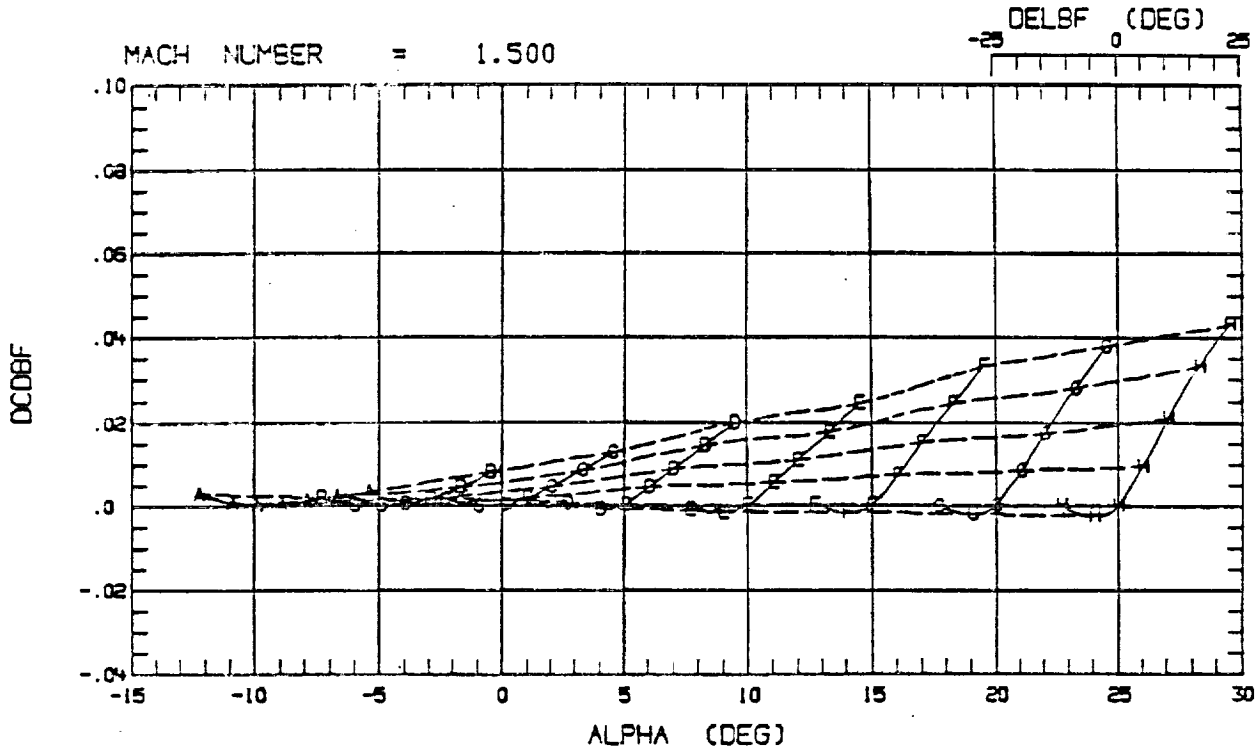
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.00700	0.00549	0.00300	0.00096	0.00011	-0.00257	-0.00400	-0.00600
-5.000	0.00213	0.00144	0.00042	-0.00069	-0.00158	-0.00262	-0.00328	-0.00415
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00031	0.00007	0.00075	0.00238	0.00647	0.00728	0.00816	0.00872
10.000	0.00048	0.00151	0.00274	0.00641	0.01331	0.01481	0.01661	0.01861
16.300	0.00200	0.00476	0.00752	0.01365	0.02195	0.02431	0.02700	0.03000
22.500	0.00400	0.00939	0.01498	0.02307	0.03051	0.03370	0.03700	0.04000

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.2-46
EFFECT OF BODY FLAP

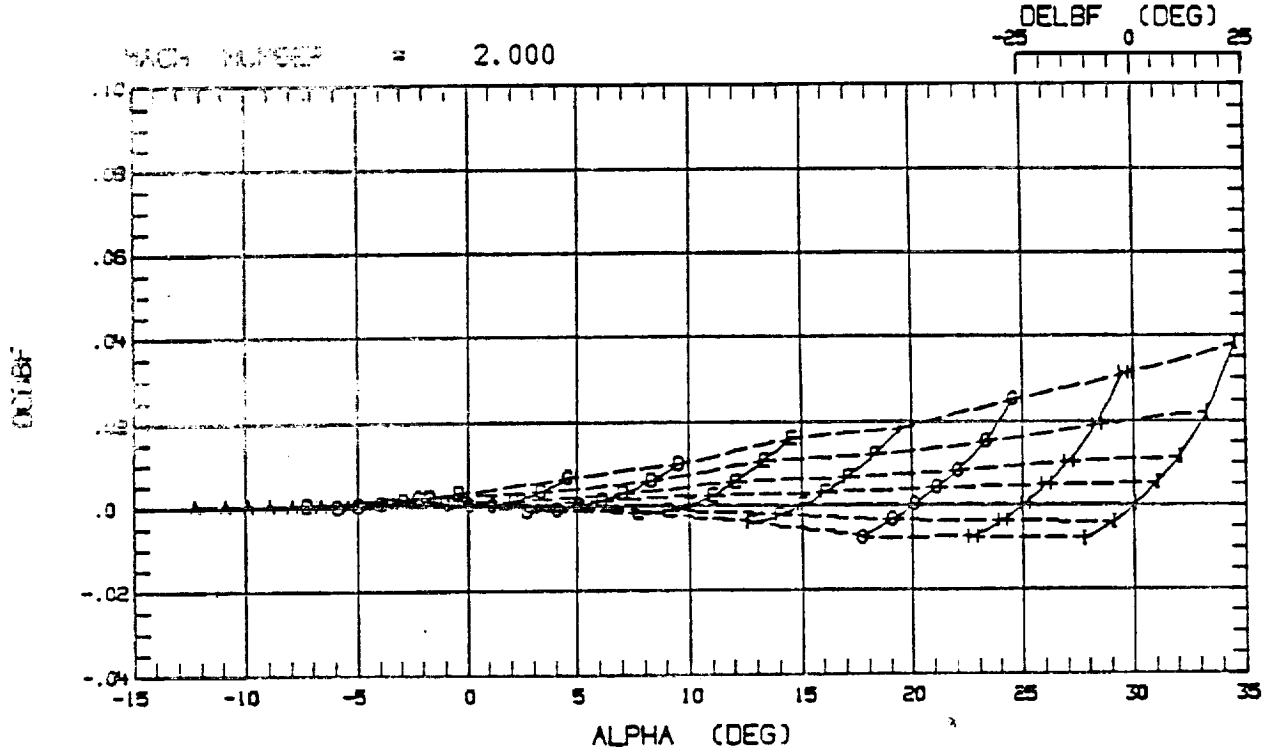


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.00256	0.00182	0.00149	0.00062	-0.00085	0.00029	-0.00006	0.0
-5.000	0.00067	0.00028	-0.00014	-0.00085	-0.00157	-0.00169	-0.00207	-0.00244
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00042	0.00047	0.00180	0.00432	0.00541	0.00724	0.00826	0.00935
10.000	0.00119	0.00169	0.00455	0.00875	0.01082	0.01499	0.01728	0.02075
16.300	0.00224	0.00429	0.00846	0.01432	0.01764	0.02430	0.02797	0.03321
22.500	0.00336	0.00802	0.01272	0.01982	0.02434	0.03306	0.03787	0.04326

ENGINEER WMZ
DATE 8-10-78

FIGURE 4.1.2.2-47
EFFECT OF BODY FLAP



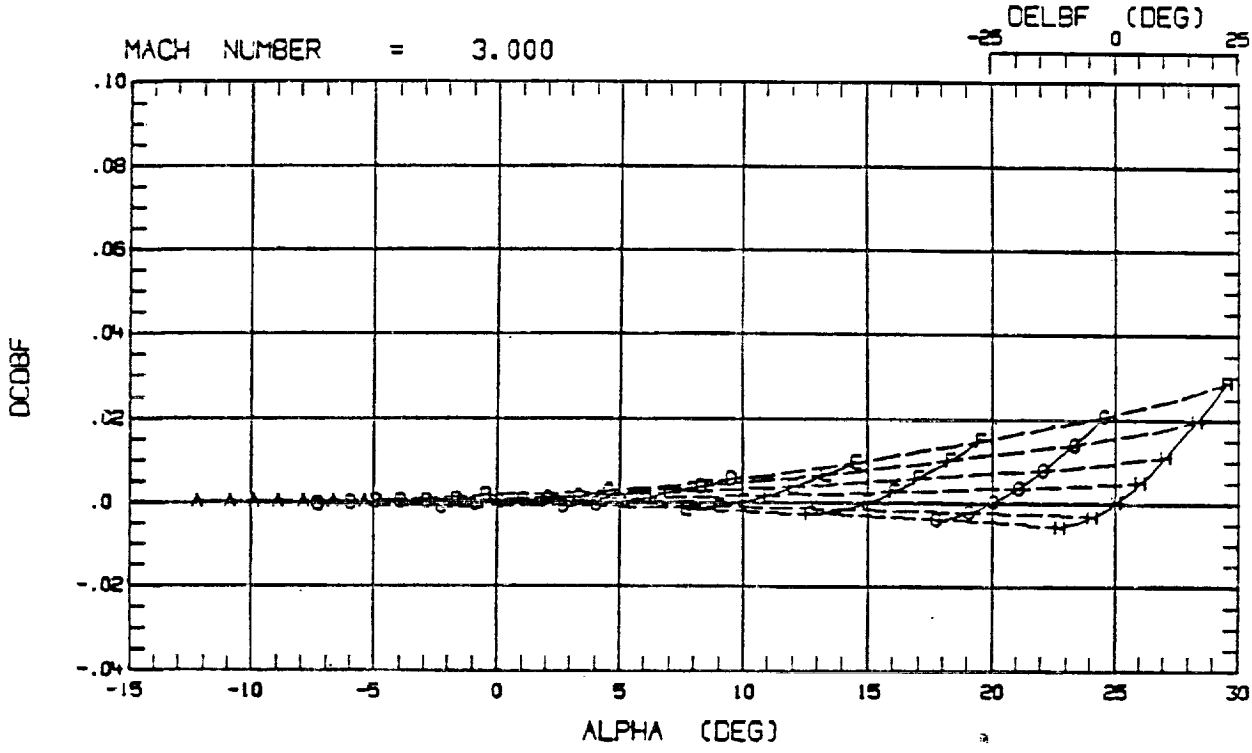
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT								
-11.700	0.0	0.0	0.00210	-0.00111	-0.00177	-0.00425	-0.00750	-0.00750	-0.00798
-5.000	0.0	-0.00015	0.00044	-0.00079	-0.00134	-0.00227	-0.00354	-0.00383	-0.00421
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.00045	0.00026	0.00120	0.00239	0.00296	0.00389	0.00460	0.00512
10.000	0.0	0.00109	0.00122	0.00283	0.00563	0.00659	0.00813	0.01002	0.01120
16.300	0.0	0.00200	0.00336	0.00560	0.01044	0.01205	0.01500	0.01900	0.02200
22.500	0.0	0.00300	0.00648	0.00990	0.01585	0.01837	0.02500	0.03100	0.03800

ENGINEER Wm Z
DATE 9-12-78

FIGURE 4.1.2.2-48
EFFECT OF BODY FLAP



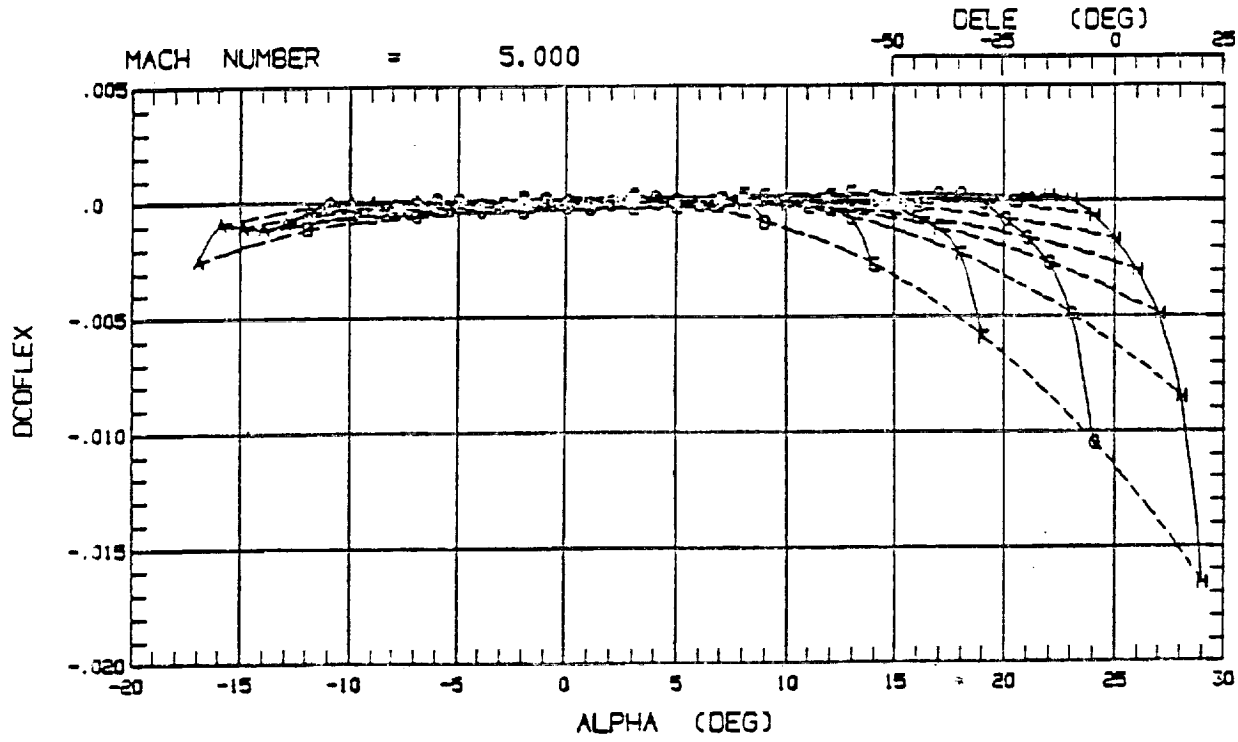
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.0	-0.00050	-0.00119	-0.00080	-0.00169	-0.00285	-0.00425	-0.00575
-5.000	0.0	-0.00020	-0.00049	-0.00053	-0.00102	-0.00167	-0.00240	-0.00328
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.00017	0.00044	0.00094	0.00160	0.00256	0.00347	0.00481
10.000	0.0	0.00029	0.00081	0.00212	0.00363	0.00574	0.00776	0.01081
16.300	0.0	0.00050	0.00136	0.00373	0.00646	0.01011	0.01381	0.01926
22.500	0.0	0.00150	0.00267	0.00542	0.00951	0.01476	0.02035	0.02841

ENGINEER wm2
DATE 9-20-78

FIGURE 4.1.2.2-49
EFFECT OF BODY FLAP



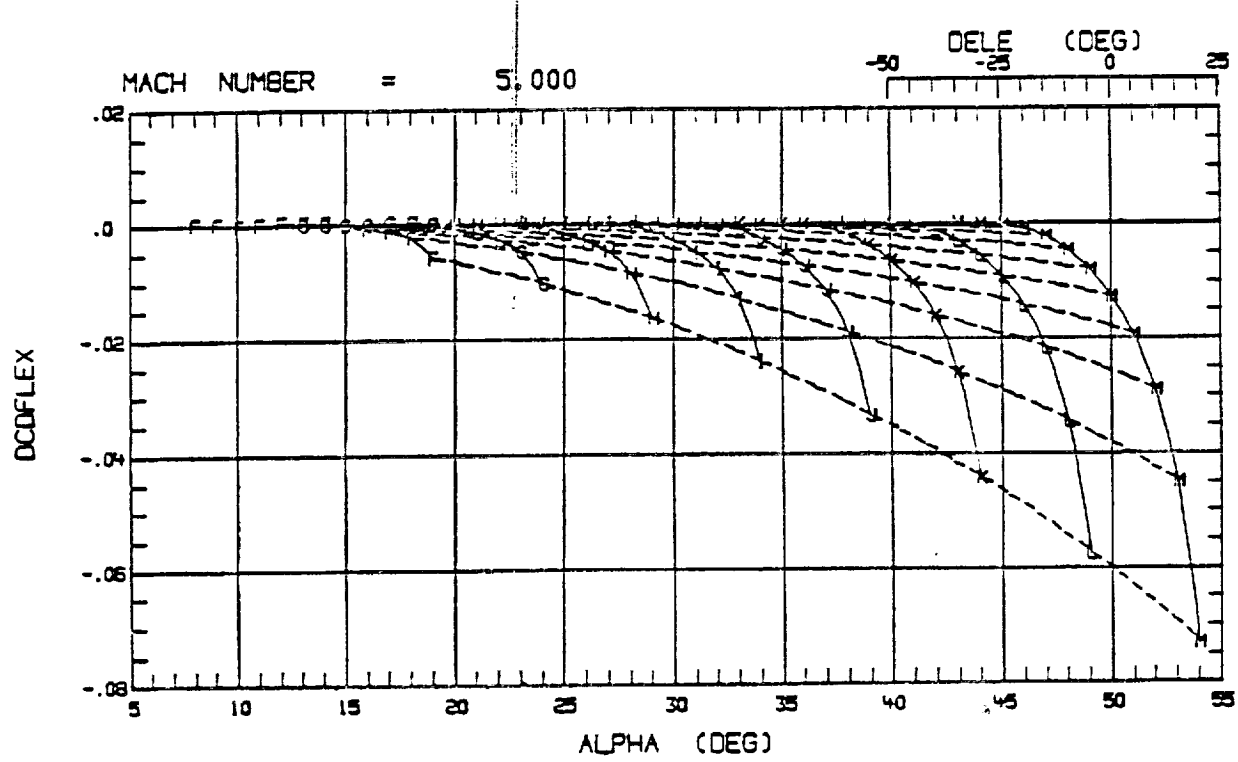
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00257	-0.00118	-0.00065	-0.00045	-0.00031	-0.00015	0.0	0.00010
-30.000	-0.00097	-0.00013	0.00004	0.0	-0.00005	-0.00005	-0.00004	-0.00004
-25.000	-0.00106	-0.00041	-0.00026	-0.00026	-0.00024	-0.00018	-0.00012	-0.00010
-20.000	-0.00117	-0.00062	-0.00043	-0.00032	-0.00019	-0.00005	0.00004	0.00007
-15.000	-0.00089	-0.00047	-0.00027	-0.00012	0.00005	0.00019	0.00025	0.00018
-10.000	-0.00040	-0.00016	-0.00003	0.00011	0.00024	0.00030	0.00023	-0.00003
-5.000	-0.00002	0.00001	0.00006	0.00014	0.00020	0.00013	-0.00015	-0.00069
0.0	0.00008	-0.00004	-0.00004	0.0	-0.00004	-0.00028	-0.00083	-0.00173
5.000	-0.00004	-0.00019	-0.00017	-0.00014	-0.00028	-0.00075	-0.00166	-0.00307
10.000	-0.00013	-0.00017	-0.00008	-0.00007	-0.00040	-0.00125	-0.00276	-0.00499
15.000	-0.00001	0.00009	0.00021	0.00002	-0.00077	-0.00238	-0.00497	-0.00860
20.000	-0.00002	0.00006	-0.00012	-0.00096	-0.00282	-0.00595	-0.01053	-0.01662

ENGINEER
DATE 4-2-75

FIGURE 4.1.2.2-112
FLEX DRAG COEFFICIENT INCREMENT (BF=0, SB=25, Q=300)



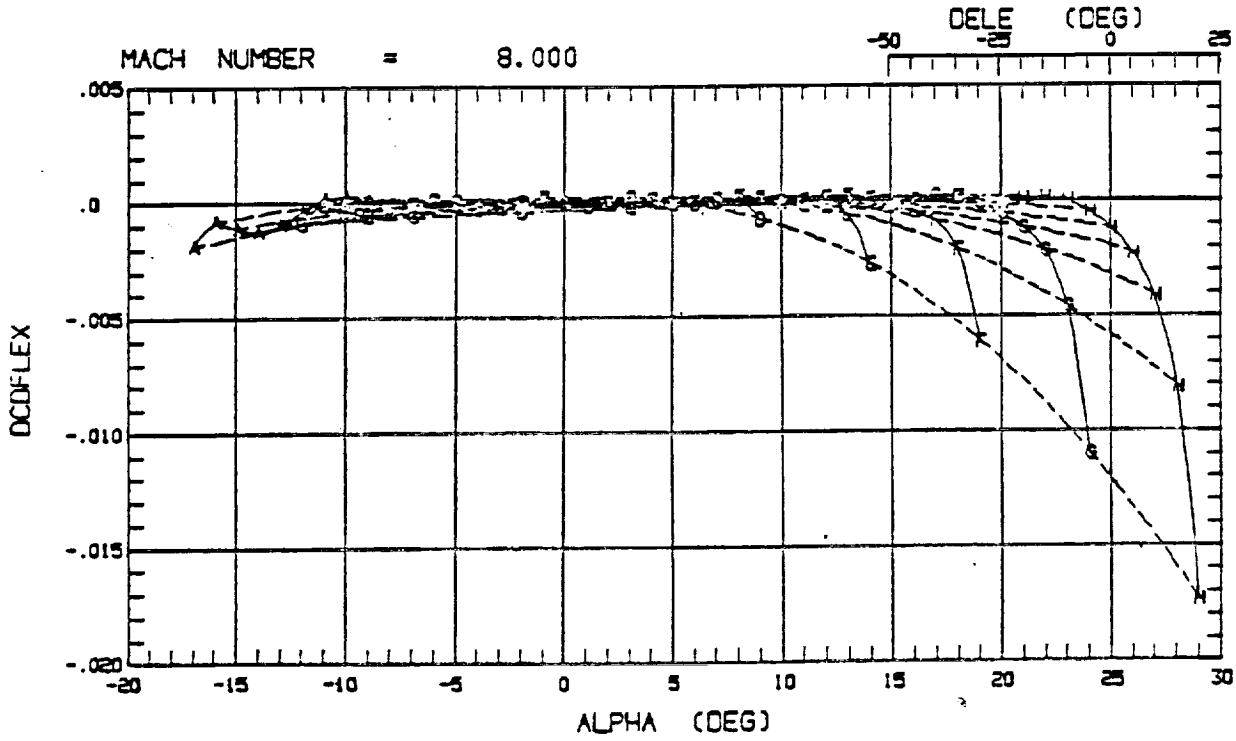
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00015	0.0	0.00010	0.00013	0.00009	0.00002	-0.00003	-0.00005
-30.000	-0.00005	-0.00004	-0.00004	-0.00009	-0.00016	-0.00023	-0.00029	-0.00033
-25.000	-0.00018	-0.00012	-0.00010	-0.00012	-0.00018	-0.00025	-0.00034	-0.00052
-20.000	-0.00006	0.00004	0.00007	0.00001	-0.00011	-0.00030	-0.00057	-0.00108
-15.000	0.00019	0.00025	0.00018	-0.00001	-0.00033	-0.00077	-0.00139	-0.00238
-10.000	0.00030	0.00023	-0.00003	-0.00048	-0.00111	-0.00195	-0.00307	-0.00475
-5.000	0.00013	-0.00015	-0.00069	-0.00149	-0.00256	-0.00392	-0.00572	-0.00825
0.0	-0.00028	-0.00083	-0.00173	-0.00300	-0.00464	-0.00672	-0.00938	-0.01302
5.000	-0.00075	-0.00166	-0.00307	-0.00500	-0.00747	-0.01054	-0.01441	-0.01985
10.000	-0.00125	-0.00276	-0.00499	-0.00795	-0.01169	-0.01628	-0.02197	-0.02929
15.000	-0.00238	-0.00497	-0.00860	-0.01330	-0.01911	-0.02614	-0.03469	-0.04533
20.000	-0.00595	-0.01053	-0.01662	-0.02426	-0.03350	-0.04448	-0.05754	-0.07331

ENGINEER DTC
DATE 4-2-79

FIGURE 4.1.2.2-113
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.0=300)



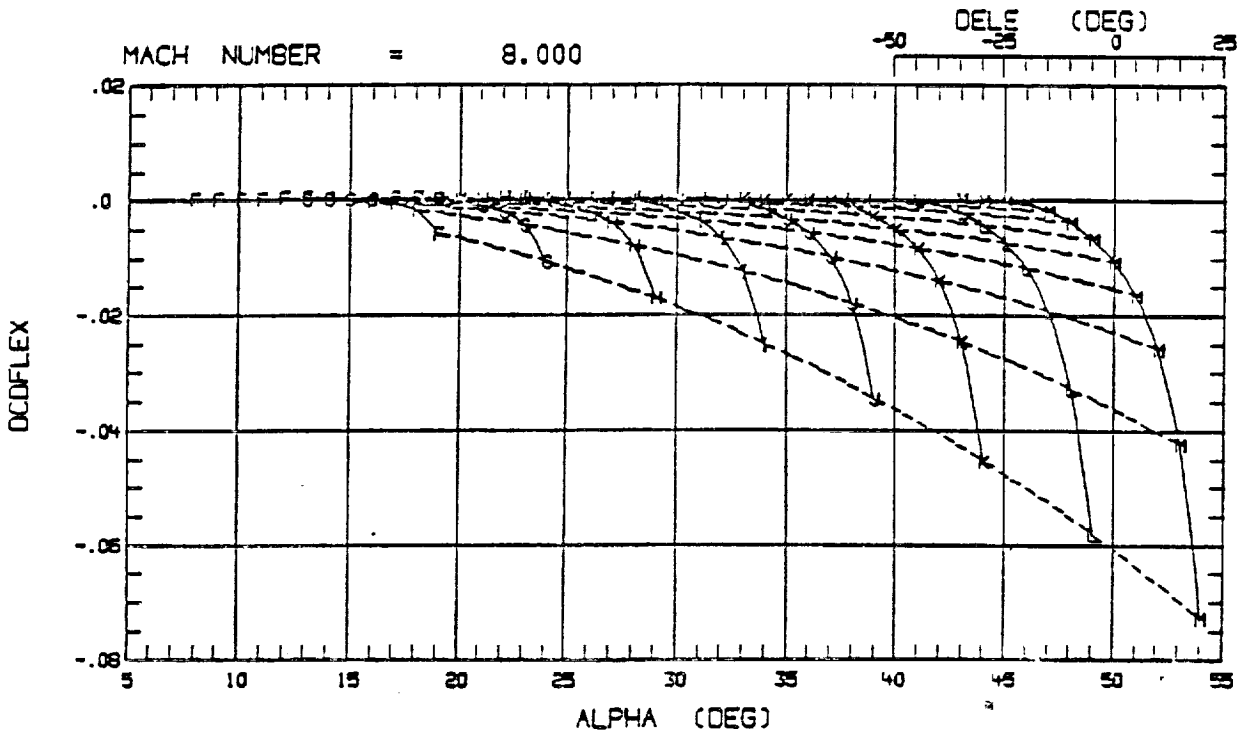
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.550	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00193	-0.00099	-0.00062	-0.00044	-0.00029	-0.00012	0.00005	0.00017
-30.000	-0.00086	-0.00012	0.00008	0.00007	0.00002	-0.00002	-0.00004	-0.00007
-25.000	-0.00116	-0.00042	-0.00017	-0.00011	-0.00011	-0.00012	-0.00012	-0.00013
-20.000	-0.00131	-0.00062	-0.00032	-0.00018	-0.00010	-0.00004	0.00001	0.00002
-15.000	-0.00098	-0.00046	-0.00020	-0.00005	0.00006	0.00013	0.00016	0.00012
-10.000	-0.00039	-0.00015	-0.00002	0.00009	0.00016	0.00019	0.00013	-0.00004
-5.000	0.00009	0.00004	0.00004	0.00008	0.00011	0.00005	-0.00015	-0.00052
0.0	0.00023	-0.00003	-0.00008	-0.00006	-0.00007	-0.00023	-0.00061	-0.00127
5.000	0.00007	-0.00022	-0.00022	-0.00015	-0.00020	-0.00052	-0.00121	-0.00233
10.000	-0.00016	-0.00029	-0.00014	-0.00004	-0.00024	-0.00093	-0.00222	-0.00417
15.000	-0.00015	-0.00006	0.00016	0.00008	-0.00062	-0.00217	-0.00467	-0.00819
20.000	0.00002	0.00016	0.00005	-0.00081	-0.00280	-0.00616	-0.01103	-0.01743

ENGINEER [signature]
DATE 7-2-74

FIGURE 4.1.2.2-114
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.0=300)



CONFIGURATION

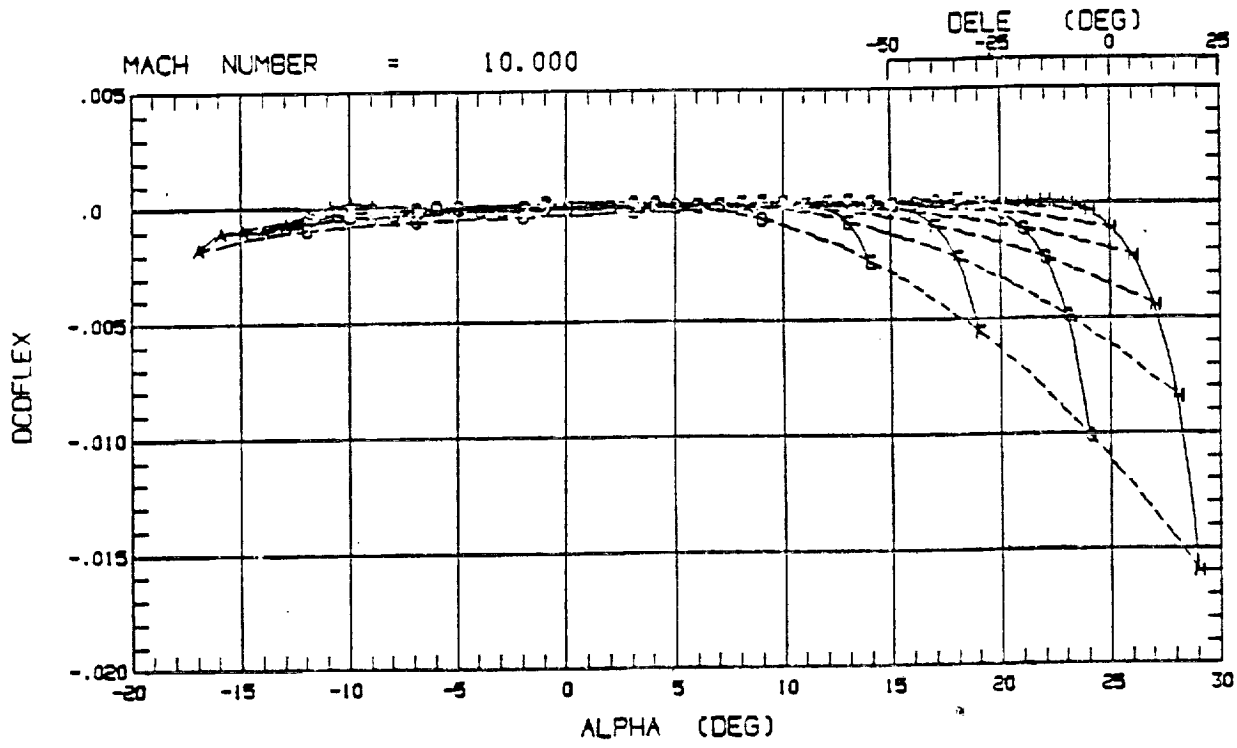
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1078.7 IN.	REFERENCE DIMENSIONS	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	FLEXIBLE CRAG INCREMENT							
-35.000	-0.00012	0.00005	0.00017	0.00021	0.00015	0.00003	-0.00009	-0.00014
-30.000	-0.00002	-0.00004	-0.00007	-0.00014	-0.00022	-0.00031	-0.00037	-0.00040
-25.000	-0.00012	-0.00012	-0.00013	-0.00015	-0.00020	-0.00025	-0.00031	-0.00044
-20.000	-0.00004	0.00001	0.00002	-0.00001	-0.00007	-0.00019	-0.00040	-0.00083
-15.000	0.00013	0.00016	0.00012	0.00001	-0.00020	-0.00052	-0.00105	-0.00197
-10.000	0.00019	0.00013	-0.00004	-0.00034	-0.00078	-0.00144	-0.00243	-0.00400
-5.000	0.00005	-0.00015	-0.00052	-0.00109	-0.00189	-0.00301	-0.00459	-0.00695
0.0	-0.00023	-0.00061	-0.00127	-0.00223	-0.00353	-0.00527	-0.00763	-0.01096
5.000	-0.00052	-0.00121	-0.00233	-0.00390	-0.00597	-0.00863	-0.01209	-0.01674
10.000	-0.00093	-0.00222	-0.00417	-0.00680	-0.01015	-0.01431	-0.01949	-0.02611
15.000	-0.00217	-0.00467	-0.00819	-0.01274	-0.01832	-0.02501	-0.03301	-0.04276
20.000	-0.00616	-0.01103	-0.01743	-0.02534	-0.03474	-0.04568	-0.05834	-0.07312

ENGINEER [signature]
DATE 7-2-72

FIGURE 4.1.2.2- 115
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.0=300)



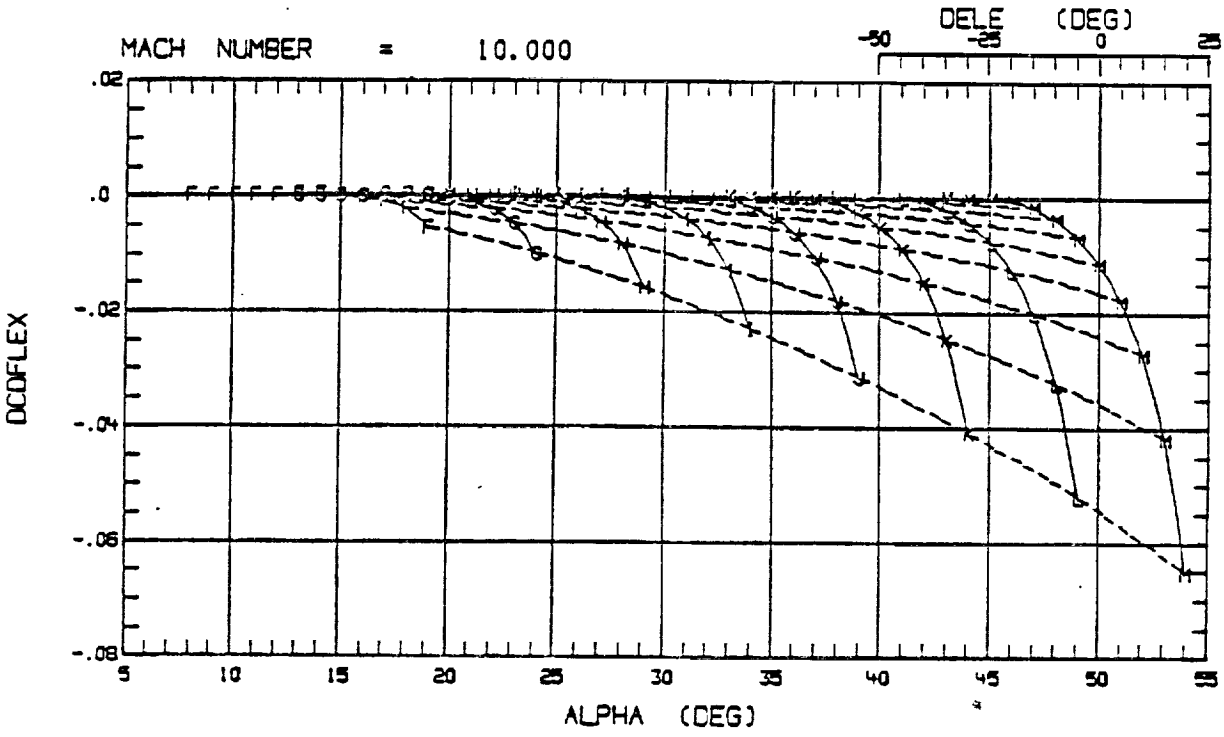
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00178	-0.00096	-0.00063	-0.00046	-0.00029	-0.00010	0.00007	0.00018
-30.000	-0.00106	-0.00031	-0.00008	-0.00003	-0.00002	0.0	0.0	-0.00003
-25.000	-0.00105	-0.00037	-0.00014	-0.00008	-0.00007	-0.00006	-0.00007	-0.00010
-20.000	-0.00099	-0.00043	-0.00022	-0.00013	-0.00007	-0.00004	-0.00001	-0.00002
-15.000	-0.00069	-0.00034	-0.00018	-0.00008	0.0	0.00006	0.00008	0.00005
-10.000	-0.00027	-0.00017	-0.00009	-0.00001	0.00008	0.00012	0.00009	-0.00005
-5.000	0.00006	-0.00006	-0.00006	0.00002	0.00009	0.00008	-0.00008	-0.00042
0.0	0.00016	-0.00008	-0.00009	0.0	0.00003	-0.00010	-0.00047	-0.00114
5.000	0.00005	-0.00018	-0.00013	-0.00002	-0.00007	-0.00042	-0.00117	-0.00238
10.000	-0.00012	-0.00023	-0.00007	0.00001	-0.00025	-0.00104	-0.00245	-0.00454
15.000	-0.00019	-0.00009	0.00010	-0.00003	-0.00081	-0.00243	-0.00499	-0.00852
20.000	-0.00005	0.00014	0.00010	-0.00067	-0.00252	-0.00567	-0.01019	-0.01605

ENGINEER [signature]
DATE 4-22-70

FIGURE 4.1.2.2-116
FLEX DRAG COEFFICIENT INCREMENT (BF=0, SB=25, G=300)



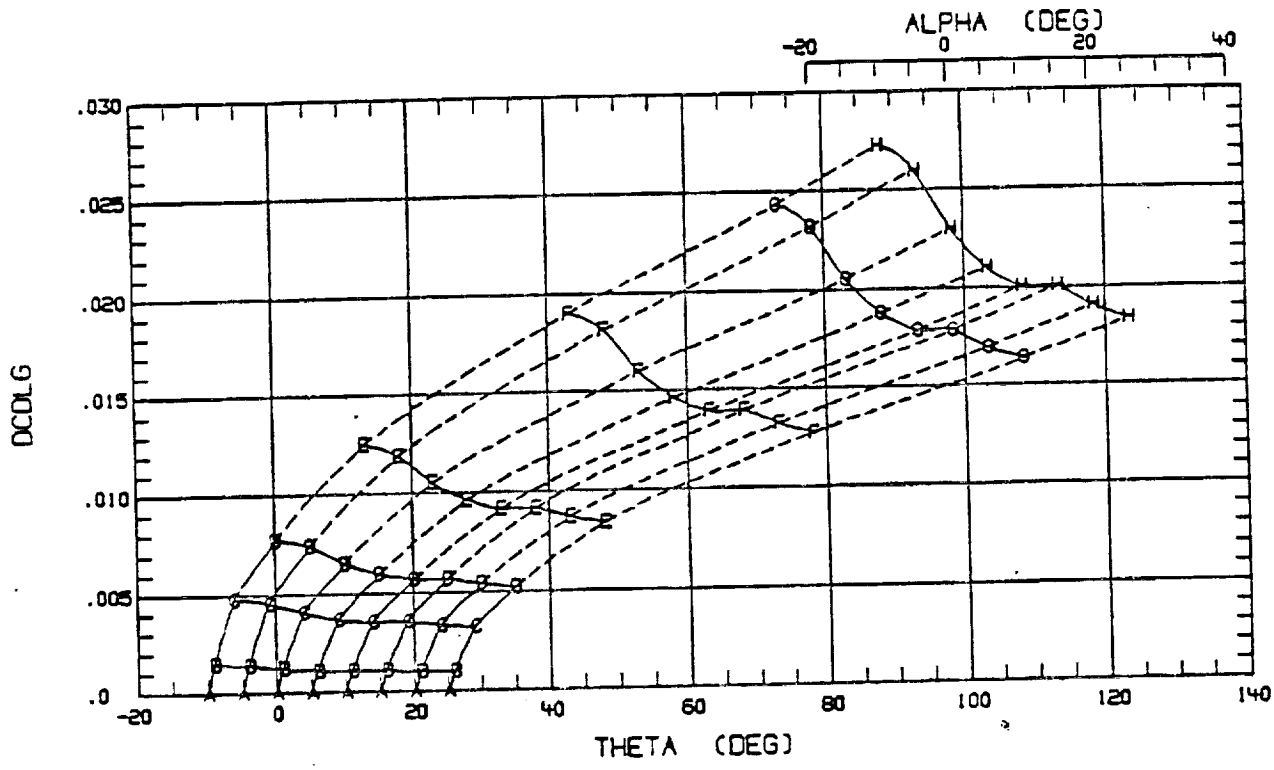
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00010	0.00007	0.00018	0.00018	0.00009	-0.00005	-0.00015	-0.00017
-30.000	0.0	0.0	-0.00003	-0.00010	-0.00019	-0.00026	-0.00029	-0.00024
-25.000	-0.00008	-0.00007	-0.00010	-0.00014	-0.00017	-0.00019	-0.00020	-0.00028
-20.000	-0.00004	-0.00001	-0.00002	-0.00005	-0.00009	-0.00016	-0.00031	-0.00071
-15.000	0.00006	0.00008	0.00005	-0.00004	-0.00020	-0.00046	-0.00093	-0.00186
-10.000	0.00012	0.00009	-0.00005	-0.00030	-0.00070	-0.00131	-0.00229	-0.00394
-5.000	0.00008	-0.00008	-0.00042	-0.00096	-0.00175	-0.00287	-0.00453	-0.00712
0.0	-0.00010	-0.00047	-0.00114	-0.00214	-0.00350	-0.00534	-0.00790	-0.01163
5.000	-0.00042	-0.00117	-0.00238	-0.00407	-0.00628	-0.00913	-0.01299	-0.01803
10.000	-0.00104	-0.00245	-0.00454	-0.00731	-0.01079	-0.01509	-0.02048	-0.02747
15.000	-0.00243	-0.00499	-0.00852	-0.01300	-0.01841	-0.02485	-0.03257	-0.04210
20.000	-0.00567	-0.01019	-0.01605	-0.02321	-0.03159	-0.04123	-0.05235	-0.06546

ENGINEER [illegible]
DATE 4-2-72

FIGURE 4.1.2.2-117
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.0=300)



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.0 IN.

	THETA (DEG)							
	0.0 A	1.000 B	4.000 C	10.000 D	23.000 E	53.000 F	83.000 G	98.000 H
ALPHA (DEG)	LANDING GEAR DRAG INCREMENT							
-10.000	0.0	0.00142	0.00475	0.00771	0.01246	0.01898	0.02432	0.02729
-5.000	0.0	0.00136	0.00452	0.00735	0.01187	0.01809	0.02317	0.02600
0.0	0.0	0.00120	0.00400	0.00650	0.01050	0.01600	0.02050	0.02300
5.000	0.0	0.00110	0.00365	0.00593	0.00959	0.01461	0.01872	0.02100
10.000	0.0	0.00104	0.00348	0.00565	0.00913	0.01391	0.01783	0.02000
15.000	0.0	0.00104	0.00348	0.00565	0.00913	0.01391	0.01783	0.02000
20.000	0.0	0.00099	0.00330	0.00537	0.00867	0.01322	0.01693	0.01900
25.000	0.0	0.00096	0.00319	0.00518	0.00837	0.01275	0.01634	0.01833

ENGINEER
DATE 9/7/78

FIGURE 4.1.2.2-118
LANDING GEAR DRAG COEFFICIENT INCREMENT

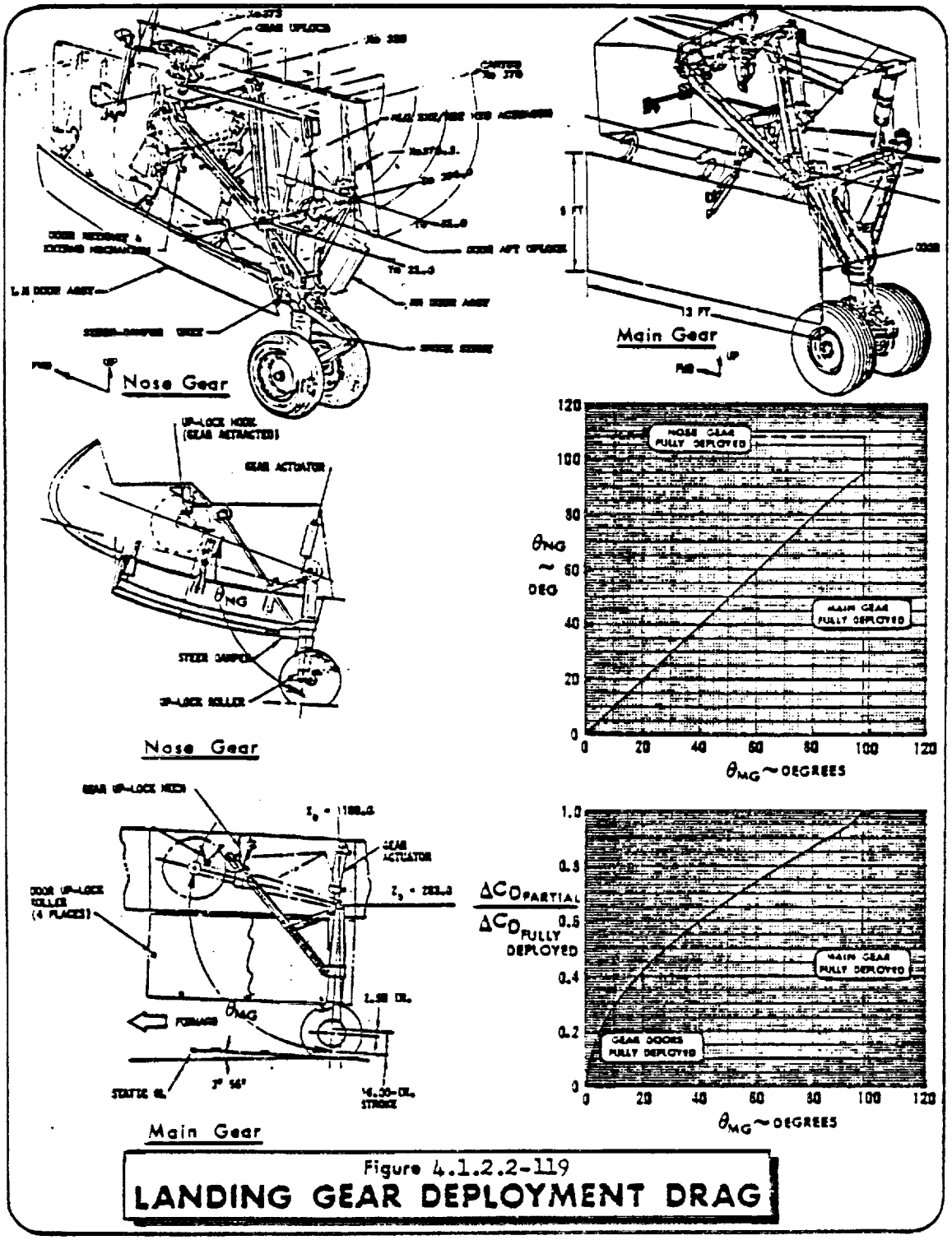
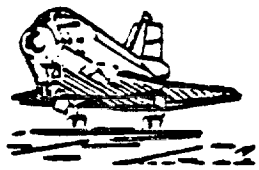


Figure 4.1.2.2-119
LANDING GEAR DEPLOYMENT DRAG

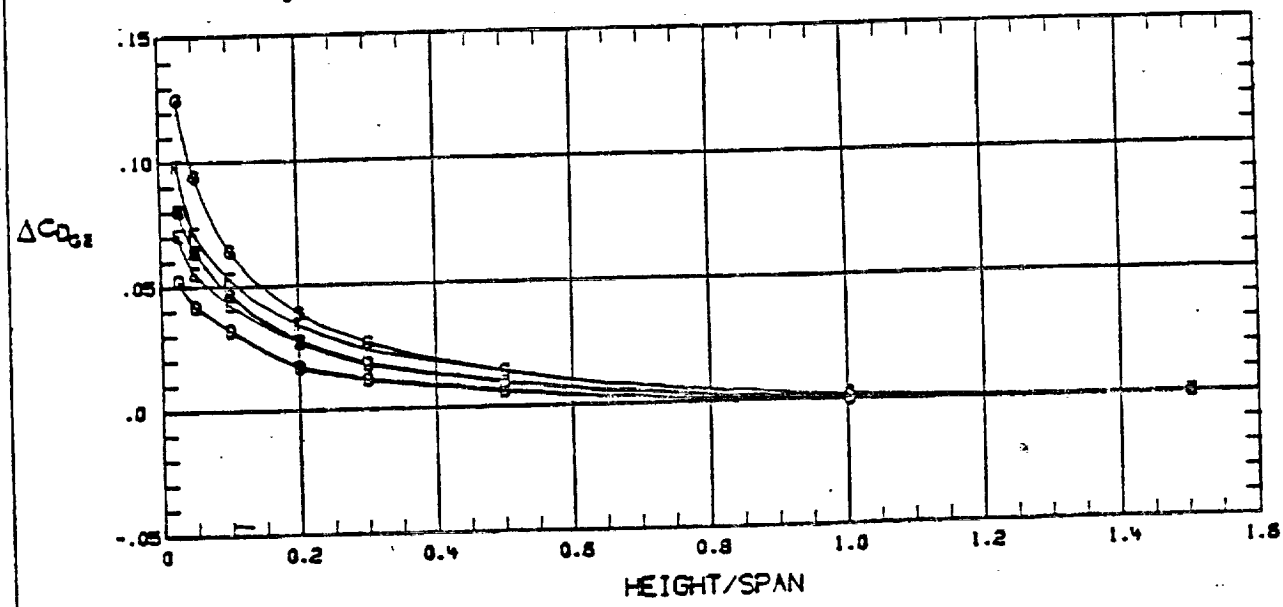
Landing Gear Down

$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$



CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -40.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} = ALL$



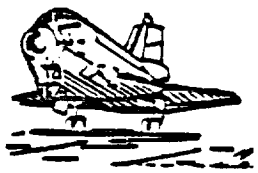
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.08000	0.08000	0.05200	0.05200	0.07000	0.09800	0.12500
0.050	0.06400	0.06400	0.04160	0.04170	0.05500	0.07070	0.09370
0.100	0.04680	0.04630	0.03210	0.03180	0.04230	0.05260	0.06360
0.200	0.02730	0.02770	0.01710	0.01700	0.02870	0.03370	0.03830
0.300	0.01790	0.01820	0.01180	0.01150	0.01740	0.02320	0.02500
0.500	0.00950	0.00980	0.00630	0.00600	0.01000	0.01400	0.01400
1.000	0.00050	0.00050	0.0	0.0	0.00100	0.00150	0.00200
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JJ
DATE: 9-14-77
REVISED:

Figure 4.1.2.2-120
GROUND EFFECT

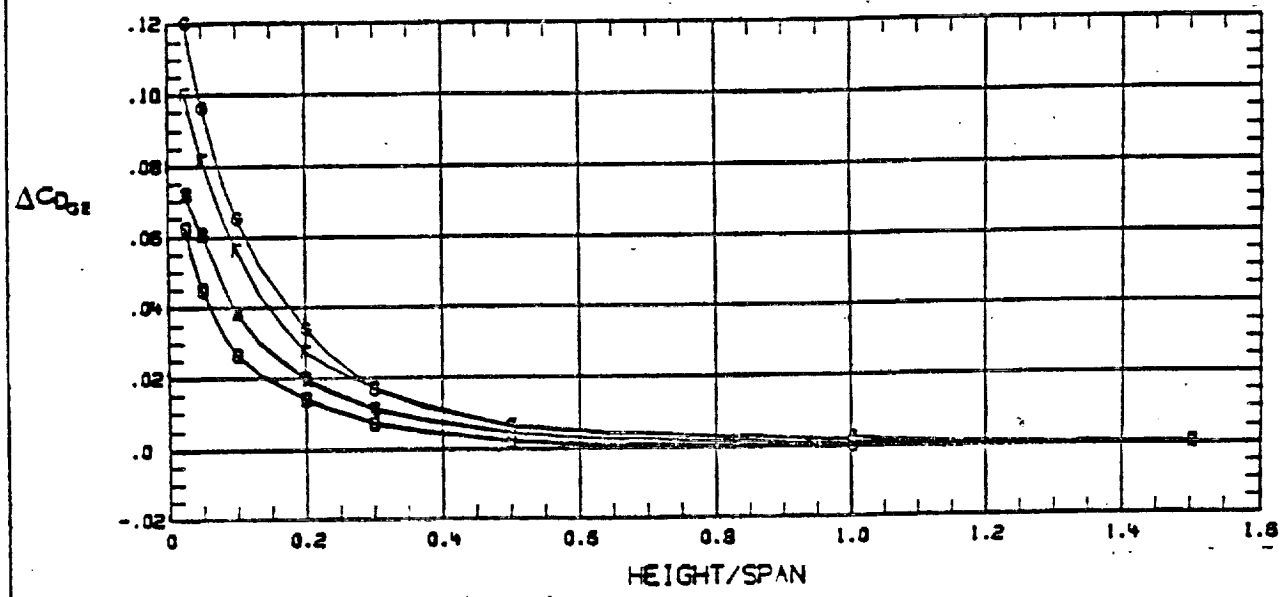
Landing Gear Down

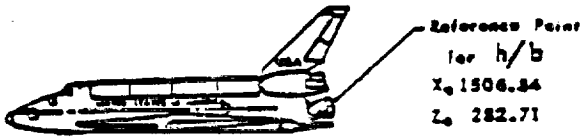


$$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -30.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} =$ All



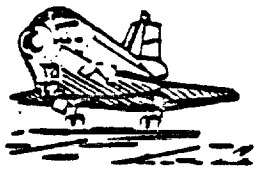


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.07200	0.07200	0.06200	0.06200	0.06200	0.10000	0.12000
0.050	0.06010	0.06030	0.04460	0.04500	0.04460	0.08140	0.09600
0.100	0.03800	0.03830	0.02650	0.02540	0.02630	0.05580	0.06480
0.200	0.01920	0.01990	0.01400	0.01380	0.01400	0.02740	0.03390
0.300	0.01080	0.01140	0.00720	0.00710	0.00710	0.01700	0.01650
0.500	0.00410	0.00440	0.00180	0.00190	0.00220	0.00630	0.00580
1.000	0.00100	0.00100	0.0	0.0	0.0	0.00200	0.00200
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 9-14-77
REVISED:

Figure 4.1.2.2-121
GROUND EFFECT

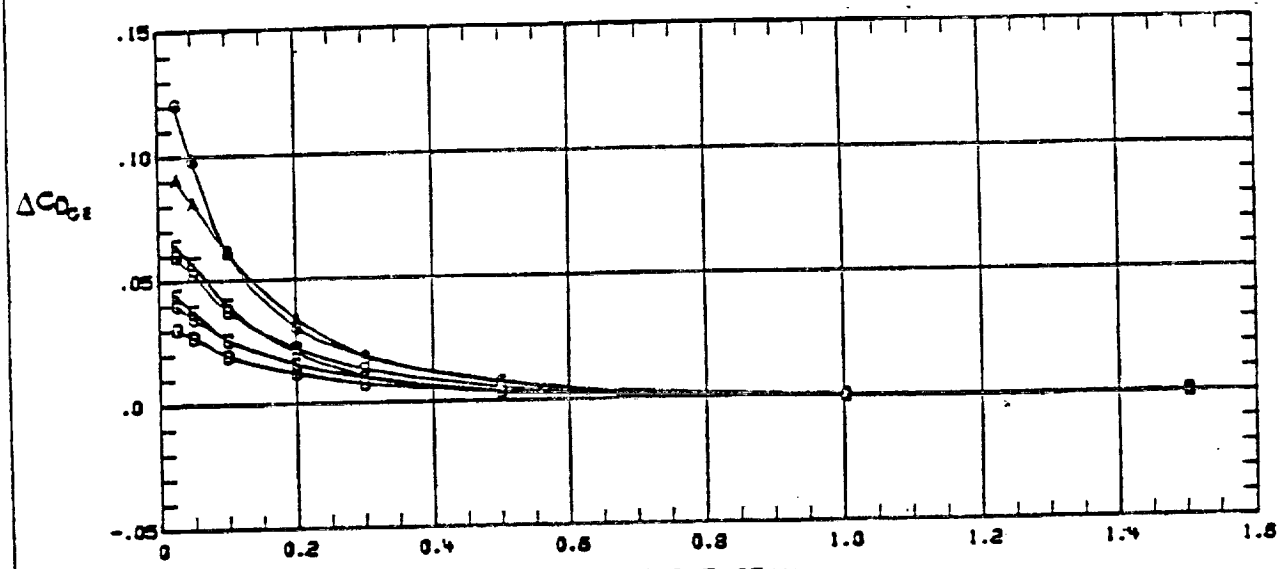
Landing Gear Down

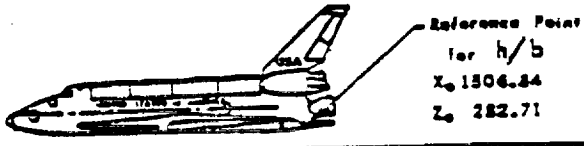


$$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE SERITES VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -20.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} = All$



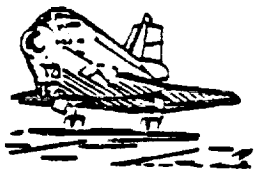


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.09020	0.09970	0.03980	0.03020	0.04410	0.06400	0.12020
0.050	0.08070	0.05180	0.03460	0.02660	0.03730	0.05660	0.09790
0.100	0.06070	0.03710	0.02590	0.01950	0.02590	0.03980	0.06070
0.200	0.03410	0.02230	0.01590	0.01210	0.01590	0.02010	0.03030
0.300	0.01870	0.01340	0.00960	0.00750	0.00960	0.01070	0.01820
0.500	0.00870	0.00510	0.00350	0.00350	0.00350	0.00350	0.00730
1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: J3
DATE: 9-14-77
REVISED:

Figure 4.1.2.2-122
GROUND EFFECT

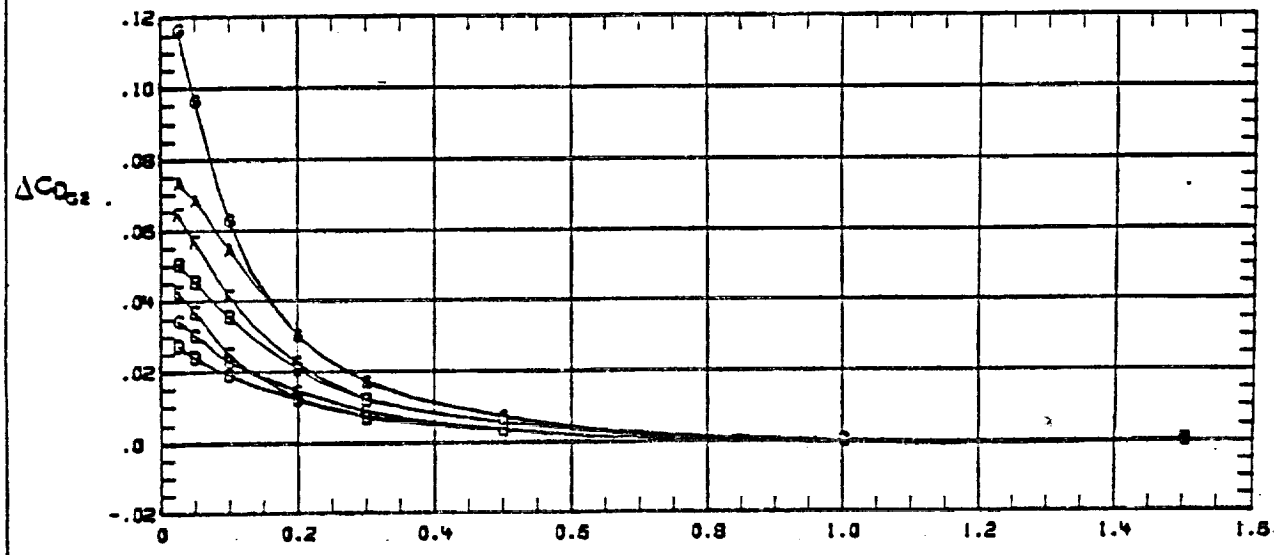
Landing Gear Down

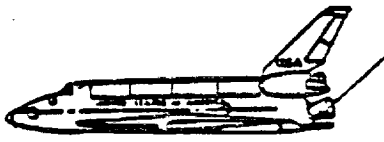


$$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY OR MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -15.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} = All$



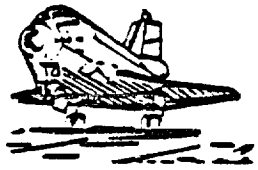


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.07330	0.05030	0.03430	0.02740	0.04230	0.08420	0.11840
0.050	0.06810	0.04610	0.03020	0.02380	0.03660	0.05630	0.09630
0.100	0.05450	0.03530	0.02250	0.01880	0.02460	0.04120	0.06250
0.200	0.03010	0.02050	0.01460	0.01190	0.01250	0.02210	0.03010
0.300	0.01680	0.01200	0.00880	0.00720	0.00720	0.01200	0.01680
0.500	0.00690	0.00530	0.00320	0.00320	0.00320	0.00530	0.00690
1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JF
DATE: 9-14-77
REVISED:

Figure 4.1.2.2-123
GROUND EFFECT

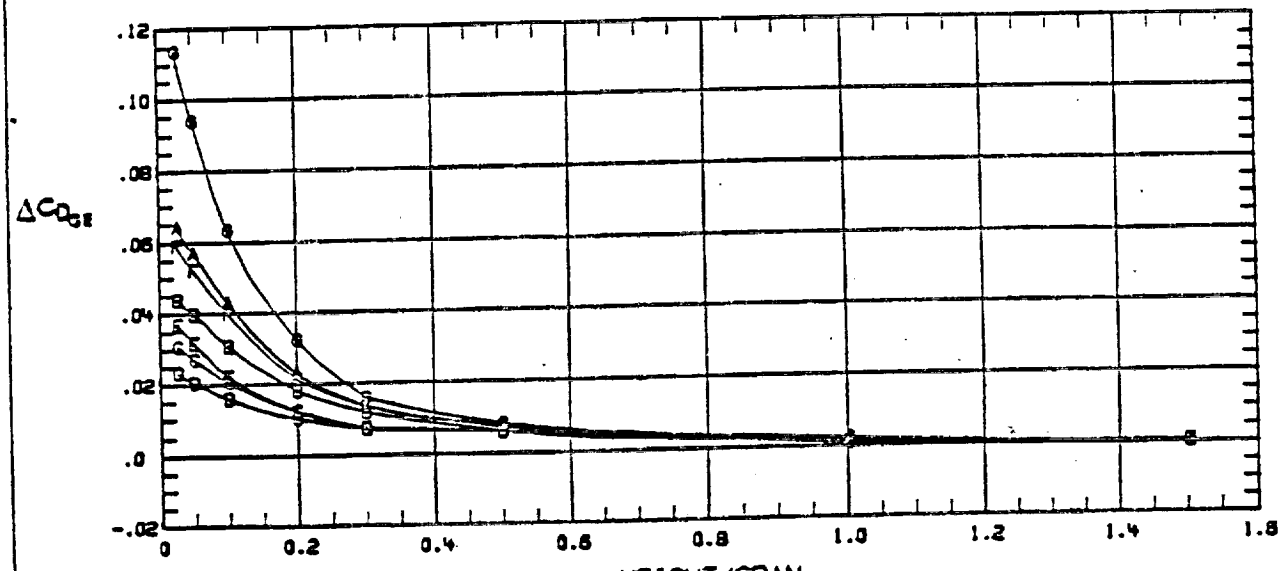
Landing Gear Down



$$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OB
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

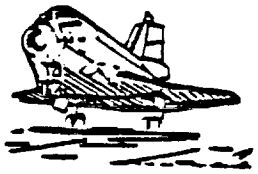
$\delta_e = -10.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} =$ All



HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.06400	0.04380	0.03040	0.02300	0.03680	0.05870	0.11360
0.050	0.05660	0.03950	0.02870	0.02030	0.03150	0.05180	0.09390
0.100	0.04280	0.03050	0.02040	0.01560	0.02200	0.03960	0.06300
0.200	0.02260	0.01780	0.01190	0.00980	0.01190	0.02100	0.03220
0.300	0.01310	0.01150	0.00730	0.00730	0.00730	0.01310	0.01580
0.500	0.00690	0.00590	0.00590	0.00590	0.00590	0.00590	0.00800
1.000	0.00150	0.00100	0.00100	0.00100	0.00100	0.00150	0.00200
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 9-14-77
REVISED:

Figure 4.1.2.2-124
GROUND EFFECT

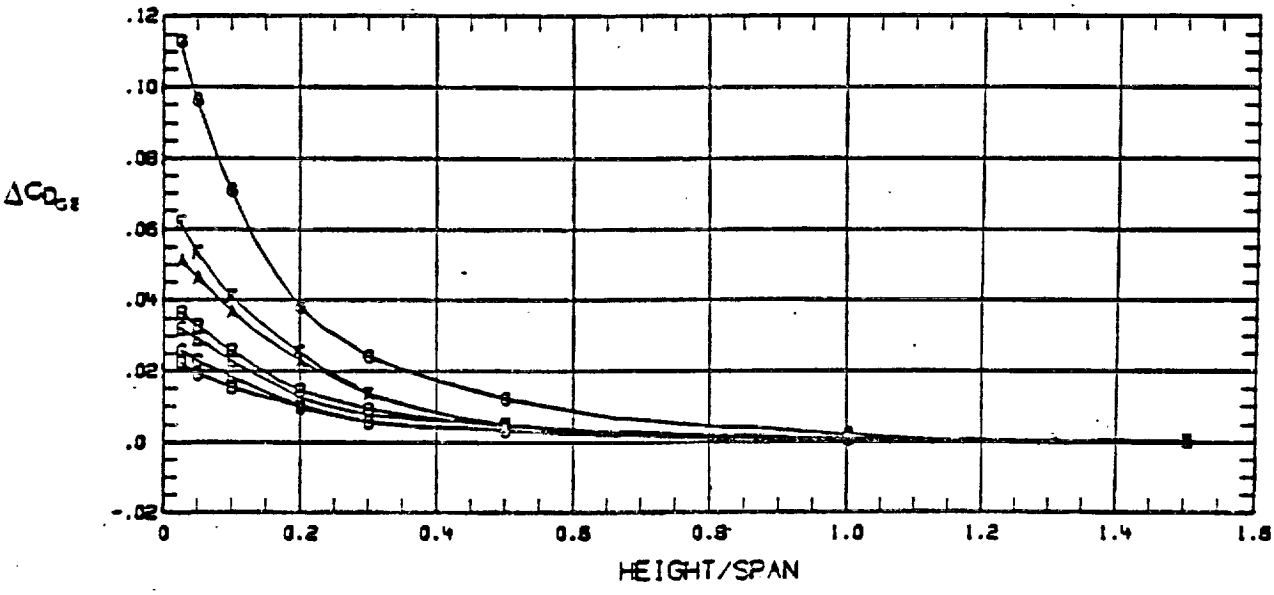


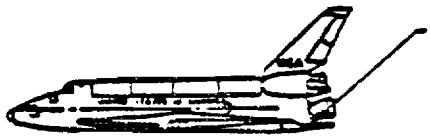
Landing Gear Down

$$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -5.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} =$ ALL





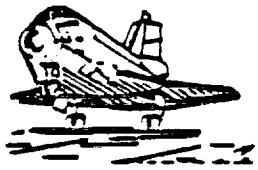
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A −4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.05100	0.03810	0.02550	0.02230	0.03190	0.06160	0.11260
0.050	0.04620	0.03240	0.02290	0.01910	0.02870	0.05310	0.09610
0.100	0.03870	0.02550	0.01810	0.01550	0.02290	0.04090	0.07070
0.200	0.02290	0.01440	0.01020	0.00970	0.01230	0.02510	0.03780
0.300	0.01340	0.00920	0.00550	0.00550	0.00780	0.01340	0.02410
0.500	0.00450	0.00450	0.00290	0.00290	0.00450	0.00450	0.01190
1.000	0.00100	0.00100	0.00050	0.00050	0.00100	0.00100	0.00200
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: 3
DATE: 9-14-77
REVISED:

Figure 4.1.2.2-125
GROUND EFFECT

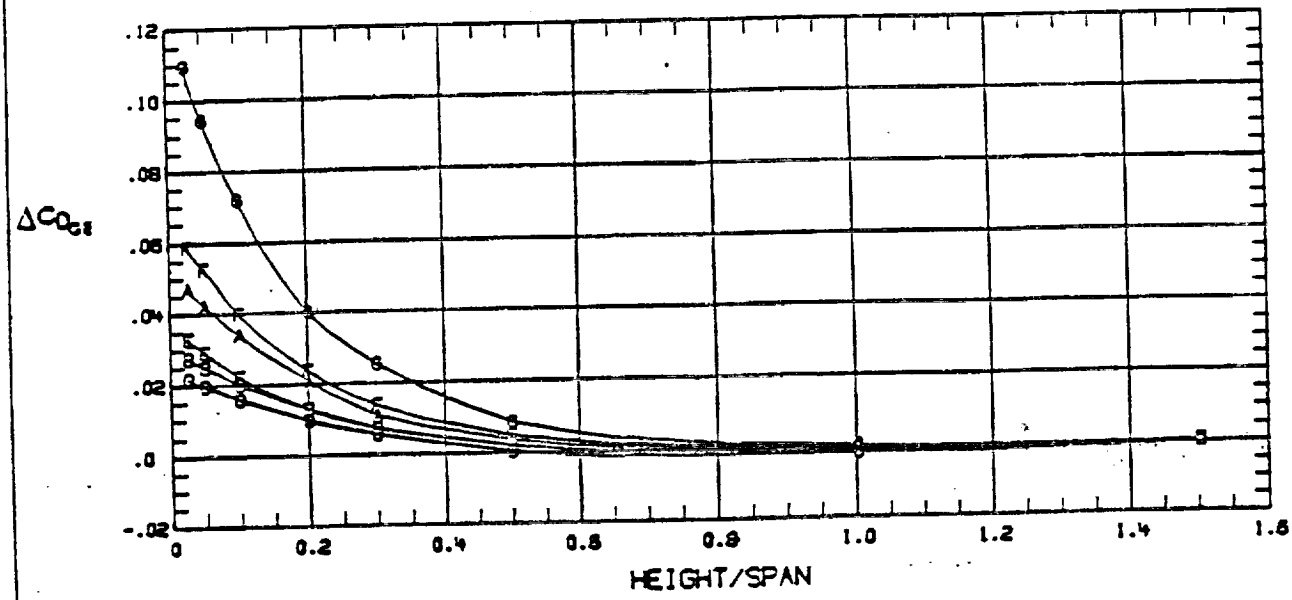
Landing Gear Down

$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$



CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 0.0°$ $\delta_{sf} = -11.7°$ $\delta_{sb} =$ ALL

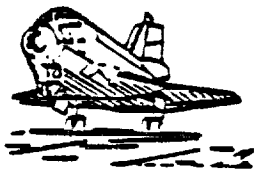


HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.04680	0.02720	0.02130	0.02130	0.03250	0.05850	0.10940
0.050	0.04210	0.02460	0.01930	0.01930	0.02880	0.05220	0.09410
0.100	0.03370	0.01990	0.01570	0.01570	0.02200	0.03960	0.07140
0.200	0.02070	0.01270	0.00960	0.00960	0.01270	0.02340	0.03980
0.300	0.01090	0.00720	0.00560	0.00560	0.00720	0.01350	0.02520
0.500	0.00350	0.00190	0.00030	0.00030	0.00190	0.00450	0.00820
1.000	-0.00050	-0.00150	-0.00200	-0.00200	-0.00150	-0.00050	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: J 3
DATE: 9-14-77
REVISED:

Figure 4.1.2.2-126
GROUND EFFECT

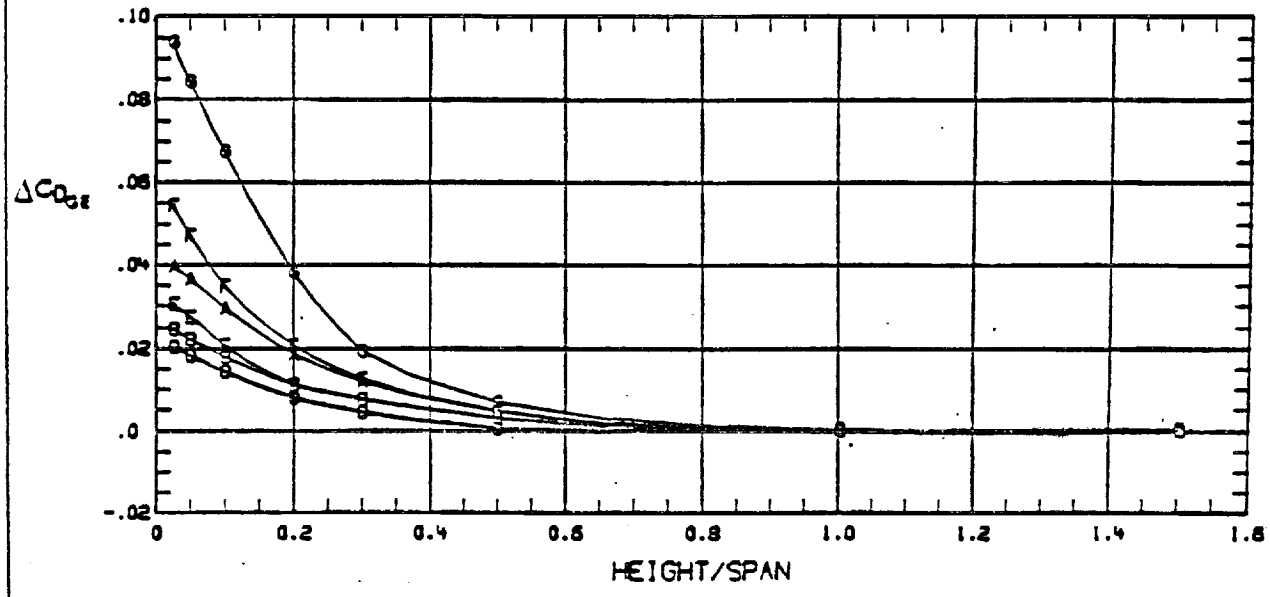
Landing Gear Down

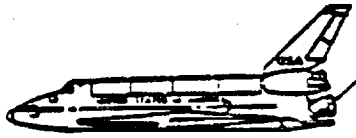


$$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 5.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} = All$





Reference Point
for h/b
X_o 1506.84
Z_o 282.71

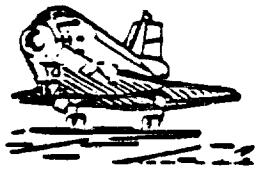
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.03930	0.02460	0.02020	0.02020	0.03030	0.05420	0.09350
0.050	0.03620	0.02150	0.01810	0.01810	0.02720	0.04680	0.08400
0.100	0.02940	0.01770	0.01400	0.01400	0.02030	0.03470	0.06710
0.200	0.01840	0.01090	0.00780	0.00780	0.01090	0.02050	0.03800
0.300	0.01160	0.00740	0.00420	0.00420	0.00740	0.01220	0.01910
0.500	0.00450	0.00290	0.00030	0.00030	0.00290	0.00450	0.00660
1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [signature]
DATE: 9-14-77
REVISED:

Figure 4.1.2.2-127
GROUND EFFECT

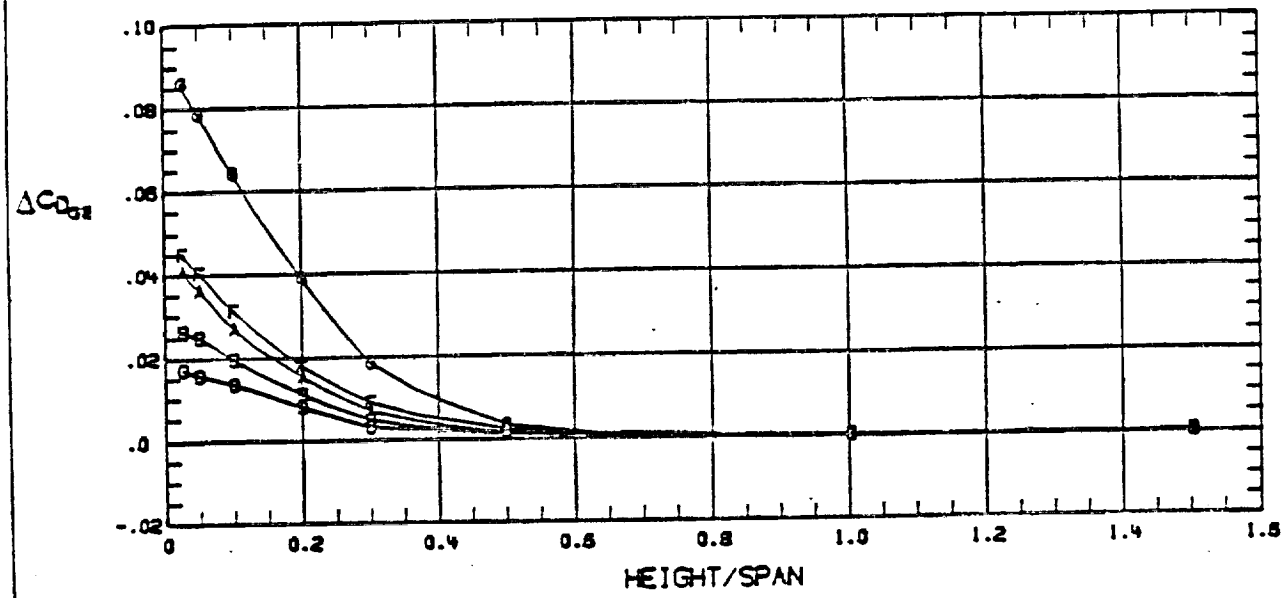
Landing Gear Down

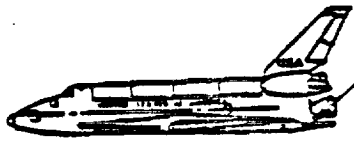
$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$



CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 10.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} = All$



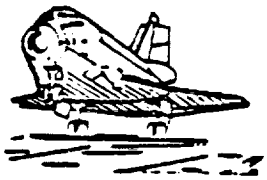


HEIGHT/SPAN h/b	Angle of Attack, α – Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.04060	0.02620	0.01710	0.01710	0.02620	0.04460	0.08[illegible]
0.050	0.03580	0.02460	0.01550	0.01550	0.02460	0.04010	0.07850
0.100	0.02680	0.01930	0.01340	0.01340	0.01930	0.03100	0.06410
0.200	0.01510	0.01090	0.00770	0.00770	0.01090	0.01780	0.03860
0.300	0.00870	0.00460	0.00300	0.00300	0.00460	0.00890	0.01850
0.500	0.00110	0.00110	0.00110	0.00110	0.00110	0.00210	0.00320
1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

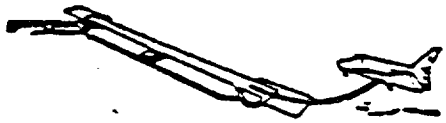
ENGINEER:
DATE: 3-14-77
REVISED:

Figure 4.1.2.2-128
GROUND EFFECT

Landing Gear Down



$$\Delta C_{D_{GROUND\ EFFECT}} = C_{D_{GROUND\ EFFECT}} - C_{D_{FREE\ STREAM}}$$



CONFIGURATION

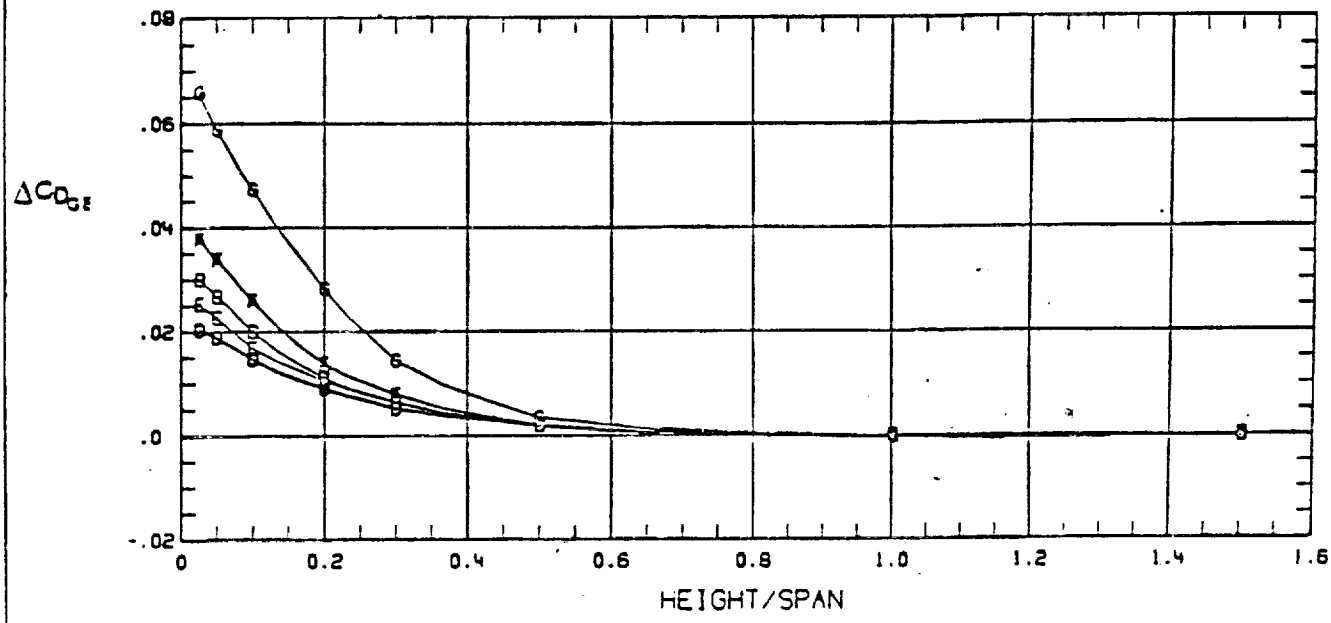
BASELINE ORBITER VEHICLE

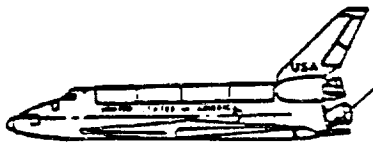
CENTER OF GRAVITY X_{cg} = FS 1076.70
OR Y_{cg} = BL 0.00
MOMENT REFERENCE Z_{cg} = WL 375.00

REFERENCE DIMENSIONS

AREA S_{ref} = 2690.000 ft²
SPAN b_{ref} = 78.056 in
MAC c_{ref} = 35.560 in
BODY LENGTH L_B = 1296.300 in

δ_e = 15.000° δ_{BF} = −11.7° δ_{SB} = All





Reference Point
for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A −4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Drag Force Coefficient, $\Delta C_{D_{GRND\ EFFECT}}$						
0.025	0.03740	0.02990	0.02030	0.02030	0.02510	0.03740	0.06560
0.050	0.03370	0.02670	0.01870	0.01870	0.02250	0.03370	0.05870
0.100	0.02580	0.01990	0.01460	0.01460	0.01670	0.02580	0.04710
0.200	0.01370	0.01100	0.00890	0.00890	0.01050	0.01370	0.02610
0.300	0.00790	0.00630	0.00530	0.00530	0.00630	0.00790	0.01430
0.500	0.00190	0.00190	0.00190	0.00190	0.00190	0.00190	0.00350
1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE
REVISED

Figure 4.1.2.2-129
GROUND EFFECT

4.1.2.3 LIFT-TO-DRAG RATIO. This section presents the untrimmed lift-to-drag ratio data as a function of Mach number for the Orbiter Vehicle basic configuration. These data are based on the two preceding sections [4.1.2.1 and 4.1.2.2]. Figure 4.1.2.3-1 presents the maximum untrimmed lift-to-drag ratio as a function of Mach number. Figures 4.1.2.3-2 through 4.1.2.3-7 present the basic lift-to-drag ratio curves. Mach numbers are repeated on some figures to provide consistent fairings of the data.

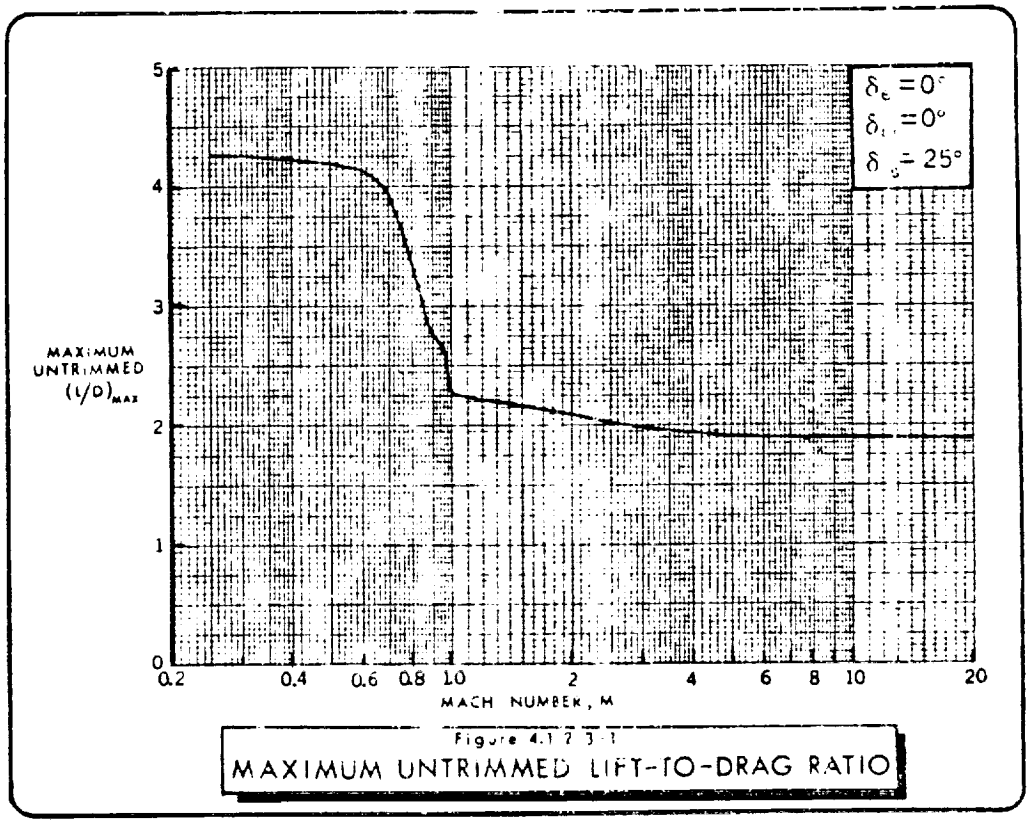
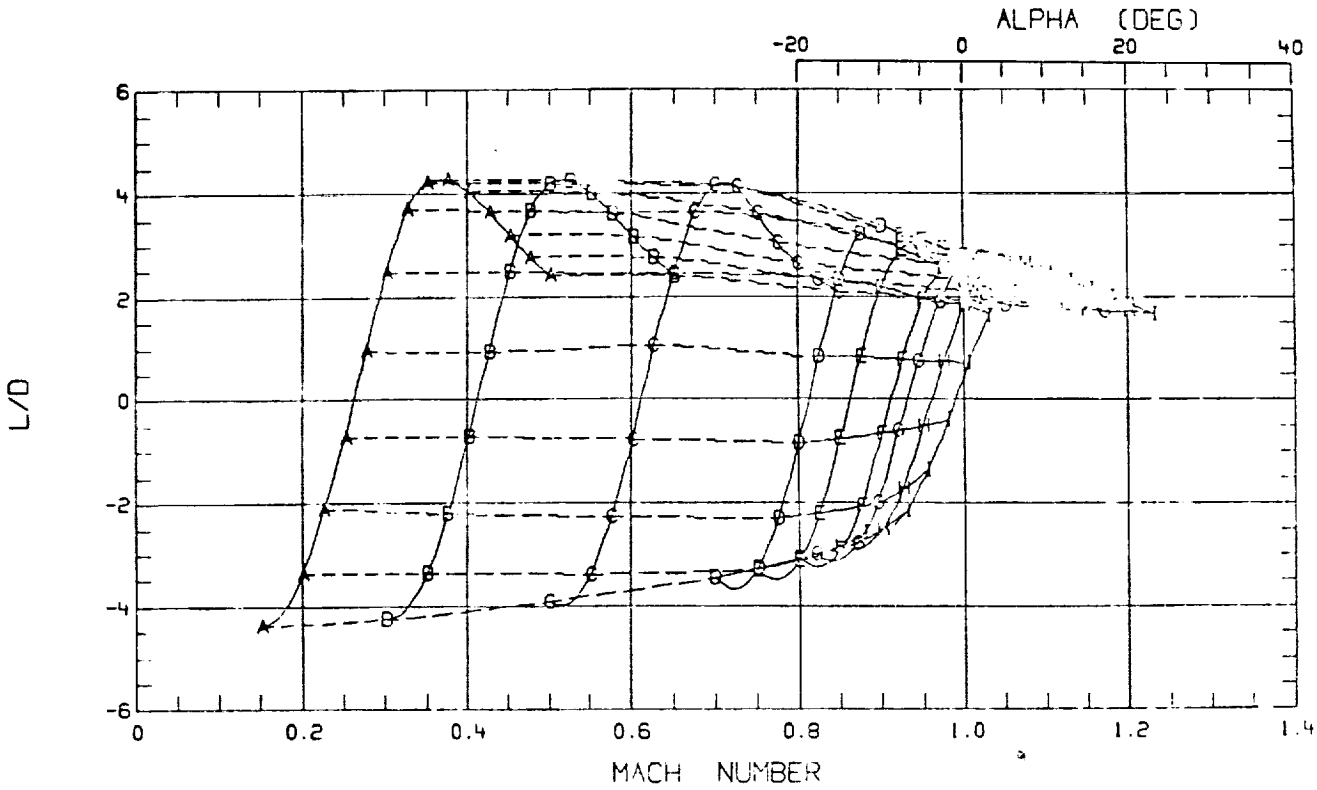


Figure 4.1.2.3-1
MAXIMUM UNTRIMMED LIFT-TO-DRAG RATIO



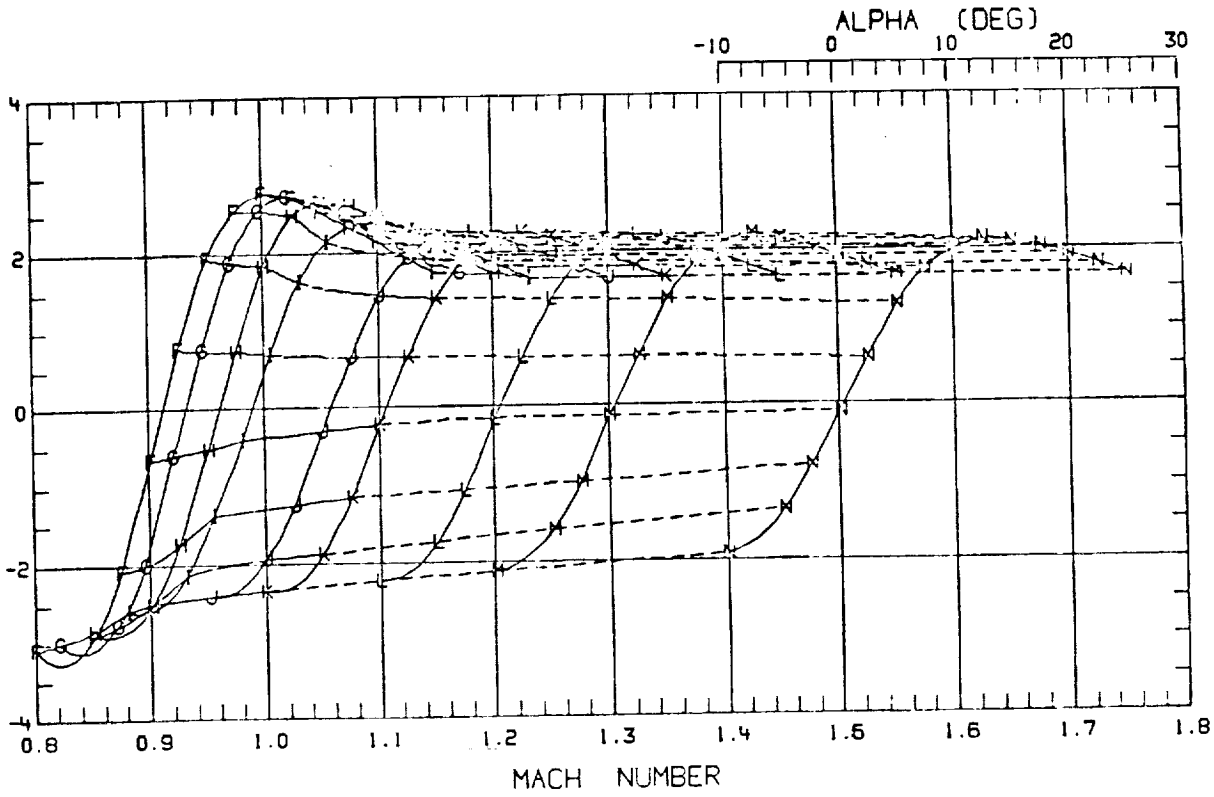
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	0.250	0.400	0.600	0.800	0.850	0.900	0.9[illegible]	0.9[illegible]	0.9[illegible]
	A	B	C	D	E	F	G	H	I
ALPHA (DEG)	LIFT-TO-DRAG RATIO								
-10.000	-4.40087	-4.26597	-3.91665	-3.45943	-3.31079	-3.09623	-3.01102	-2.88775	-2.80[illegible]
-5.000	-3.[illegible]357	-3.37443	-3.40127	-3.29157	-3.13858	-2.92461	-2.79101	-2.52337	-2.15[illegible]
-2.500	-2.[illegible]022	-2.23035	-2.28655	-2.30145	-2.21206	-2.08233	-2.01242	-1.75116	-1.37509
0.0	-0.74184	-0.73421	-0.76348	-0.85190	-0.76543	-0.66152	-0.60606	-0.52402	-0.40063
2.500	0.92927	0.92071	1.02710	0.81726	0.81941	0.76281	0.74293	0.72620	0.68987
5.000	2.47963	2.45816	2.43918	2.30691	2.16420	1.92510	1.87399	1.82425	1.81991
7.500	3.[illegible]3731	3.64530	3.62204	3.18420	2.89700	2.54220	2.53491	2.47008	2.13792
10.000	4.21377	4.18660	4.12714	3.36548	3.06984	2.75902	2.72873	2.64908	2.35249
12.500	4.2[illegible]559	4.2395[illegible]	4.10301	3.16823	2.93240	2.70049	2.63944	2.60484	2.36635
15.000	4.02819	3.99324	3.58230	2.86359	2.69645	2.52431	2.48913	2.45375	2.27044
17.500	3.63830	3.60258	3.00359	2.56451	2.43940	2.32384	2.29297	2.26134	2.13358
20.000	3.17603	3.14842	2.61412	2.29941	2.20554	2.12367	2.10212	2.07586	1.98297
22.500	2.74574	2.73293	2.31710	2.04832	1.97533	1.91136	1.90211	1.87997	1.81176
25.000	2.39287	2.37707	2.07315	1.82613	1.76730	1.72761	1.71703	1.70462	1.65328
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

ENGINEER [illegible]
DATE 10-3-[illegible]

FIGURE 4.1.2.3-2
BASIC LIFT TO DRAG RATIO



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

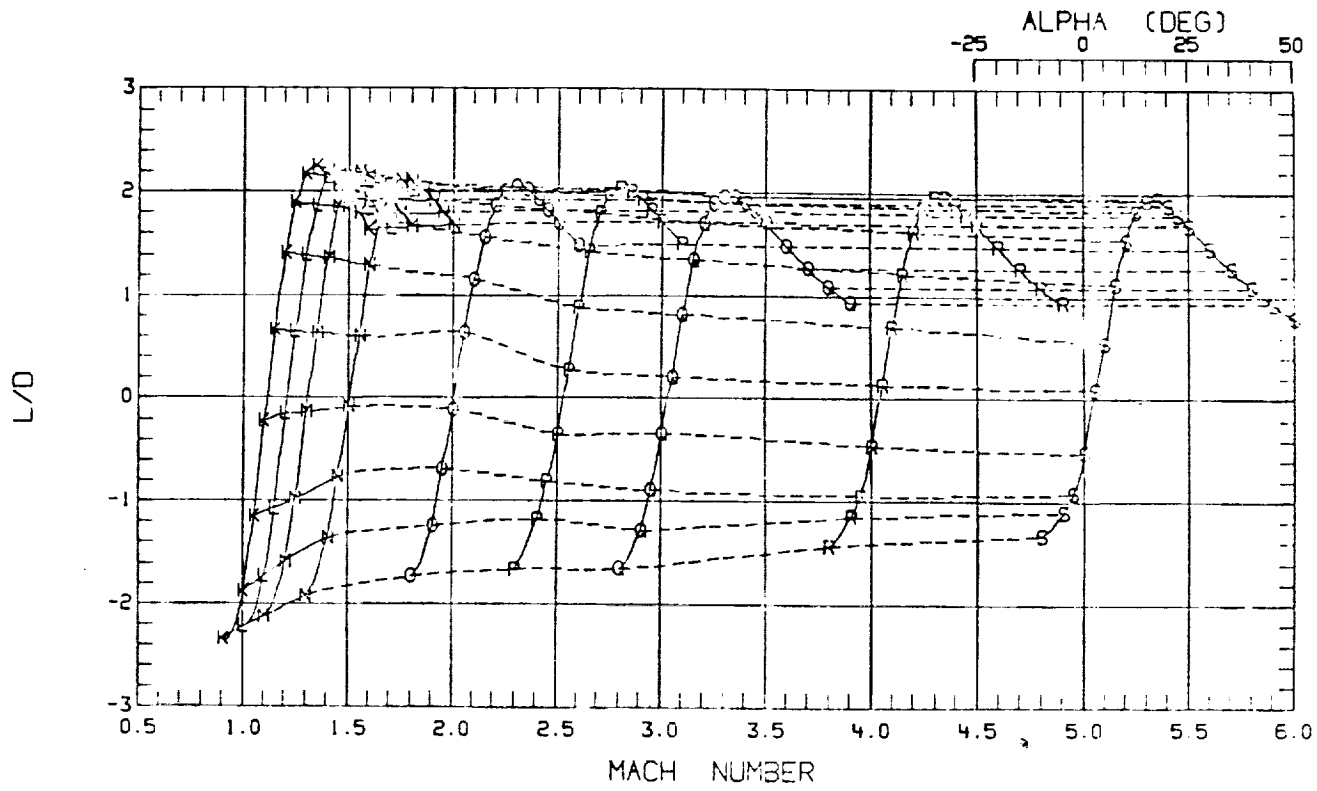
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	MACH NUMBER								
	0.900 F	0.920 G	0.950 H	0.980 I	1.050 J	1.100 K	1.200 L	1.300 M	1.500 N
ALPHA (DEG)	LIFT-TO-DRAG RATIO								
-10.000	-3.09623	-3.01102	-2.85775	-2.60102	-2.40627	-2.34758	-2.22579	-2.13341	-1.92831
-5.000	-2.92461	-2.79151	-2.52387	-2.15092	-1.95057	-1.80391	-1.73680	-1.59721	-1.36557
-2.500	-2.08233	-2.01242	-1.75116	-1.37529	-1.24977	-1.15889	-1.07418	-0.98827	-0.78379
0.0	-0.66152	-0.60606	-0.52402	-0.40862	-0.30500	-0.22727	-0.15489	-0.14277	-0.09512
2.500	0.76281	0.74293	0.72620	0.68997	0.64732	0.65926	0.63386	0.62764	0.58775
5.000	1.92510	1.87399	1.82425	1.61991	1.44166	1.40390	1.37902	1.35354	1.27559
7.500	2.54220	2.53491	2.47089	2.13792	1.92043	1.88136	1.86523	1.83813	1.72986
10.000	2.75902	2.72873	2.64892	2.35242	2.20984	2.16680	2.13050	2.08131	1.97077
12.500	2.70049	2.63944	2.60484	2.38335	2.25221	2.23839	2.20021	2.18705	2.10362
15.000	2.52431	2.48913	2.45375	2.27044	2.18266	2.16919	2.15155	2.13494	2.07962
17.500	2.32384	2.29297	2.26134	2.13359	2.06438	2.05480	2.03436	2.03565	2.00797
20.000	2.12367	2.10212	2.07586	1.98297	1.93110	1.92739	1.90928	1.91325	1.90870
22.500	1.91136	1.90211	1.87997	1.81178	1.78123	1.77784	1.77366	1.78132	1.79032
25.000	1.72761	1.71703	1.70460	1.65326	1.63553	1.63562	1.64132	1.65520	1.67103
30.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
45.000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50.000	.....	.....	.....	.....	.....	.....	.....	.....	.....

ENGINEER DGD
DATE 10-3-75

FIGURE 4.1.2.3-3
BASIC LIFT TO DRAG RATIO



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

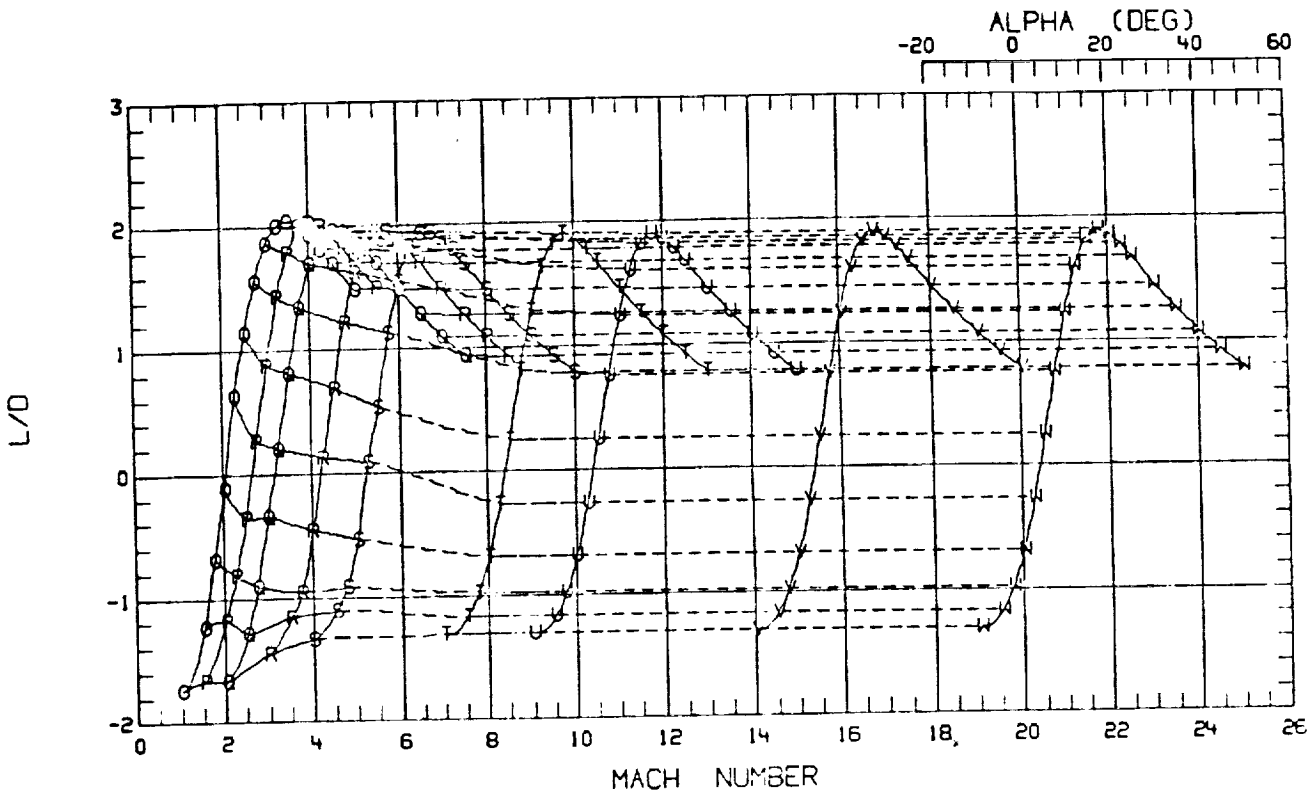
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT
BODY LENGTH LB = 1290.3 IN

	MACH NO.								
	1.100	1.200	1.300	1.500	2.000	2.500	3.000	4.000	5.000
ALPHA (DEG)	K	L	M	N	O	P	Q	R	S
	LIFT-TO-DRAG RATIO								
-10.000	-2.34798	-2.22579	-2.13341	-1.92661	-1.74257	-1.67103	-1.66570	-1.44037	-1.33560
-5.000	-1.88391	-1.73880	-1.59721	-1.36557	-1.24361	-1.18475	-1.29126	-1.16395	-1.11278
-2.500	-1.15883	-1.07418	-0.99827	-0.78379	-0.69414	-0.82344	-0.90560	-0.95359	-0.92711
0.0	-0.22727	-0.15489	-0.14277	-0.09512	-0.12002	-0.36172	-0.34644	-0.46979	-0.53987
2.500	0.65926	0.63765	0.62794	0.58775	0.62703	0.25748	0.19694	0.12431	0.07655
5.000	1.40390	1.37942	1.35354	1.27559	1.13644	0.86742	0.80374	0.68123	0.53125
7.500	1.88136	1.86523	1.83813	1.72956	1.55164	1.42140	1.33673	1.21049	1.11837
10.000	2.16680	2.13050	2.08131	1.97077	1.85451	1.78004	1.69078	1.61817	1.54471
12.500	2.23839	2.20031	2.16305	2.10362	2.00200	1.96251	1.88593	1.84828	1.81566
15.000	2.16919	2.15105	2.13494	2.07962	2.03662	2.02472	1.95628	1.95184	1.92599
17.500	2.05480	2.03436	2.03565	2.00797	2.00292	2.00204	1.95013	1.95101	1.93742
20.000	1.92739	1.90828	1.91325	1.90870	1.91782	1.92316	1.89308	1.88712	1.88034
22.500	1.77784	1.77366	1.78139	1.79032	1.81112	1.81902	1.80597	1.78038	1.78873
25.000	1.63562	1.64132	1.65520	1.67102	1.69678	1.71265	1.69798	1.69017	1.68679
30.000	.....	.....	.....	.....	1.47901	1.48837	1.47967	1.47223	1.46883
35.000	.....	.....	.....	.....	.....	.....	1.27130	1.26284	1.25740
40.000	.....	.....	.....	.....	.....	.....	1.08679	1.08174	1.07911
45.000	.....	.....	.....	.....	.....	.....	0.92732	0.92716	0.92127
50.000	.....	.....	.....	.....	.....	.....	.....	.....	0.78189

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.2.3-4
BASIC LIFT TO DRAG RATIO



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

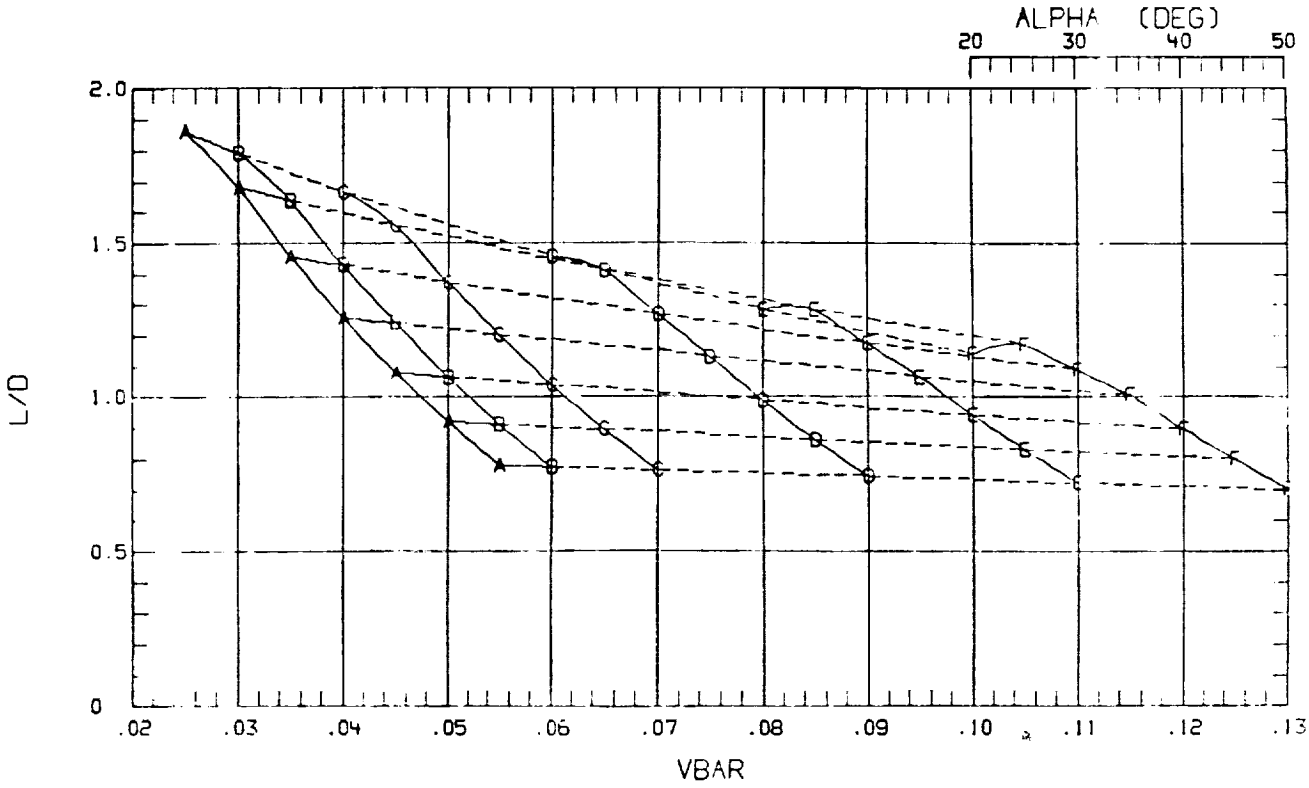
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN

	MACH NUMB. R								
	2.000 Q	2.500 P	3.000 Q	4.000 R	5.000 S	8.000 T	10.000 U	15.000 V	20.000 W
ALPHA (DEG)	LIFT-TO-DRAG RATIO								
-10.000	-1.74257	-1.67103	-1.66570	-1.44937	-1.33760	-1.32000	-1.32000	-1.32000	-1.32000
-5.000	-1.24361	-1.18475	-1.29126	-1.16396	-1.11276	-1.18103	-1.18103	-1.18103	-1.18103
-2.500	-0.69414	-0.82344	-0.90560	-0.95369	-0.92711	-0.98302	-0.98302	-0.98302	-0.98302
0.0	-0.12602	-0.36172	-0.34644	-0.46978	-0.53927	-0.69250	-0.69250	-0.69250	-0.69250
2.500	0.62363	0.25748	0.19694	0.12431	0.07805	-0.27490	-0.27490	-0.27490	-0.27490
5.000	1.13644	0.86742	0.80374	0.68123	0.53125	0.24839	0.24566	0.24566	0.24566
7.500	1.55164	1.42140	1.33673	1.21049	1.11837	0.80586	0.75640	0.75640	0.75640
10.000	1.85451	1.78004	1.69078	1.61817	1.54471	1.29065	1.24110	1.24110	1.24110
12.500	2.00200	1.96251	1.88593	1.84828	1.81556	1.64775	1.60604	1.60604	1.60604
15.000	2.03662	2.02472	1.95628	1.95184	1.92598	1.84826	1.82147	1.82147	1.82147
17.500	2.00292	2.00204	1.95013	1.95101	1.93742	1.91107	1.89799	1.89799	1.89799
20.000	1.91782	1.92316	1.89308	1.88712	1.88034	1.86051	1.85562	1.85562	1.85562
22.500	1.81112	1.81902	1.80597	1.78638	1.78837	1.78294	1.78216	1.78216	1.78216
25.000	1.69678	1.71255	1.69798	1.69017	1.68232	1.67784	1.67707	1.67707	1.67707
30.000	1.47901	1.48837	1.47967	1.47223	1.46383	1.45883	1.45378	1.45378	1.45378
35.000	.....	.....	1.27130	1.26284	1.25740	1.25648	1.25604	1.25604	1.25604
40.000	.....	.....	1.08679	1.08174	1.07911	1.07789	1.07656	1.07656	1.07656
45.000	.....	.....	0.92732	0.92316	0.92122	0.91905	0.91817	0.91817	0.91817
50.000	.....	.....	.....	.....	0.78153	0.77894	0.77806	0.77806	0.77806

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.2.3-5
BASIC LIFT TO DRAG RATIO

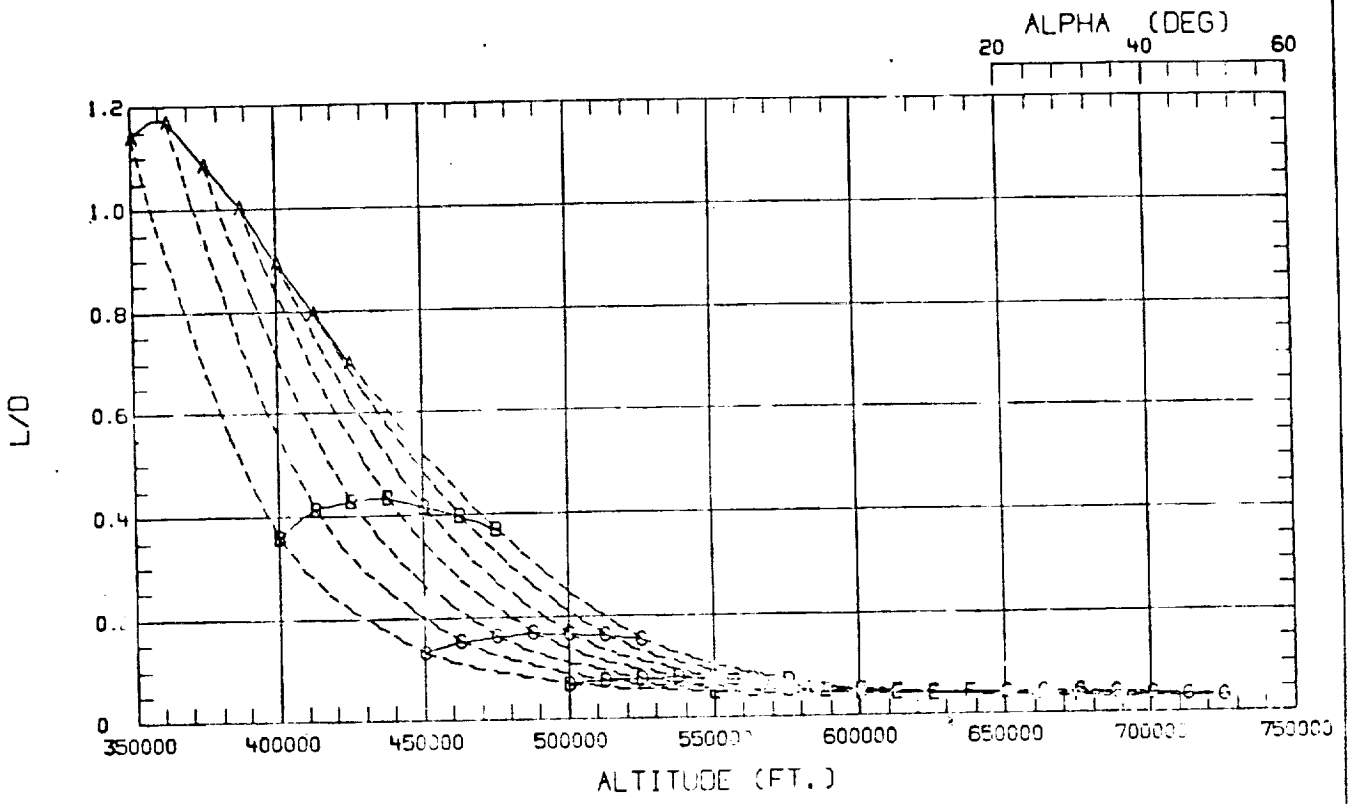


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005	0.010	0.020	0.040	0.060	0.080
	A	B	C	D	E	F
ALPHA (DEG)	VISCOUS LIFT-TO-DRAG RATIO					
20.000	1.85562	1.78710	1.66207	1.45097	1.27972	1.13804
25.000	1.67707	1.63381	1.55182	1.40009	1.27959	1.16943
30.000	1.45378	1.42405	1.36755	1.26357	1.17016	1.08577
35.000	1.25604	1.23647	1.19920	1.12880	1.06344	1.00258
40.000	1.07656	1.06307	1.03667	0.98582	0.93781	0.89212
45.000	0.91817	0.90947	0.89241	0.86907	0.82701	0.79592
50.000	0.77806	0.77267	0.76178	0.74046	0.71968	0.69954

ENGINEER _____
DATE _____

FIGURE 4.1.2.3-6
BASIC LIFT TO DRAG RATIO



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.050 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE LIFT-TO-DRAG RATI						
20.000	1.13804	0.35671	0.13176	0.06841	0.04961	0.04407	0.04323
25.000	1.16943	0.41176	0.15175	0.07452	0.05114	0.04430	0.04325
30.000	1.08577	0.42644	0.16047	0.07682	0.05109	0.04344	0.04232
35.000	1.00258	0.43298	0.16662	0.07773	0.04988	0.04159	0.04033
40.000	0.89212	0.41488	0.16378	0.07537	0.04721	0.03877	0.03749
45.000	0.79592	0.39537	0.15995	0.07245	0.04404	0.03548	0.03418
50.000	0.69864	0.36778	0.15297	0.06869	0.04082	0.03235	0.03105

ENGINEER WMZ
DATE 10-3-78

FIGURE 4.1.2.3-7
BASIC LIFT TO DRAG RATIO

4.2 LATERAL-DIRECTIONAL CHARACTERISTICS. Aerodynamic characteristics pertaining to the lateral-directional degrees of freedom are presented as full-scale rigid and elastic force and moment coefficients. The lateral-directional aerodynamic coefficients are presented in the following subsection:

4.2.1 BODY-AXIS DATA

This subsection is further divided into the pertinent coefficients which are considered separately and prefaced by the appropriate equation for obtaining the total coefficient for any selected flight condition. Each element of the equation is defined and referenced to its associated figure (or table) for obtaining the corresponding numerical values, which comprise the remainder of the subdivisions.

The aerodynamic data are based on wind tunneltest data involving scale models at various attitudes, Reynolds numbers, and Mach numbers.

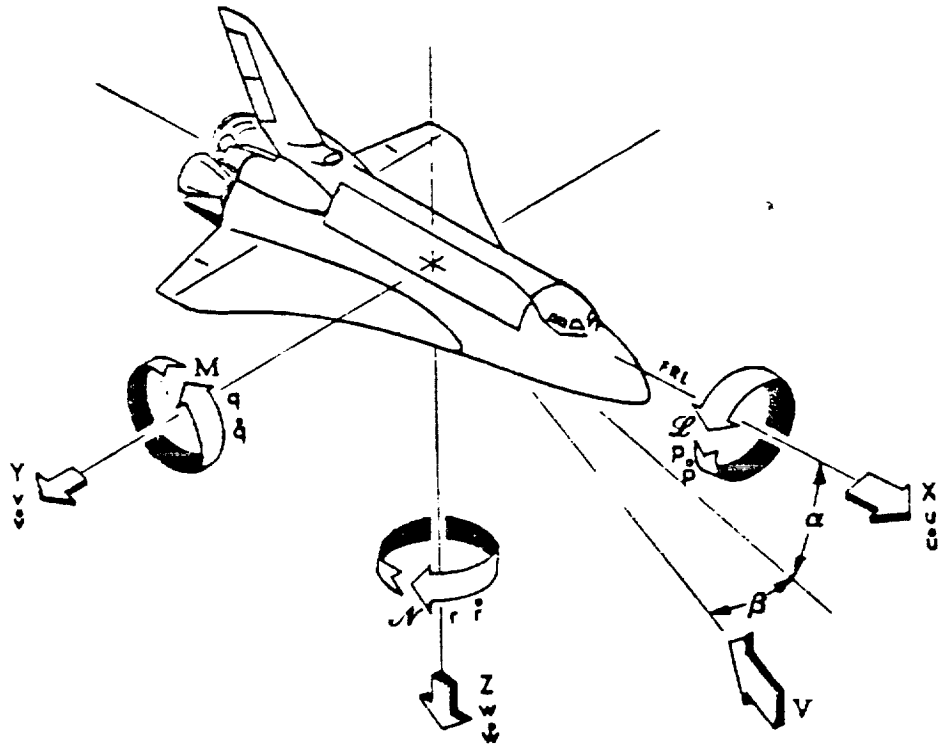
4.2.1 BODY AXIS DATA. The lateral-directional aerodynamic characteristics in the body axis system are:

4.2.1.1 SIDE FORCE COEFFICIENT

4.2.1.2 YAWING MOMENT COEFFICIENT

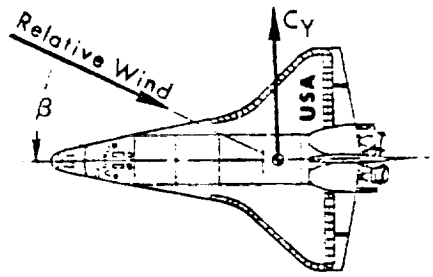
4.2.1.3 ROLLING MOMENT COEFFICIENT

The pertinent equation for obtaining the total coefficient for any given flight condition precedes the presentation of data. Each element of the equation is defined and referenced to the appropriate figures and/or tables for obtaining the corresponding numerical values. Where additional information is considered beneficial (e.g., aeroelastic deformation, hypersonic viscous interaction, and PCS impingement), Appendices have been included for reference.



BODY AXIS SYSTEM

4.2.1.1 SIDE FORCE COEFFICIENT. The Orbiter Vehicle aerodynamic side force coefficient is defined in this section. The basic aerodynamic side force coefficient data are presented in three forms: 1) as a function of angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty$) from 0.005 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet through 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.2.1.1]. Uncertainties associated with the side force characteristics are available in Section 6.0.



The RCS flow field interaction data are presented as a contribution to the total side force (Y) rather than the coefficient (C_Y) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where RCS is used in conjunction with the aerodynamic side force (cf. Section 3.6); i.e., the aerodynamic side force coefficient must be converted to a dimensional force *before* adding the RCS flow field interaction effect (see also Appendix B).

The total side force is:

$$Y_{TOTAL} = \bar{q}\, S\, C_{Y_{TOTAL\ AERO}} + Y_{RCS}$$

*The total aerodynamic side force coefficient is obtained by the following equation:

$$C_{Y_{TOTAL\ AERO}} = C_{Y_{BASIC}} + \Delta C_{Y_{\beta_{ELEVON}}} \beta + C_{Y_{\delta_a}} \delta_a + \Delta C_{Y_{BODY\ FLAP}} + C_{Y_{\delta_r}} \delta_r + \Delta C_{Y_{\beta_{SPEED\ BRAKE}}} \beta$$

$$+ C_{Y_{\hat{p}}} \frac{pb}{2V} + C_{Y_{\hat{r}}} \frac{rb}{2V} + \Delta C_{Y_{FLEX}} + \Delta C_{Y_{\beta_{LANDING\ GEAR}}} \beta + \Delta C_{Y_{GROUND\ EFFECT}} + \Delta C_{Y_{SILTS\ POD}}$$

where,

*Refer to Appendix D when using digitized data.

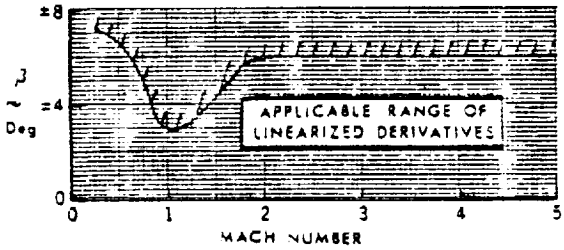
NOTE: The increment presented in Appendix E should be added to the total from above calculations to account for OV102 manufacturing misalignments.

$C_{Y_{BASIC}}$ = Basic, full-scale, freestream, rigid-body side force coefficient. (Figures 4.2.1.1-1 through -29)

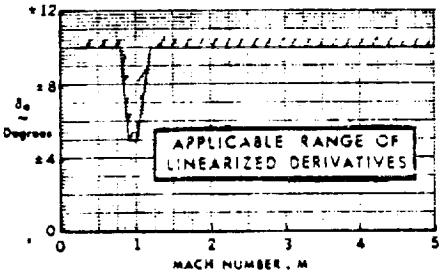
NOTE: 1. Hypersonic-high altitude data given as C_{Y_β} (must be multiplied by β).

2. All control surfaces neutral *except* $\delta_{SB} = 25°$.

$\Delta C_{Y_{\beta_{ELEVON}}}$ = Change in side force coefficient with change in sideslip (β) due to elevon deflection, δ_e. (Figures 4.2.1.1-30 through -42)



$C_{Y_{\delta_a}}$ = Change in side force coefficient with change in aileron deflection, δ_a, when inboard and outboard angles are equal. (Figures 4.2.1.1-43 through -73)



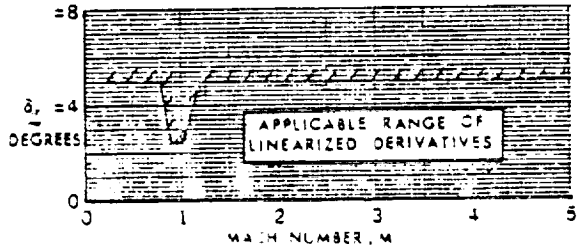
NOTE 1. Partial span factor, K_y, to be used for elevon-body flap interconnect flight system where δ_e is limited to ±5° and inboard and outboard angles are not equal. ($K_y = 0.6$)

$$\Delta C_{Y_{\substack{AILERON \\ \delta_{a_i} \neq \delta_{a_o}}}} = C_{Y_{\delta_a}} [K_y \delta_{a_i} + (1 - K_y) \delta_{a_o}]$$

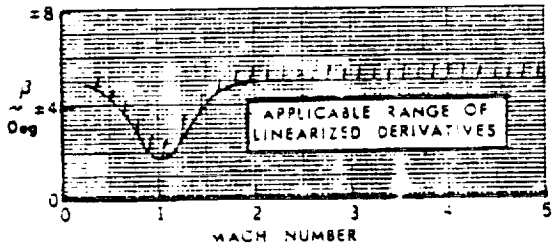
SPACE DIVISION

$\Delta C_{Y_{\substack{\text{BODY}\\\text{FLAP}}}}$ = Change in side force coefficient due to body flap deflection, δ_{BF}. (Assume zero)

$C_{Y_{\delta_r}}$ = Change in side force coefficient with change in rudder deflection, δ_r. (Figures 4.2.1.1-74 through -100)



$\Delta C_{Y_{\substack{\beta\\\text{SPEED}\\\text{BRAKE}}}}$ = Change in side force coefficient with change in sideslip (β) for various speed brake settings, δ_{SB}. (Figures 4.2.1.1-101 through -127)



$C_{Y_{\hat{p}}}$ = Change in side force coefficient due to roll rate, p, (per radian).* (Assume zero)

$C_{Y_{\hat{r}}}$ = Change in side force coefficient due to yaw rate, r, (per radian).* (Assume zero)

*For rotary derivative transfer equations see NASA SP-3070, "Summary of Transformation Equations and Equations of Motion Used in Free-Flight and Wind Tunnel Data Reduction and Analysis," Gainer, T. G., and S. Hoffman, Langley Research Center, Hampton, Virginia (1972)

$\Delta C_{Y_{FLEX}}$ = Change in side force coefficient due to aeroelastic deformation.

$$= -(1 - \eta_{Y_{WB}})(C^R_{Y_{BASIC}} - \Delta C^R_{Y_{\beta_V}}\beta) - (1 - \eta_{Y_V})(\Delta C^R_{Y_{\beta_V}} + \Delta C^R_{Y_{\beta_{SB}}})\beta$$

$$-(1 - \eta_{Y_a})\Delta C_{Y_{AILERON}} - (1 - \eta_{Y_r})\, C^R_{Y_{\delta r}}\, \delta_r - (1-\eta_{Y_e})\Delta C_{Y_{\beta_{ELEVON}}}\beta$$

where the flexible (F) to rigid (R) ratios are,

$\eta_{Y_{WB}}$ =	wing-body contribution	(Figure 4.2.1.1-128)
η_{Y_V} =	vertical tail contribution	(Figure 4.2.1.1-129)
η_{Y_a} =	aileron	(Figure 4.2.1.1-130)
η_{Y_r} =	rudder	(Figure 4.2.1.1-131)
η_{Y_e} =	elevon	(Assume 1.0)

and,

$\Delta C^R_{Y_{\beta_V}}$ =	incremental effect of vertical tail due to sideslip	(Figure 4.2.1.1-132 and 133)

NOTE: 1. Detailed discussion of aeroelasticity may be obtained from Appendix A.

$\Delta C_{Y_{\beta_{LANDING\ GEAR}}}$ = Change in side force coefficient due to extending landing gear. (Figure 4.2.1.1-134)

$\Delta C_{Y_{GROUND\ EFFECT}}$ = Change in side force coefficient derivative due to proximity of ground, f(h/b). (Assume zero)

NOTE: 1. See Section 3.4 for ground clearance and scrape attitude.

$\Delta C_{Y_{SILTS\ POD}}$ = Change in side force coefficient due to addition of SILTS pod.

$$= \Delta C_{Y_{\beta_{SILTS\ POD}}}\beta + \Delta C_{Y_{\delta r_{SILTS\ POD}}}\delta_r$$

where,

$\Delta C_{Y_{\beta_{SILTS\ POD}}} = -0.0000258677 - 0.000131367\ M + 0.0000427817\ M^2$

for $M \leq 6.0$

= zero for $M > 6.0$

$$\Delta C_{Y_{\delta r_{\substack{SILTS \\ POD}}}} = 0.0000694244 - 0.0001976\ M + 0.000054135\ M^2$$

for $M \leq 6.0$

= zero for $M > 6.0$

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (Subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

*The effect of the RCS may be described as a dimensional side force (pounds) in terms of the significant contributing elements by:

$$Y_{RCS} = Y_{JT} + [Y_{SURF} + \Delta Y_{ELEVON} + \Delta Y_{\substack{BODY \\ FLAP}}] + \bar{q}\, S[\Delta C_Y + \Delta C_{Y_{ELEVON}} + \Delta C_{Y_{\substack{BODY \\ FLAP}}} + \Delta C_{Y_{\substack{DOWN\ FIRING \\ CARRYOVER \\ 2\ SIDES}}}]_{JI}$$

where,

Y_{JT} = Side force resulting from number (n) of jets being fired (Reference data only). (cf. Appendix B)

$$= \sum_{OJG} [Y_{JET} \cdot n] \sim lb$$

NOTE: 1. OJG = operating jet group
2. Values given in Figure B-1 are for reference only.

$Y_{\substack{SURF \\ IMP}}$ = Side force resulting from jet impingement on Orbiter Vehicle surfaces(s). (Figure 4.2.1.1-135 and -136)

$$= \sum_{OJG} [Y_{\substack{SURF \\ IMP}} \cdot n] \sim lb$$

$\Delta Y_{\substack{ELEVON \\ IMP}}$ = Change in side force due to jet impingement on elevon effectiveness. (No effect)

$$= \sum_{OJG} [\frac{\partial Y}{\partial \delta_e} \cdot \delta_e \cdot n] \sim lb$$

*Refer to Appendix D when using digitized data.

$\Delta Y_{\substack{BODY\\FLAP\\IMP}}$ = Change in side force due to jet impingement on body flap effectiveness. (No effect)

$$= \sum_{OJG} \left[\frac{\partial Y}{\partial \delta_{BF}} \cdot \delta_{BF} \cdot n\right] \sim lb$$

$\Delta C_{Y_{JI}}$ = Change in side force coefficient due to jet interaction. (Figures 4.2.1.1-137 through -139)

$$= \sum_{OJG} [\Delta C_{Y_{JI}}]$$

$\Delta C_{Y_{\substack{ELEVON\\JI}}}$ = Change in side force coefficient due jet interaction effect on elevon effectiveness. (No effect)

$$= \sum_{OJG} [(\Delta C_Y)_{\delta_{e_{REF}}} \cdot (\delta_e/\delta_{e_{REF}})^{0.75}]$$

$\Delta C_{Y_{\substack{BODY\\FLAP\\JI}}}$ = Change in side force coefficient due to jet interaction effect on body flap effectiveness. (No effect)

$$= \sum_{OJG} [(\Delta C_Y)_{\delta_{BF_{REF}}} \cdot (\delta_{BF}/\delta_{BF_{REF}})^{0.75}]$$

$\Delta C_{Y_{\substack{DOWN\\FIRING\\CARRYOVER\\JI\\2SIDES}}}$ = Effect of carry-over between left- and right-down firing jet groups due to jet interaction. (No effect)

$$= \left[\frac{\partial C_{Y_{JI}}}{\partial(\phi_j/\phi_\infty)}\right][(\overline{\phi_j/\phi_\infty})]$$

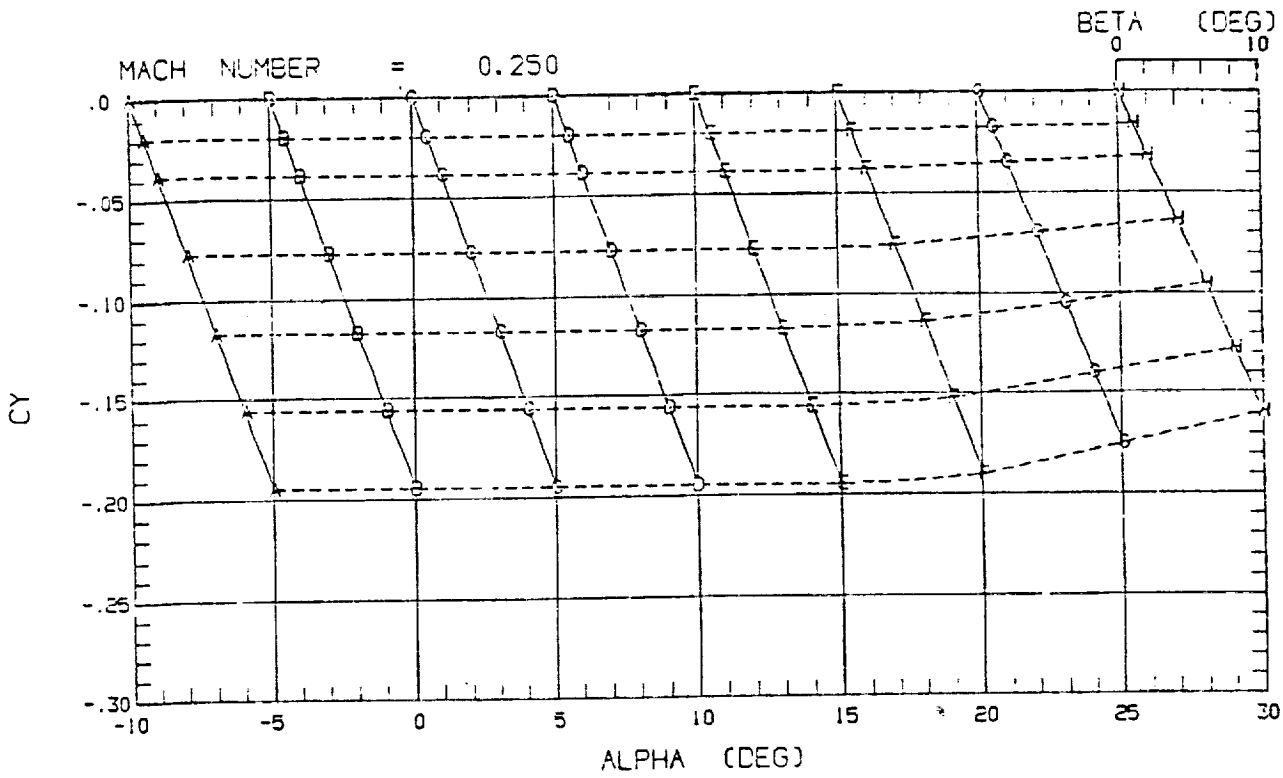
NOTE: 1. $\phi_j/\phi_\infty = (0.1543/\bar{q}_\infty)n$

2. This term is zero if down-firing jet group is inoperative on one side.

3. $(\overline{\phi_j/\phi_\infty}) = \frac{1}{2}[(\phi_j/\phi_\infty)_{LD} + (\phi_j/\phi_\infty)_{RD}]$

where: $0 < (\overline{\phi_j/\phi_\infty}) < 0.03$

The total RCS effect, Y_{RCS}, during thrust build-up and decay is obtained by reducing the full thrust value by the ratio of momentary thrust (see Ref. 4-3) to full thrust.

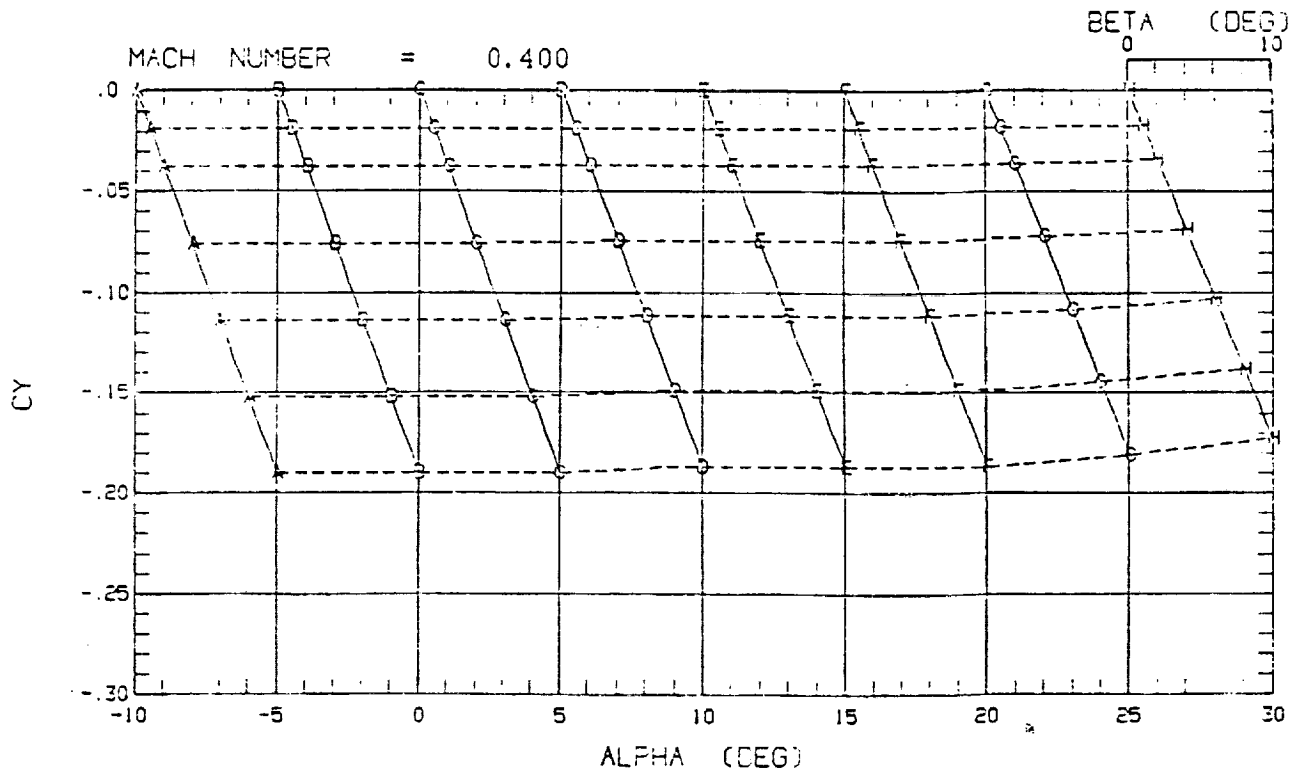


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01950	-0.01950	-0.01950	-0.01950	-0.01950	-0.01900	-0.01750	-0.01600
2.000	-0.03900	-0.03900	-0.03900	-0.03900	-0.03900	-0.03800	-0.03500	-0.03200
4.000	-0.07800	-0.07800	-0.07800	-0.07800	-0.07800	-0.07600	-0.07000	-0.06400
6.000	-0.11700	-0.11700	-0.11700	-0.11700	-0.11700	-0.11400	-0.10500	-0.09600
8.000	-0.15600	-0.15600	-0.15600	-0.15600	-0.15600	-0.15200	-0.14000	-0.12800
10.000	-0.19500	-0.19500	-0.19500	-0.19500	-0.19500	-0.19000	-0.17500	-0.16000

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.1-1
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.660 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01900	-0.01900	-0.01900	-0.01870	-0.01870	-0.01870	-0.01810	-0.01730
2.000	-0.03800	-0.03800	-0.03800	-0.03740	-0.03740	-0.03740	-0.03620	-0.03460
4.000	-0.07600	-0.07600	-0.07600	-0.07480	-0.07480	-0.07480	-0.07240	-0.06920
6.000	-0.11400	-0.11400	-0.11400	-0.11220	-0.11220	-0.11220	-0.10860	-0.10380
8.000	-0.15200	-0.15200	-0.15200	-0.14960	-0.14960	-0.14960	-0.14480	-0.13840
10.000	-0.19000	-0.19000	-0.19000	-0.18700	-0.18700	-0.18700	-0.18100	-0.17300

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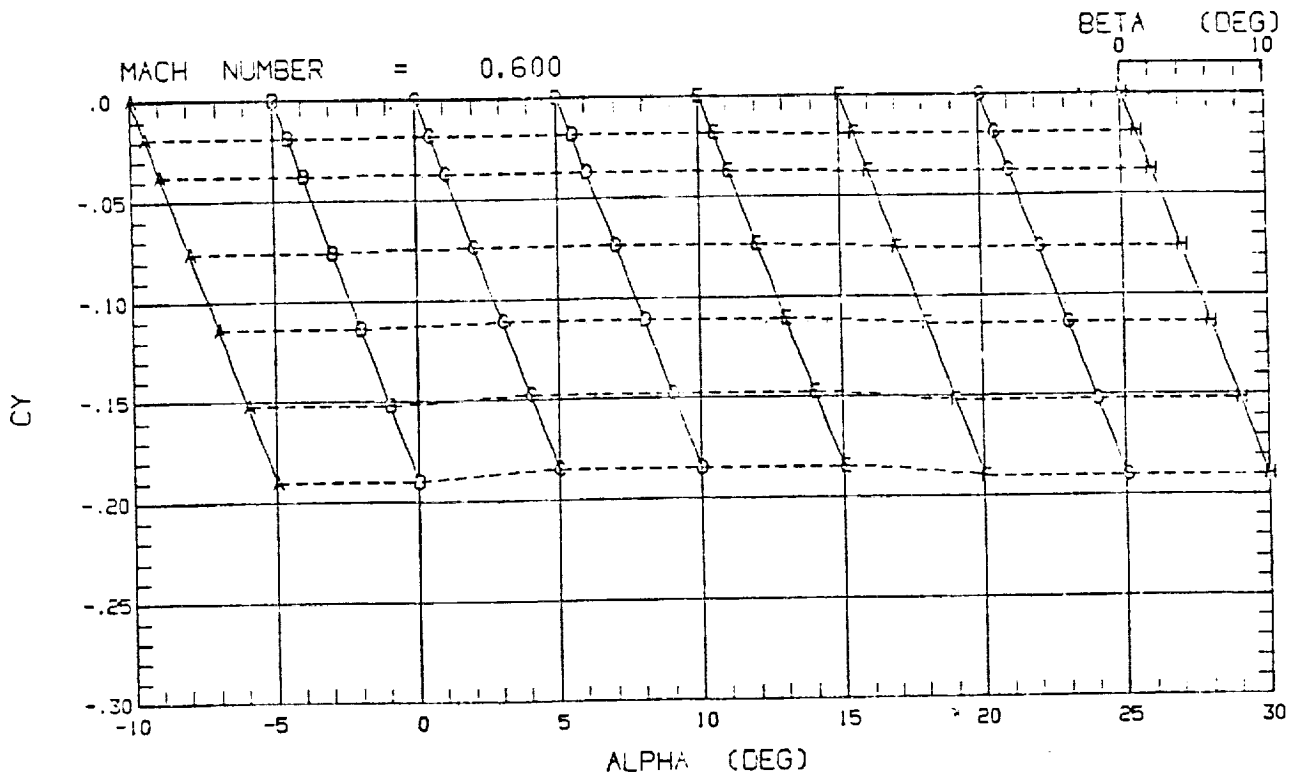
FIGURE 4.2.1.1-2
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01900	-0.01900	-0.01850	-0.01850	-0.01850	-0.01900	-0.01900	-0.01900
2.000	-0.03800	-0.03800	-0.03700	-0.03700	-0.03700	-0.03800	-0.03800	-0.03800
4.000	-0.07600	-0.07600	-0.07400	-0.07400	-0.07400	-0.07600	-0.07600	-0.07600
6.000	-0.11400	-0.11400	-0.11100	-0.11100	-0.11100	-0.11400	-0.11400	-0.11400
8.000	-0.15200	-0.15200	-0.14800	-0.14800	-0.14800	-0.15200	-0.15200	-0.15200
10.000	-0.19000	-0.19000	-0.18500	-0.18500	-0.18500	-0.19000	-0.19000	-0.19000

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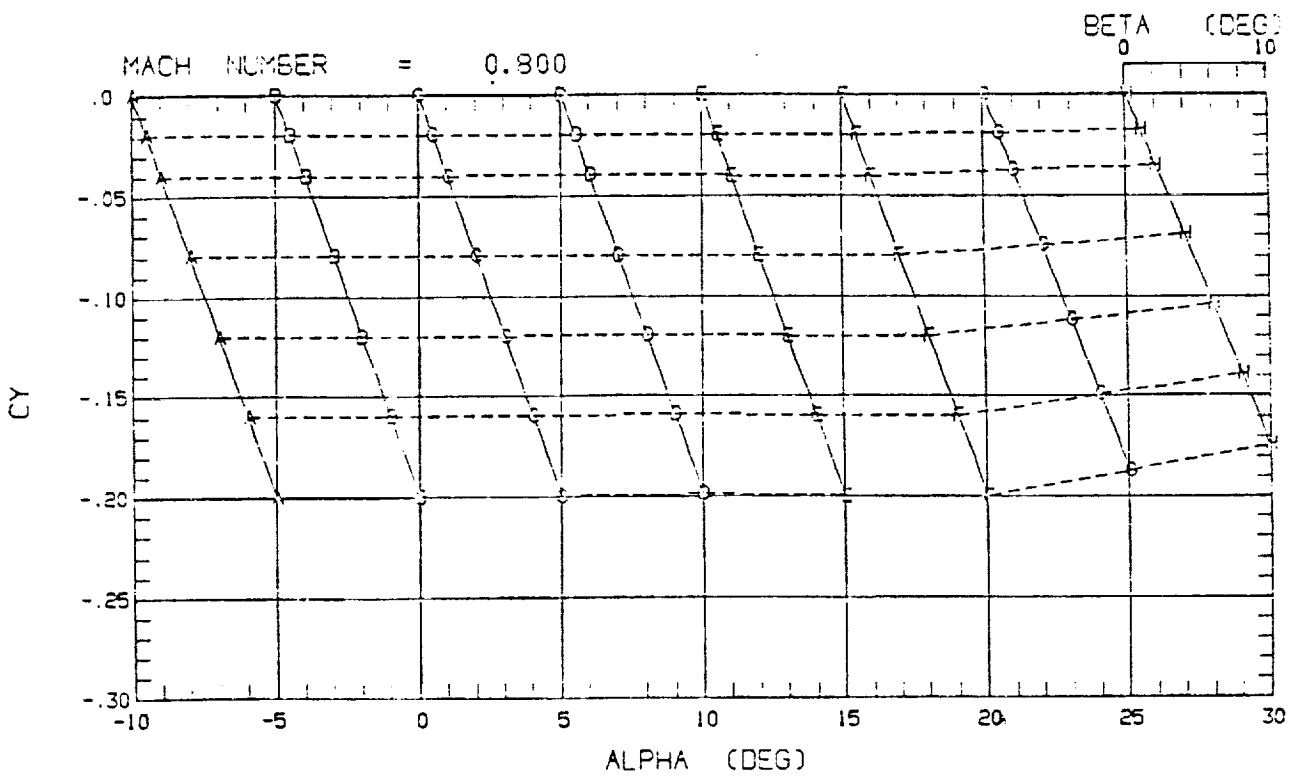
FIGURE 4.2.1.1-3
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02000	-0.02000	-0.02000	-0.01990	-0.02000	-0.02000	-0.01870	-0.01740
2.000	-0.04000	-0.04000	-0.04000	-0.03980	-0.04000	-0.04000	-0.03740	-0.03480
4.000	-0.08000	-0.08000	-0.08000	-0.07960	-0.08000	-0.08000	-0.07480	-0.06960
6.000	-0.12000	-0.12000	-0.12000	-0.11940	-0.12000	-0.12000	-0.11220	-0.10440
8.000	-0.16000	-0.16000	-0.16000	-0.15920	-0.16000	-0.16000	-0.14960	-0.13920
10.000	-0.20000	-0.20000	-0.20000	-0.19900	-0.20000	-0.20000	-0.19700	-0.17400

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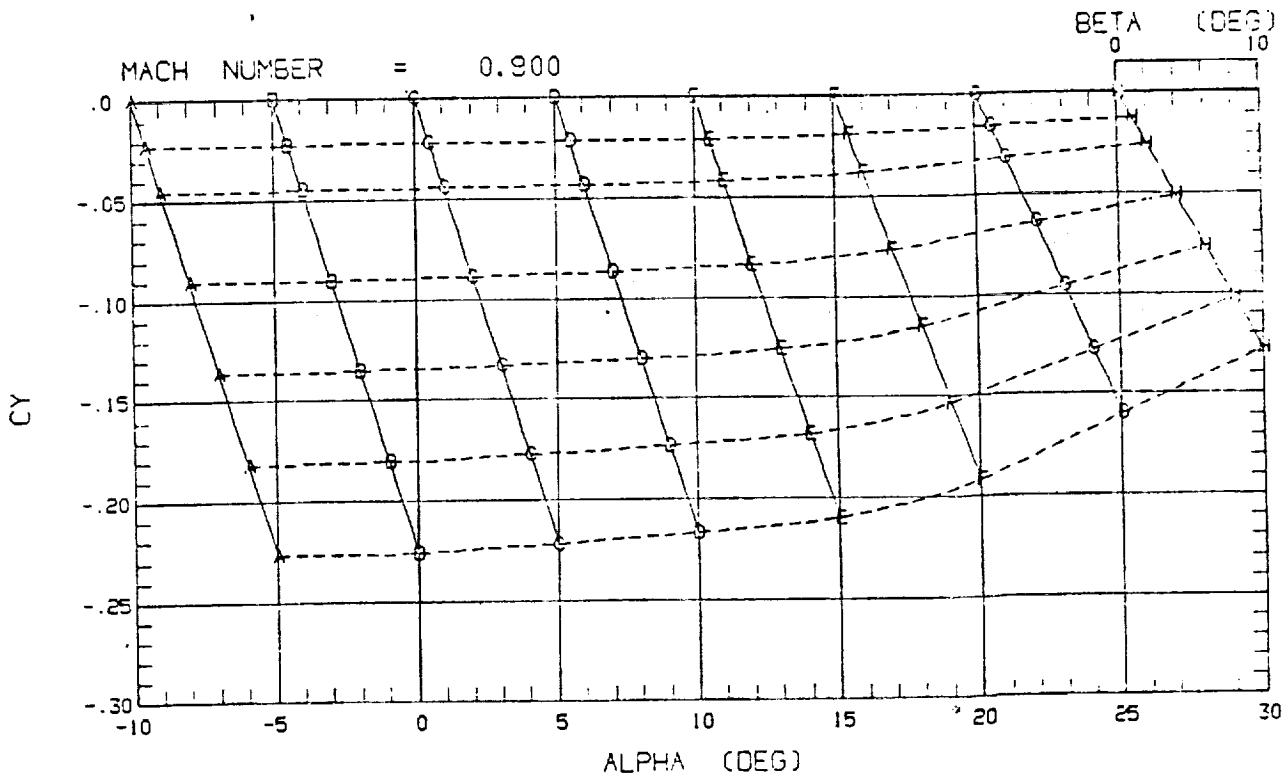
FIGURE 4.2.1.1-4
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02270	-0.02260	-0.02220	-0.02170	-0.02100	-0.01920	-0.01600	-0.01280
2.000	-0.04540	-0.04520	-0.04440	-0.04340	-0.04200	-0.03840	-0.03200	-0.02560
4.000	-0.09080	-0.09040	-0.08860	-0.08660	-0.08400	-0.07680	-0.06400	-0.05120
6.000	-0.13620	-0.13560	-0.13320	-0.13020	-0.12600	-0.11520	-0.09600	-0.07680
8.000	-0.18160	-0.18080	-0.17760	-0.17360	-0.16800	-0.15360	-0.12800	-0.10240
10.000	-0.22700	-0.22600	-0.22200	-0.21700	-0.21000	-0.19200	-0.16000	-0.12800

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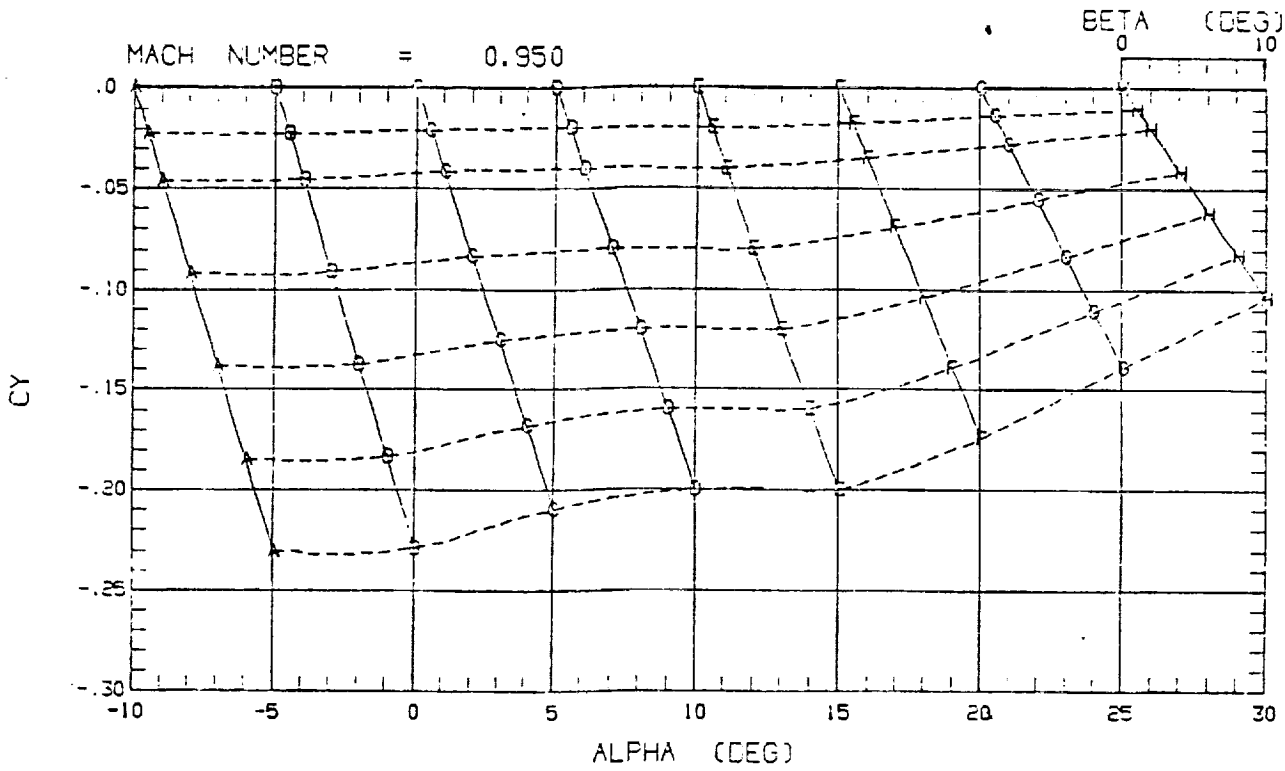
FIGURE 4.2.1.1-5
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XC = FS 1076.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0	IN.	WING SPAN	SW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0	IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02310	-0.02233	-0.02100	-0.03000	-0.02000	-0.01740	-0.01390	-0.01040
2.000	-0.04620	-0.04587	-0.04200	-0.04000	-0.04000	-0.03480	-0.02780	-0.02080
4.000	-0.09240	-0.09174	-0.08400	-0.08000	-0.08000	-0.06960	-0.05560	-0.04160
6.000	-0.13860	-0.13761	-0.12600	-0.12000	-0.12000	-0.10440	-0.08340	-0.06240
8.000	-0.18480	-0.18347	-0.16800	-0.16000	-0.16000	-0.13920	-0.11120	-0.08320
10.000	-0.23100	-0.22933	-0.21000	-0.20000	-0.20000	-0.17400	-0.13900	-0.10400

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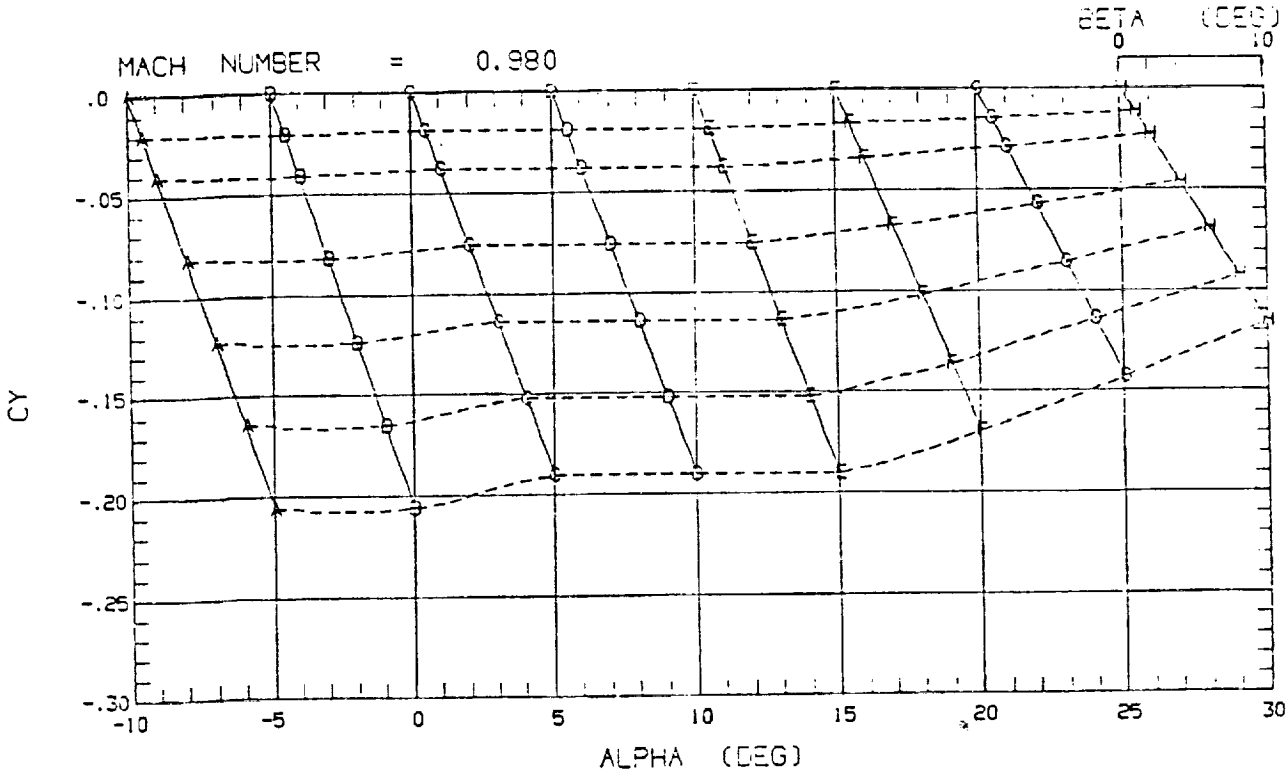
FIGURE 4.2.1.1-6
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02060	-0.02063	-0.01900	-0.01900	-0.01900	-0.01700	-0.01430	-0.01160
2.000	-0.04120	-0.04127	-0.03800	-0.03800	-0.03800	-0.03400	-0.02860	-0.02320
4.000	-0.08240	-0.08254	-0.07600	-0.07600	-0.07600	-0.06800	-0.05720	-0.04640
6.000	-0.12360	-0.12381	-0.11400	-0.11400	-0.11400	-0.10200	-0.08580	-0.06960
8.000	-0.16480	-0.16507	-0.15200	-0.15200	-0.15200	-0.13600	-0.11440	-0.09280
10.000	-0.20600	-0.20633	-0.19000	-0.19000	-0.19000	-0.17000	-0.14300	-0.11600

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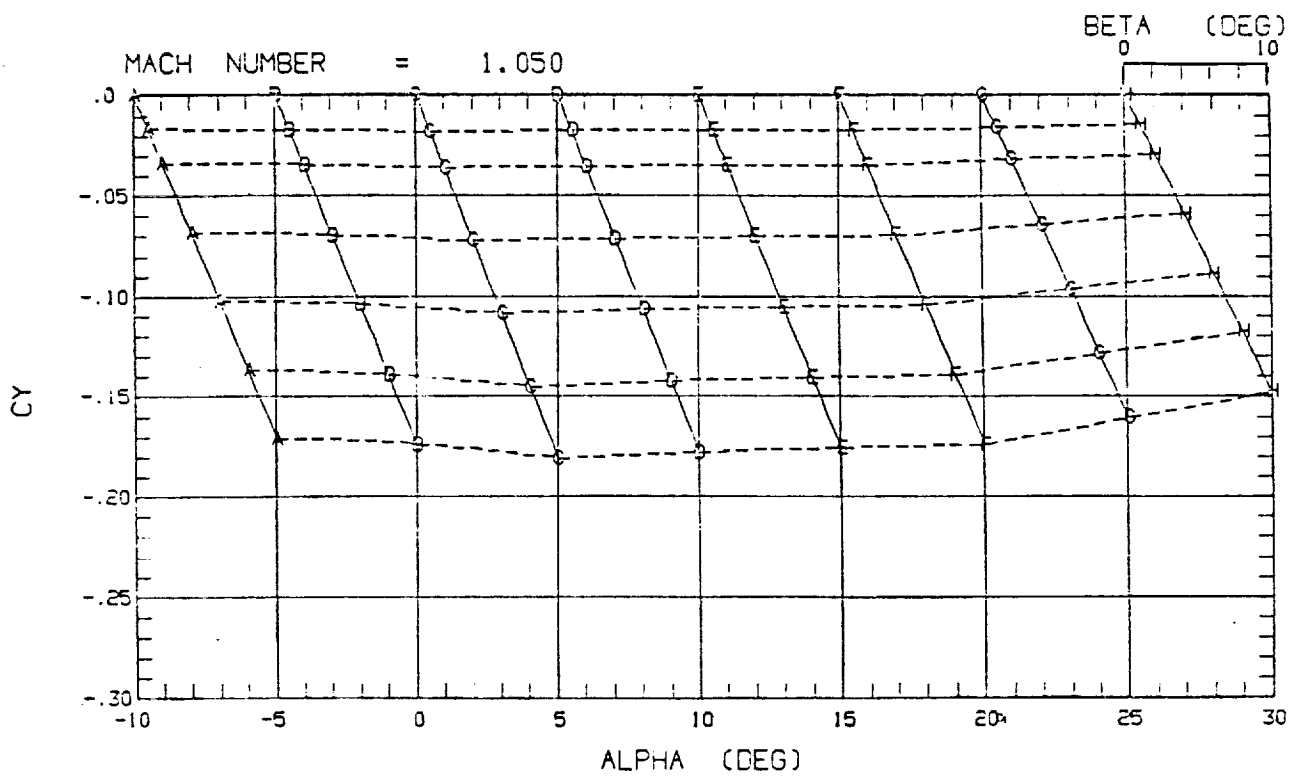
FIGURE 4.2.1.1- 7
BASIC SIDE FORCE COEFFICIENT



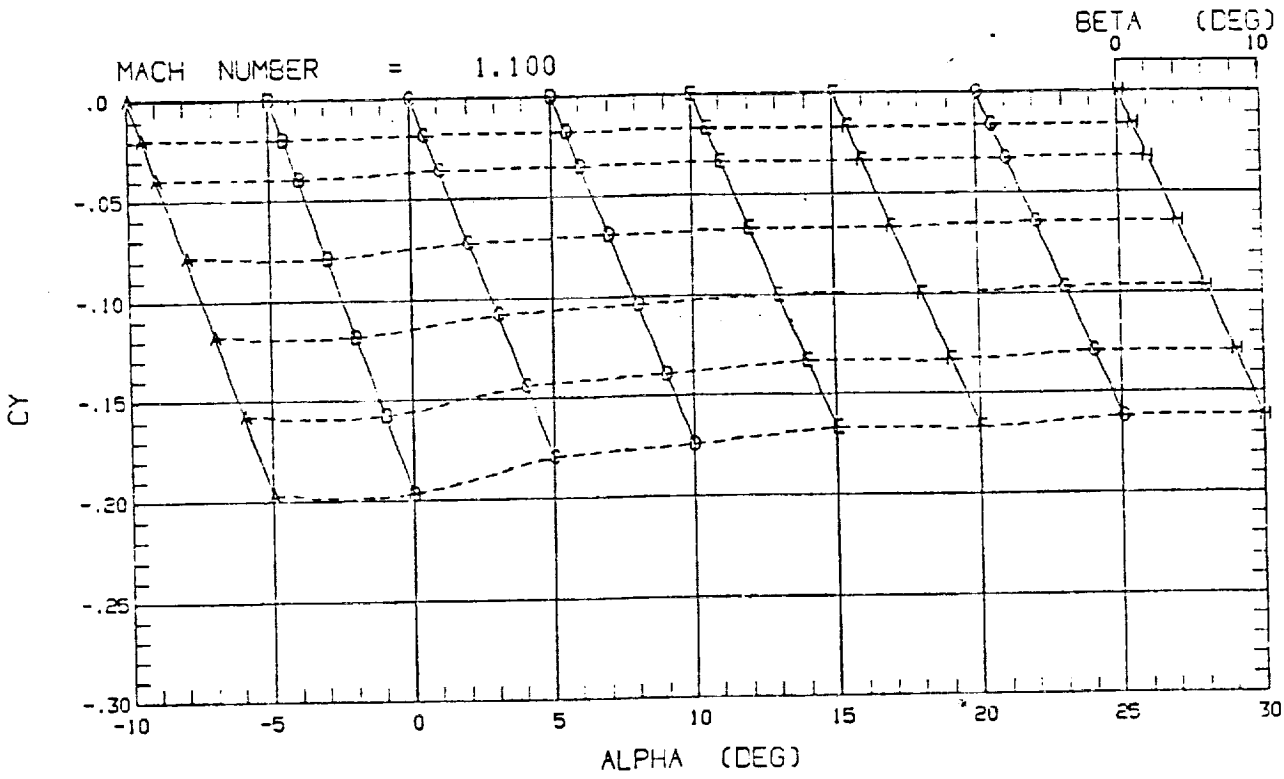
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XC = FS 1075.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YC = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZC = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01710	-0.01743	-0.01810	-0.01780	-0.01760	-0.01740	-0.01610	-0.01480
2.000	-0.03420	-0.03487	-0.03630	-0.03560	-0.03520	-0.03480	-0.03220	-0.02960
4.000	-0.06840	-0.06974	-0.07260	-0.07120	-0.07040	-0.06960	-0.06440	-0.05920
6.000	-0.10260	-0.10461	-0.10890	-0.10680	-0.10560	-0.10440	-0.09660	-0.08880
8.000	-0.13680	-0.13947	-0.14520	-0.14240	-0.14080	-0.13920	-0.12880	-0.11840
10.000	-0.17100	-0.17433	-0.18100	-0.17800	-0.17600	-0.17400	-0.16100	-0.14800

ENGINEER [illegible]
DATE 8-13-75

FIGURE 4.2.1.1- 8
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01970	-0.01973	-0.01800	-0.01740	-0.01670	-0.01670	-0.01620	-0.01620
2.000	-0.03940	-0.03947	-0.03600	-0.03480	-0.03340	-0.03340	-0.03240	-0.03240
4.000	-0.07660	-0.07894	-0.07200	-0.06960	-0.06680	-0.06680	-0.06480	-0.06480
6.000	-0.11820	-0.11841	-0.10800	-0.10440	-0.10020	-0.10020	-0.09720	-0.09720
8.000	-0.15760	-0.15787	-0.14400	-0.13920	-0.13360	-0.13360	-0.12960	-0.12960
10.000	-0.19700	-0.19733	-0.18000	-0.17400	-0.16700	-0.16700	-0.16200	-0.16200

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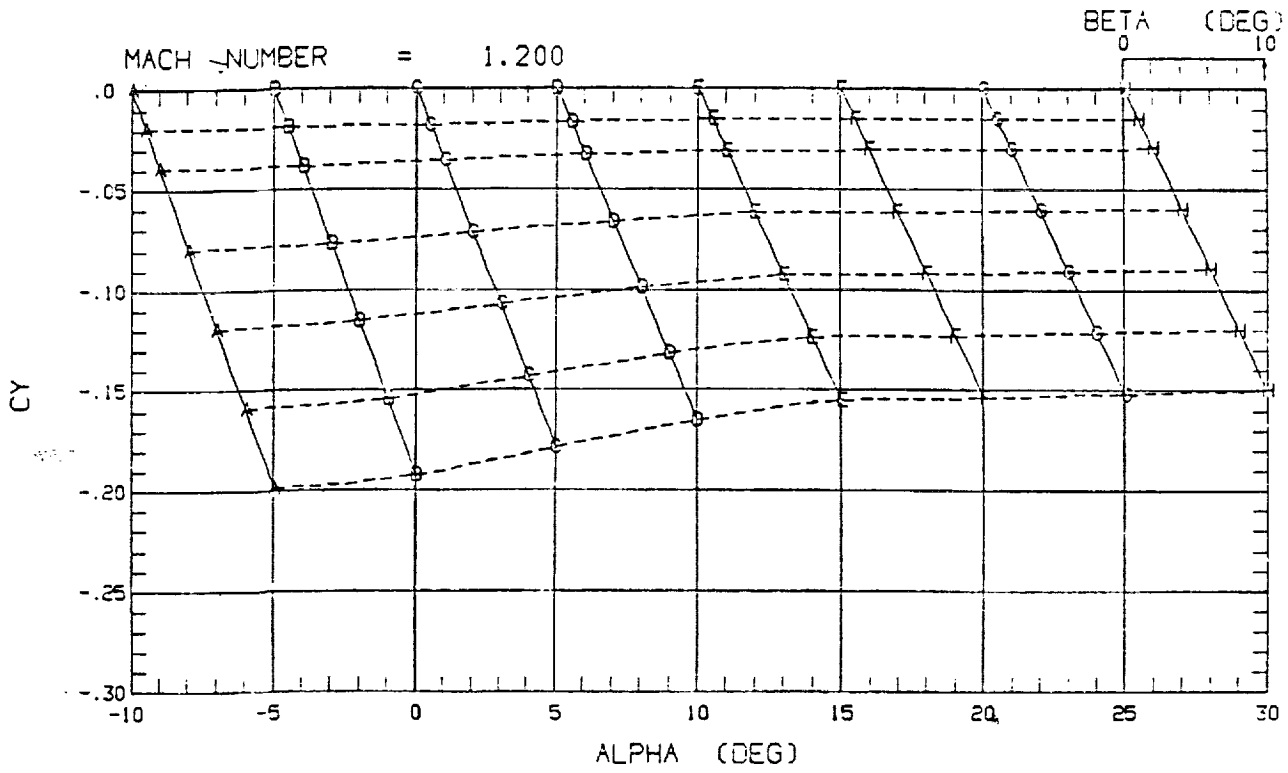
FIGURE 4.2.1.1-9
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01990	-0.01930	-0.01790	-0.01650	-0.01580	-0.01540	-0.01520	-0.01500
2.000	-0.03960	-0.03860	-0.03580	-0.03300	-0.03160	-0.03080	-0.03040	-0.03000
4.000	-0.07960	-0.07720	-0.07160	-0.06600	-0.06320	-0.06160	-0.06080	-0.06000
6.000	-0.11940	-0.11580	-0.10740	-0.09900	-0.09480	-0.09240	-0.09120	-0.09000
8.000	-0.15920	-0.15440	-0.14320	-0.13200	-0.12640	-0.12320	-0.12160	-0.12000
10.000	-0.19900	-0.19300	-0.17900	-0.16500	-0.15800	-0.15400	-0.15200	-0.15000

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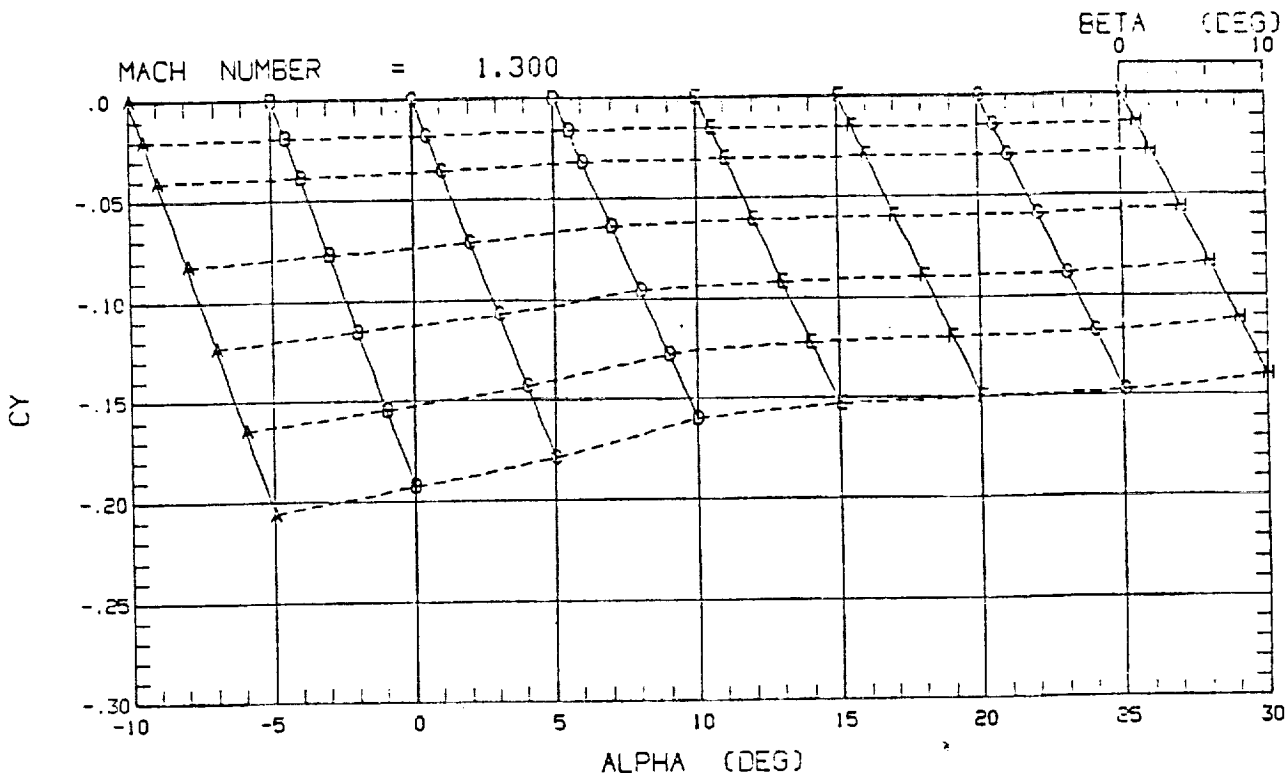
FIGURE 4.2.1.1-10
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02060	-0.01930	-0.01790	-0.01600	-0.01530	-0.01500	-0.01480	-0.01400
2.000	-0.04120	-0.03860	-0.03580	-0.03200	-0.03060	-0.03000	-0.02960	-0.02800
4.000	-0.08240	-0.07720	-0.07160	-0.06400	-0.06120	-0.06000	-0.05920	-0.05600
6.000	-0.12360	-0.11580	-0.10740	-0.09600	-0.09180	-0.09000	-0.08880	-0.08400
8.000	-0.16480	-0.15440	-0.14320	-0.12800	-0.12240	-0.12000	-0.11840	-0.11200
10.000	-0.20600	-0.19300	-0.17900	-0.16000	-0.15300	-0.15000	-0.14800	-0.14000

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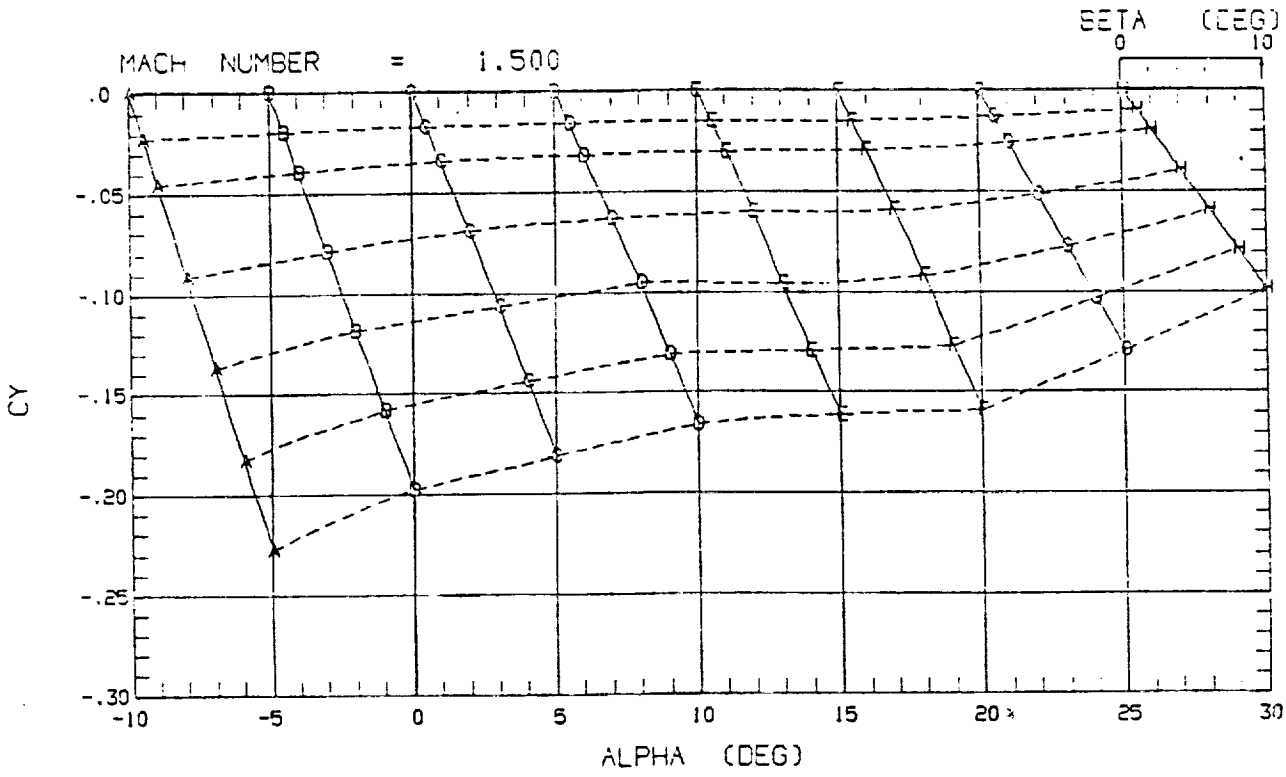
FIGURE 4.2.1.1- 11
BASIC SIDE FORCE COEFFICIENT



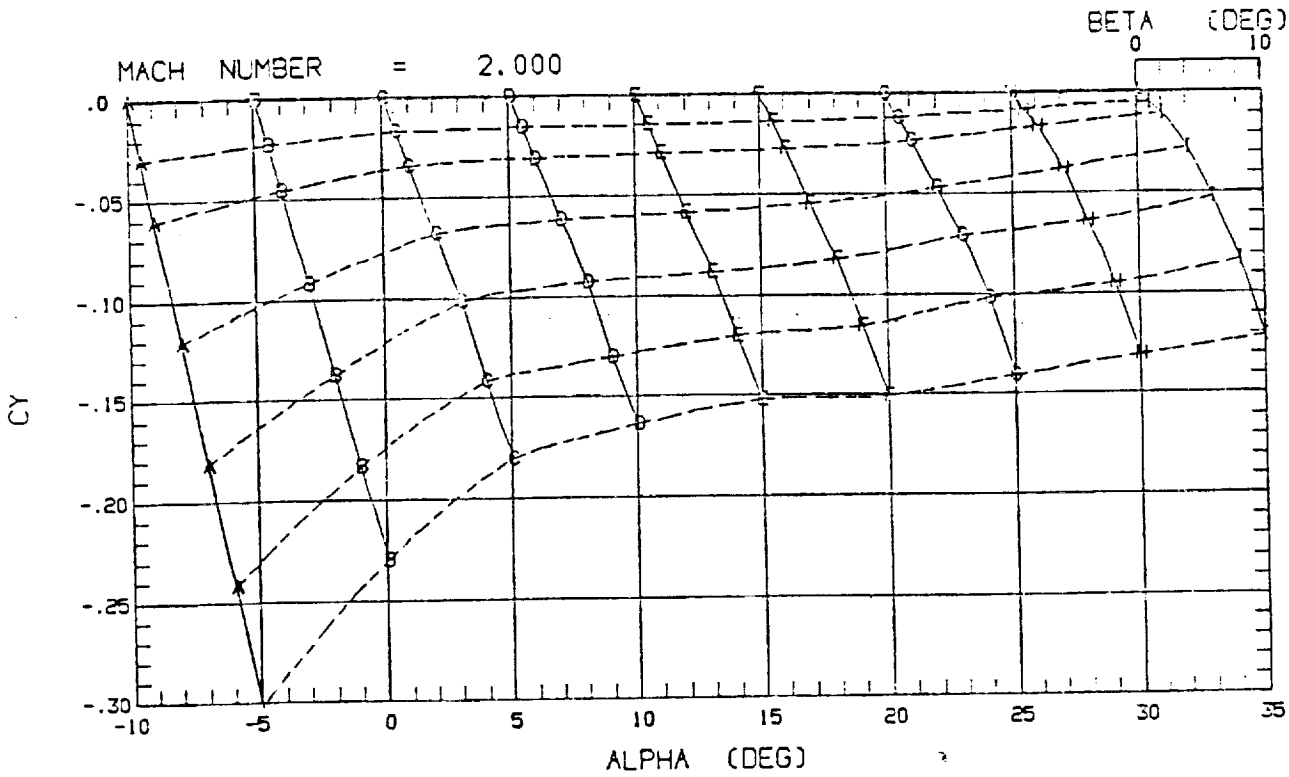
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02280	-0.01981	-0.01724	-0.01585	-0.01505	-0.01493	-0.01293	-0.00993
2.000	-0.04560	-0.03961	-0.03448	-0.03170	-0.03010	-0.02986	-0.02586	-0.01986
4.000	-0.09120	-0.07921	-0.06896	-0.06340	-0.06020	-0.05972	-0.05172	-0.03972
6.000	-0.13680	-0.11883	-0.10684	-0.09554	-0.09618	-0.09212	-0.07756	-0.05958
8.000	-0.18240	-0.15844	-0.14412	-0.13072	-0.12824	-0.12716	-0.10344	-0.07944
10.000	-0.22800	-0.19807	-0.18140	-0.16530	-0.16130	-0.15920	-0.12933	-0.09930

ENGINEER
DATE 9-13-82

FIGURE 4.2.1.1-12
BASIC SIDE FORCE COEFFICIENT



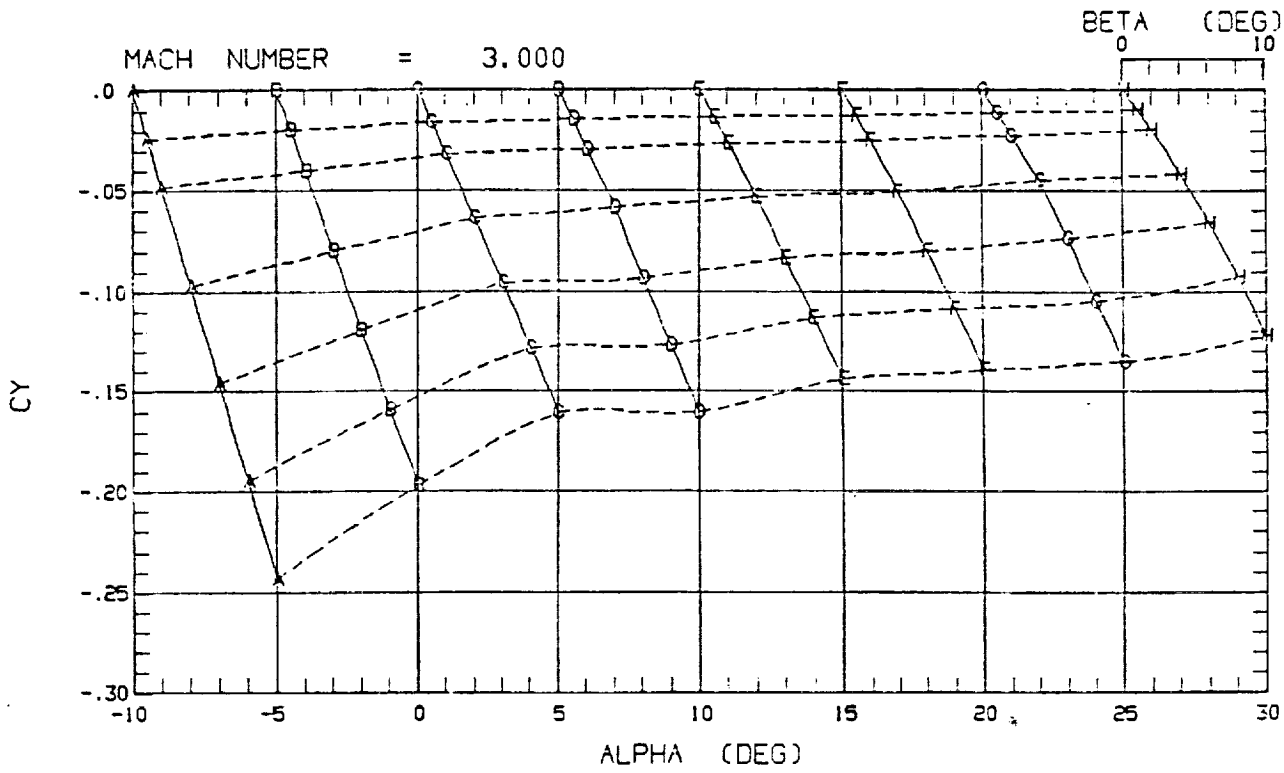
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.03027	-0.02298	-0.01698	-0.01548	-0.01465	-0.01371	-0.01186	-0.00800	-0.00500
2.000	-0.06054	-0.04596	-0.03396	-0.03096	-0.02930	-0.02742	-0.02372	-0.01664	-0.01096
4.000	-0.12108	-0.09192	-0.06792	-0.06192	-0.05860	-0.05484	-0.04744	-0.03771	-0.02814
6.000	-0.18162	-0.13788	-0.10188	-0.09288	-0.08655	-0.08226	-0.07116	-0.06382	-0.05234
8.000	-0.24216	-0.18384	-0.14166	-0.12984	-0.12045	-0.11608	-0.10228	-0.09499	-0.08356
10.000	-0.30270	-0.22980	-0.18080	-0.16380	-0.15245	-0.15110	-0.14060	-0.13120	-0.12190

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.1-13
BASIC SIDE FORCE COEFFICIENT

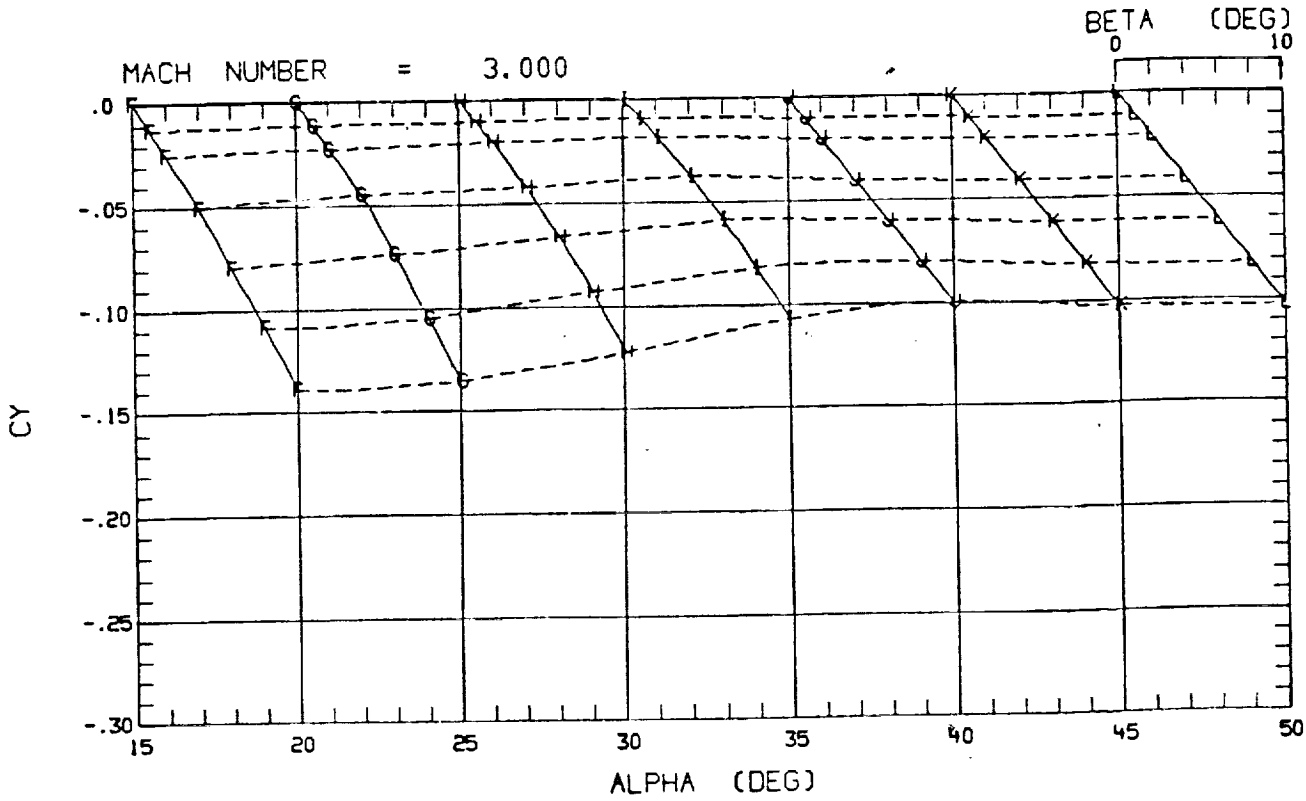


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02430	-0.02017	-0.01604	-0.01466	-0.01338	-0.01267	-0.01125	-0.01000
2.000	-0.04660	-0.04033	-0.03209	-0.02932	-0.02676	-0.02534	-0.02250	-0.02000
4.000	-0.09723	-0.08029	-0.06416	-0.05864	-0.05352	-0.05067	-0.04500	-0.04189
6.000	-0.14591	-0.11976	-0.09624	-0.08796	-0.08348	-0.08022	-0.07390	-0.06631
8.000	-0.19463	-0.15876	-0.12832	-0.12728	-0.11364	-0.10896	-0.10520	-0.09324
10.000	-0.24340	-0.19727	-0.16040	-0.16060	-0.14380	-0.13970	-0.13550	-0.12270

ENGINEER [illegible]
DATE 10-3-78

FIGURE 4.2.1.1-14
BASIC SIDE FORCE COEFFICIENT



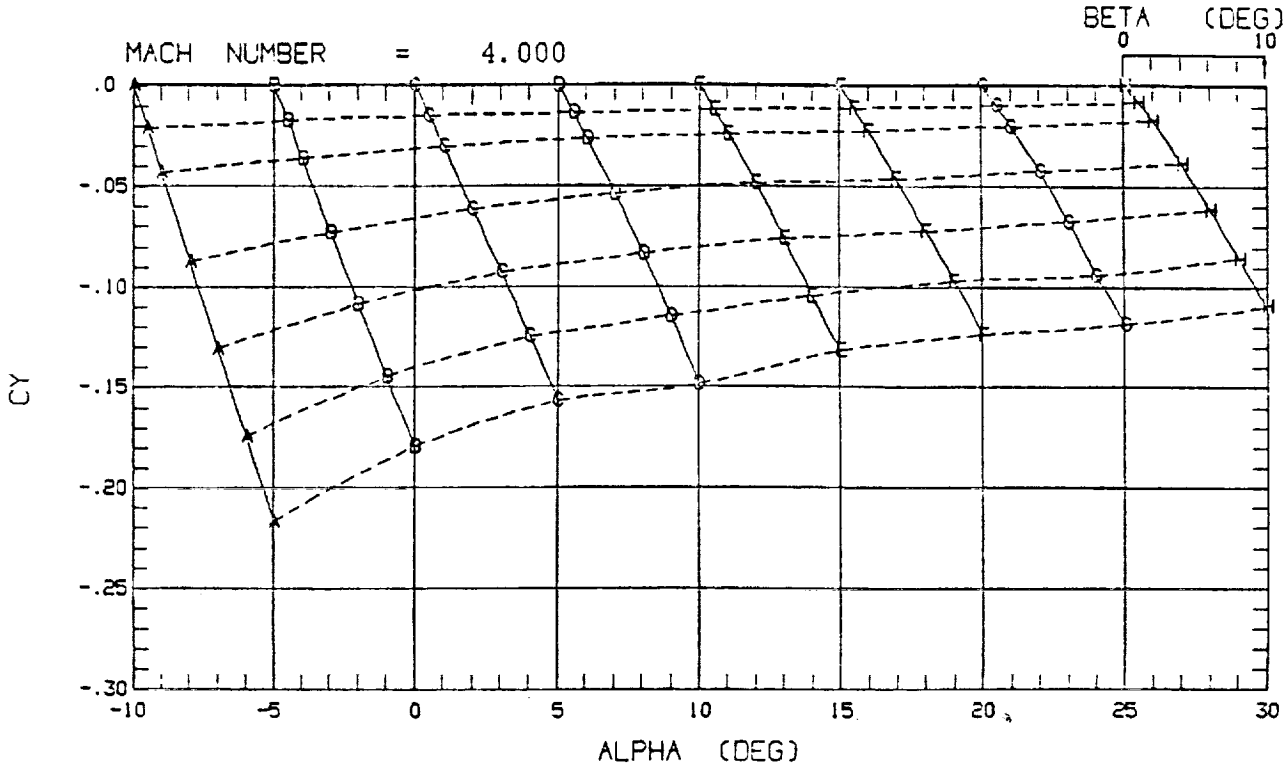
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01267	-0.01125	-0.01000	-0.00900	-0.01000	-0.01030	-0.01030
2.000	-0.02534	-0.02250	-0.02000	-0.01800	-0.02000	-0.02060	-0.02060
4.000	-0.05067	-0.04500	-0.04189	-0.03742	-0.04000	-0.04120	-0.04120
6.000	-0.08022	-0.07390	-0.06631	-0.05872	-0.06000	-0.06180	-0.06180
8.000	-0.10896	-0.10520	-0.09324	-0.08192	-0.08000	-0.08240	-0.08240
10.000	-0.13970	-0.13550	-0.12270	-0.10700	-0.10000	-0.10300	-0.10300

ENGINEER LLL
DATE 10-3-78

FIGURE 4.2.1.1-15
BASIC SIDE FORCE COEFFICIENT

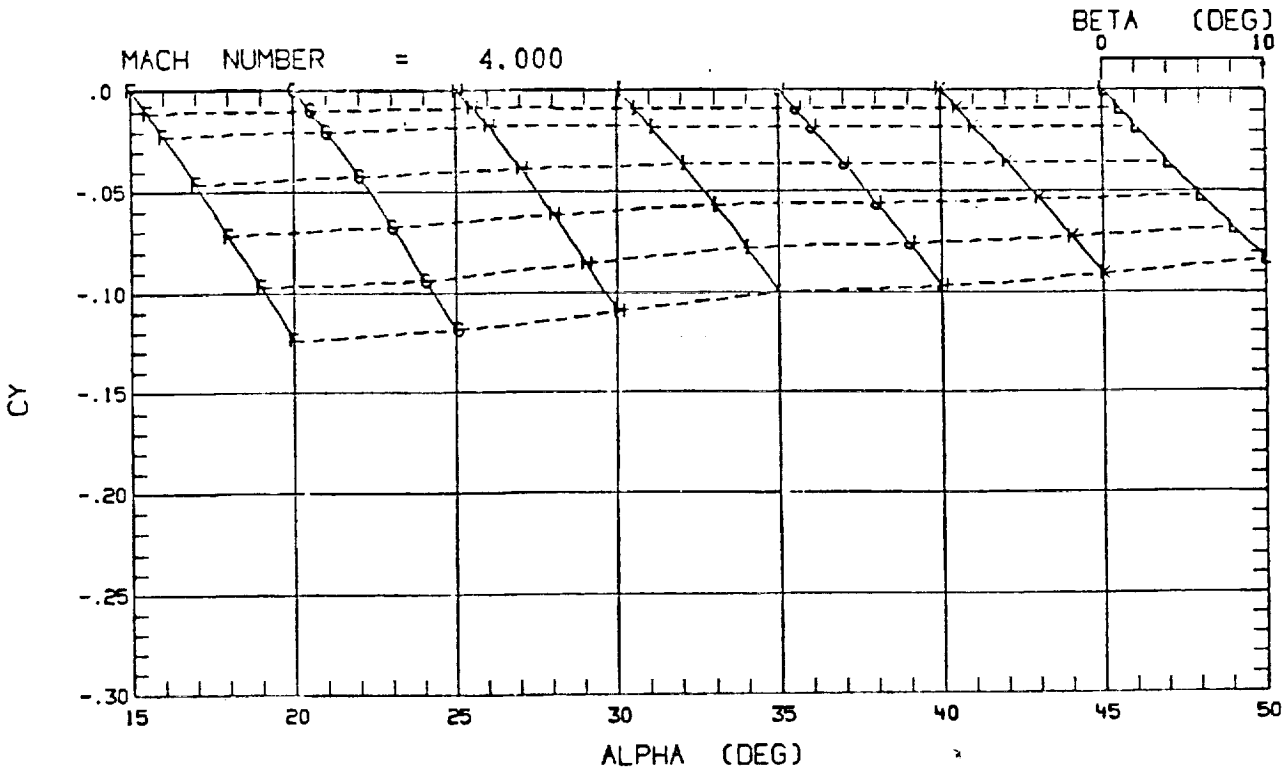


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02170	-0.01783	-0.01520	-0.01380	-0.01220	-0.01130	-0.01010	-0.00870
2.000	-0.04364	-0.03629	-0.03065	-0.02672	-0.02440	-0.02260	-0.02020	-0.01740
4.000	-0.08736	-0.07289	-0.06180	-0.05410	-0.04680	-0.04660	-0.04260	-0.03900
6.000	-0.13086	-0.10905	-0.09327	-0.08354	-0.07640	-0.07240	-0.06740	-0.06200
8.000	-0.17414	-0.14477	-0.12507	-0.11504	-0.10480	-0.09720	-0.09420	-0.08600
10.000	-0.21720	-0.18007	-0.15720	-0.14860	-0.13200	-0.12400	-0.11900	-0.11000

ENGINEER [illegible]
DATE 6-2-78

FIGURE 4.2.1.1-16
BASIC SIDE FORCE COEFFICIENT

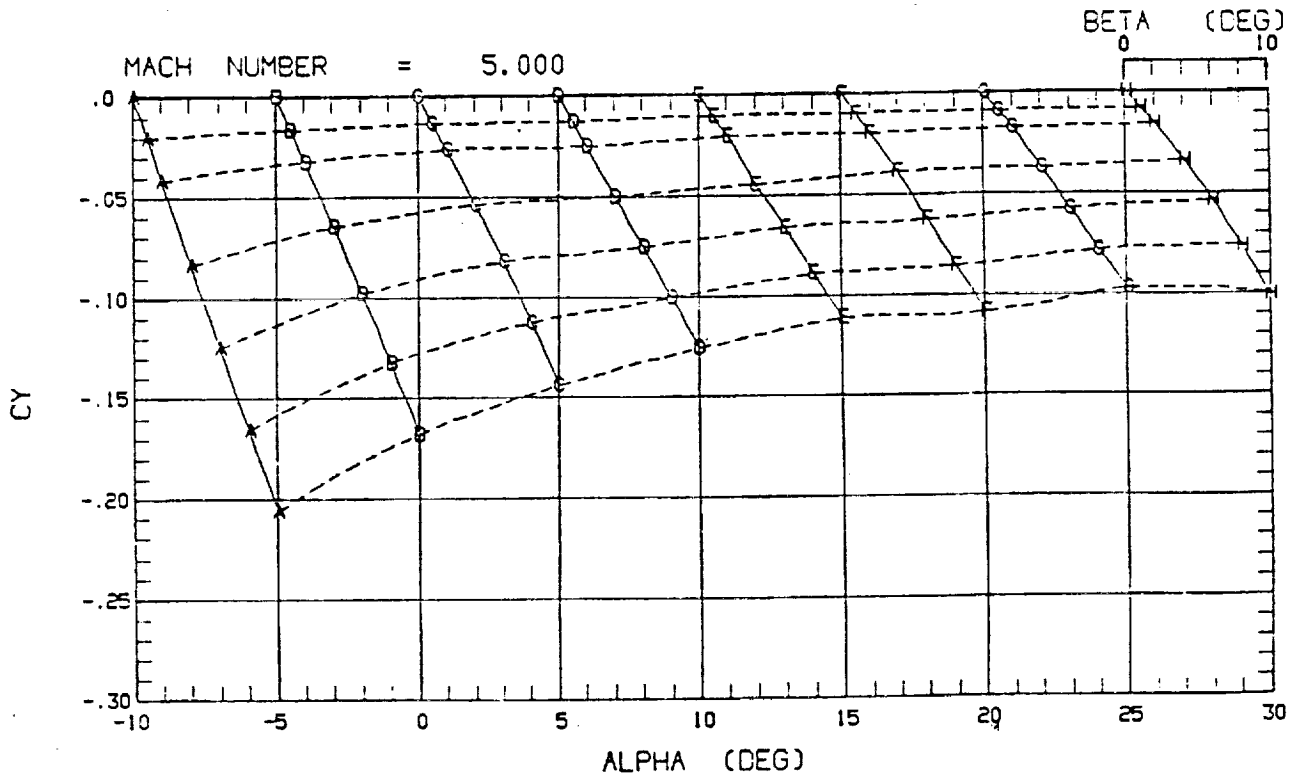


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01130	-0.01010	-0.00870	-0.00898	-0.00898	-0.00898	-0.00899
2.000	-0.02260	-0.02020	-0.01740	-0.01796	-0.01796	-0.01796	-0.01798
4.000	-0.04660	-0.04260	-0.03900	-0.03681	-0.03656	-0.03606	-0.03543
6.000	-0.07240	-0.06740	-0.06200	-0.05685	-0.05602	-0.05435	-0.05216
8.000	-0.09720	-0.09420	-0.08600	-0.07808	-0.07633	-0.07283	-0.06819
10.000	-0.12400	-0.11900	-0.11000	-0.10050	-0.09750	-0.09150	-0.08350

ENGINEER LL
DATE 10-3-78

FIGURE 4.2.1.1- 17
BASIC SIDE FORCE COEFFICIENT

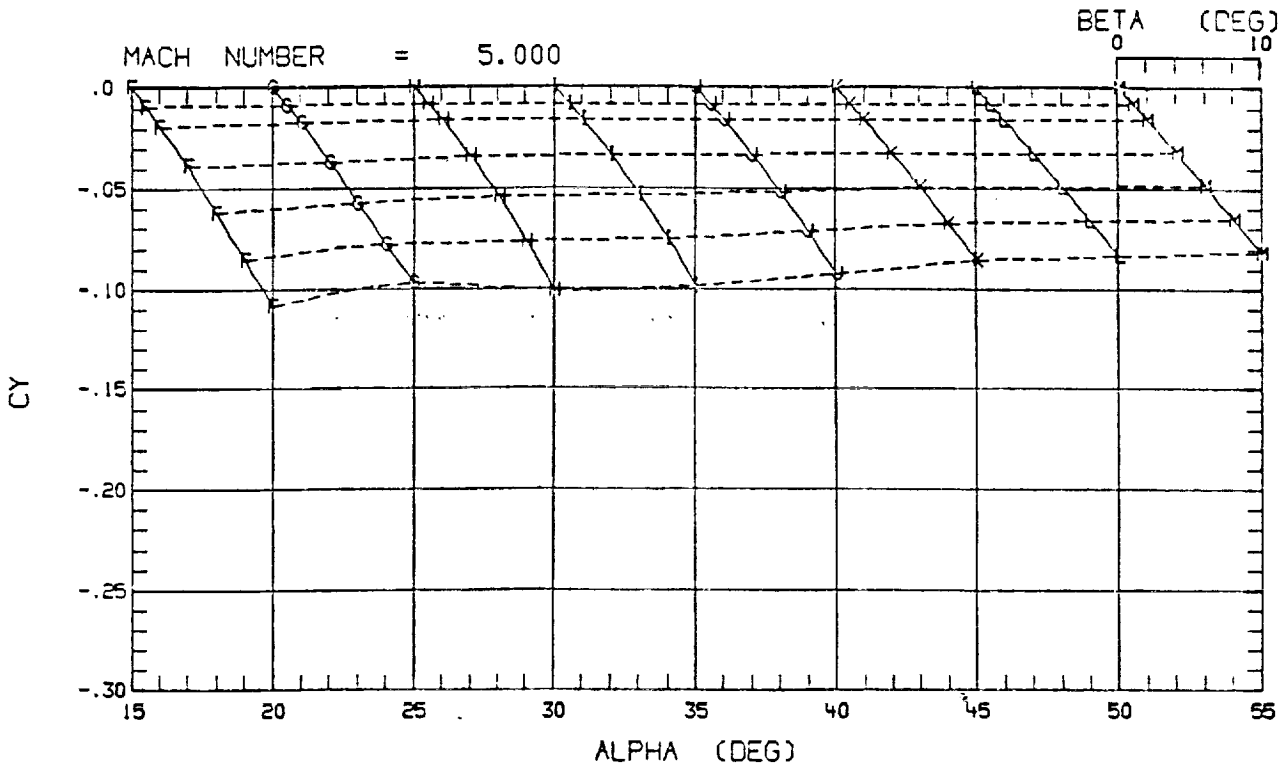


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.02060	-0.01650	-0.01400	-0.01257	-0.01045	-0.00972	-0.00877	-0.00812
2.000	-0.04162	-0.03239	-0.02682	-0.02514	-0.02090	-0.01944	-0.01754	-0.01624
4.000	-0.08380	-0.06487	-0.05369	-0.05028	-0.04460	-0.03888	-0.03710	-0.03415
6.000	-0.12516	-0.09829	-0.08219	-0.07543	-0.06590	-0.06270	-0.05760	-0.05430
8.000	-0.16594	-0.13264	-0.11233	-0.10057	-0.08920	-0.08600	-0.07820	-0.07668
10.000	-0.20610	-0.16793	-0.14410	-0.12570	-0.11150	-0.10920	-0.09770	-0.10130

ENGINEER
DATE 10-3-08

FIGURE 4.2.1.1-18
BASIC SIDE FORCE COEFFICIENT

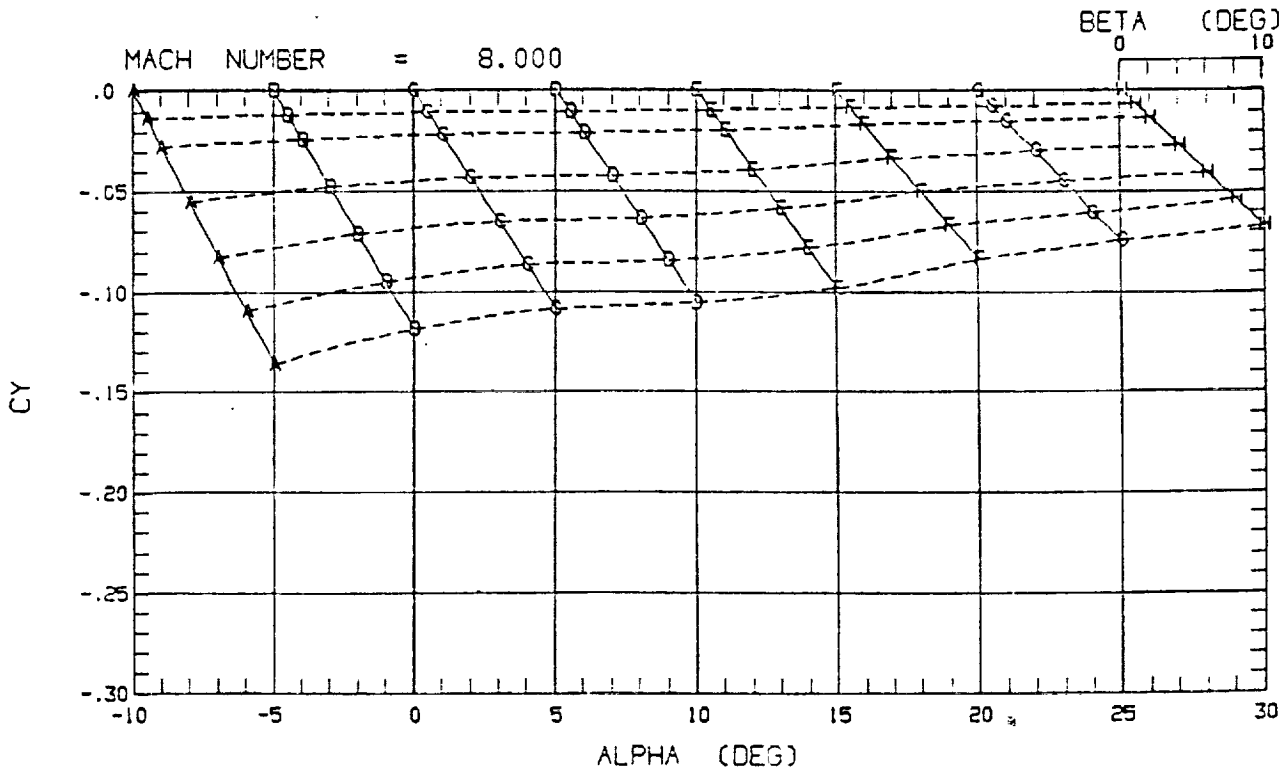


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00972	-0.00877	-0.00812	-0.00803	-0.00803	-0.00804	-0.00805	-0.00806
2.000	-0.01944	-0.01754	-0.01624	-0.01606	-0.01606	-0.01608	-0.01610	-0.01612
4.000	-0.03888	-0.03710	-0.03416	-0.03368	-0.03318	-0.03263	-0.03249	-0.03236
6.000	-0.06270	-0.05760	-0.05430	-0.05337	-0.05171	-0.04980	-0.04927	-0.04875
8.000	-0.08600	-0.07820	-0.07668	-0.07515	-0.07165	-0.06759	-0.06644	-0.06530
10.000	-0.10920	-0.09770	-0.10130	-0.09900	-0.09300	-0.08800	-0.08400	-0.08200

ENGINEER
DATE 6-3-75

FIGURE 4.2.1.1-19
BASIC SIDE FORCE COEFFICIENT

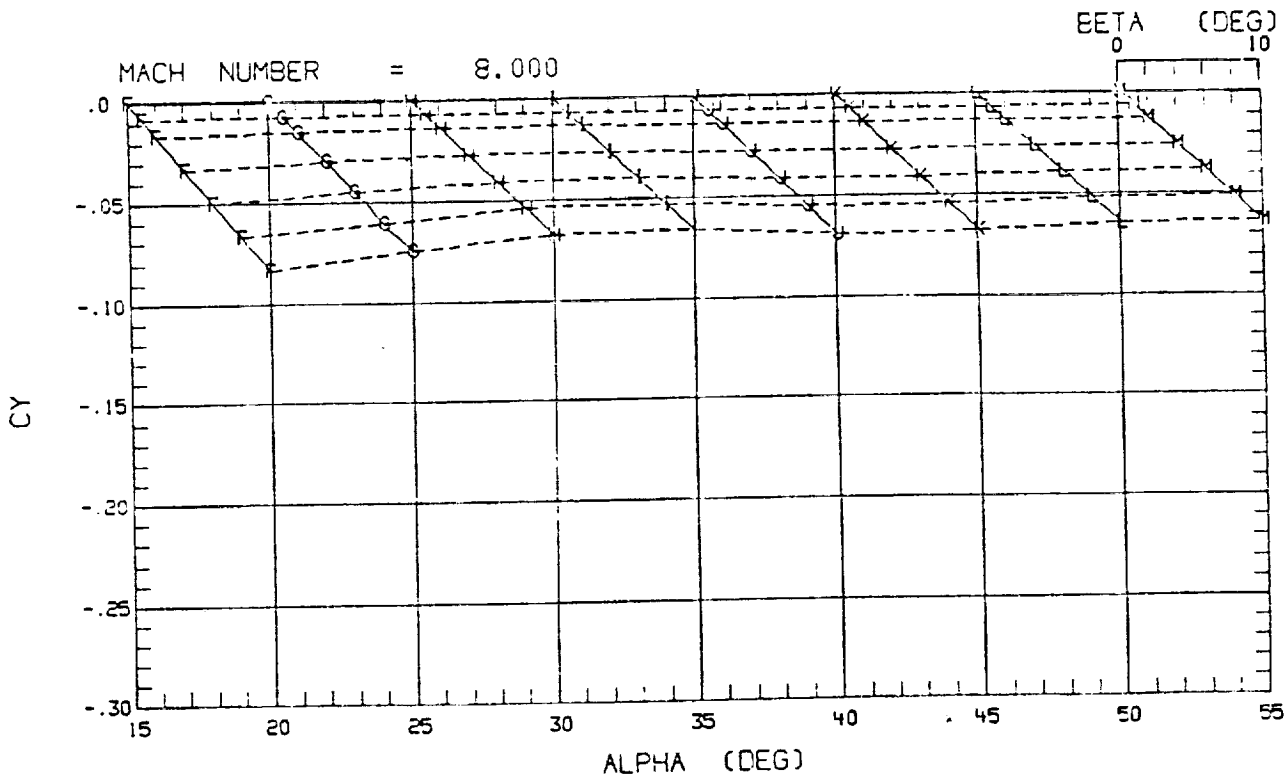


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01400	-0.01202	-0.01069	-0.01060	-0.00981	-0.00840	-0.00750	-0.00680
2.000	-0.02800	-0.02405	-0.02178	-0.02120	-0.01962	-0.01689	-0.01500	-0.01360
4.000	-0.05567	-0.04799	-0.04356	-0.04240	-0.03924	-0.03380	-0.03000	-0.02720
6.000	-0.08289	-0.07178	-0.06534	-0.06360	-0.05886	-0.05062	-0.04500	-0.04080
8.000	-0.10967	-0.09542	-0.08712	-0.08480	-0.07848	-0.06736	-0.06080	-0.05440
10.000	-0.13600	-0.11890	-0.10890	-0.10600	-0.09810	-0.08400	-0.07500	-0.06800

ENGINEER
DATE 10-3-85

FIGURE 4.2.1.1-20
BASIC SIDE FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

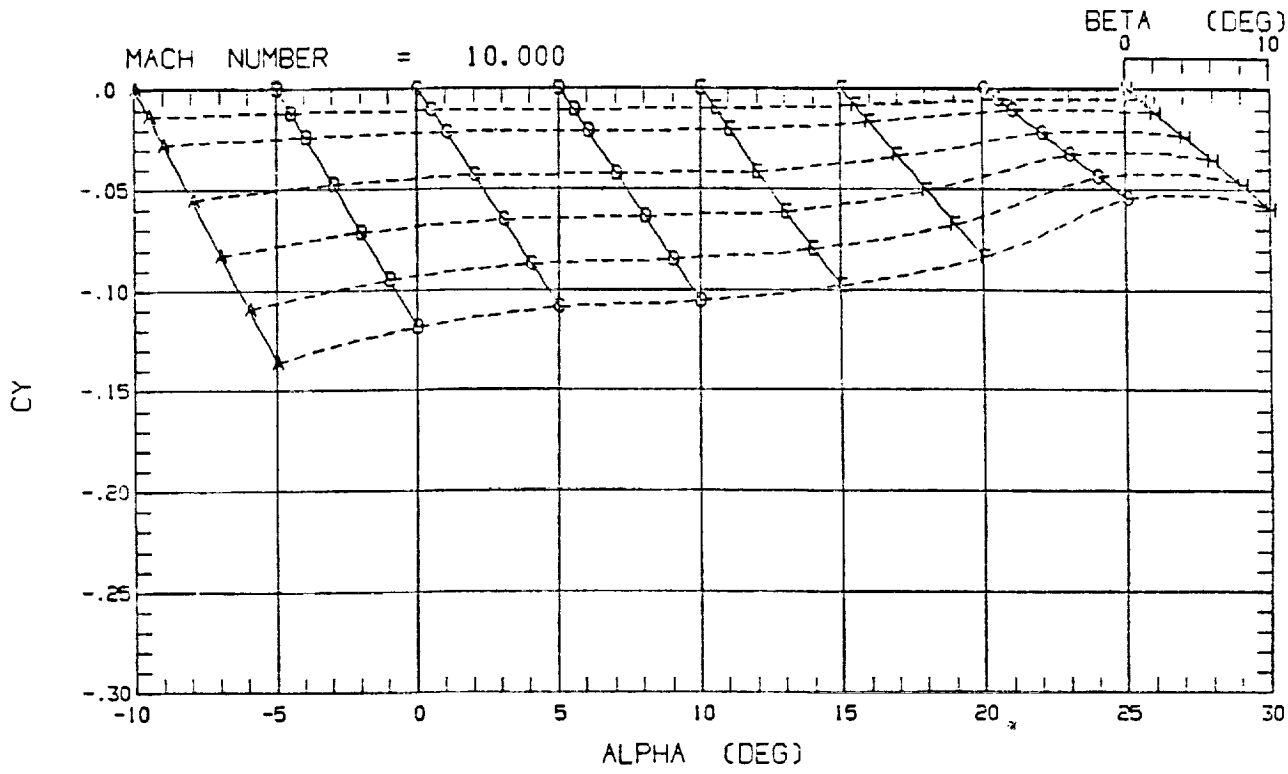
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00640	-0.00750	-0.00680	-0.00665	-0.00690	-0.00680	-0.00650	-0.00640
2.000	-0.01689	-0.01500	-0.01360	-0.01330	-0.01380	-0.01360	-0.01300	-0.01280
4.000	-0.03380	-0.03000	-0.02720	-0.02660	-0.02760	-0.02720	-0.02600	-0.02560
6.000	-0.05062	-0.04500	-0.04080	-0.03990	-0.04140	-0.04080	-0.03900	-0.03840
8.000	-0.06736	-0.06080	-0.05440	-0.05320	-0.05520	-0.05440	-0.05200	-0.05120
10.000	-0.08400	-0.07500	-0.06800	-0.06650	-0.06900	-0.06800	-0.06500	-0.06400

ENGINEER LLL
DATE 5-3-85

FIGURE 4.2.1.1-21
BASIC SIDE FORCE COEFFICIENT

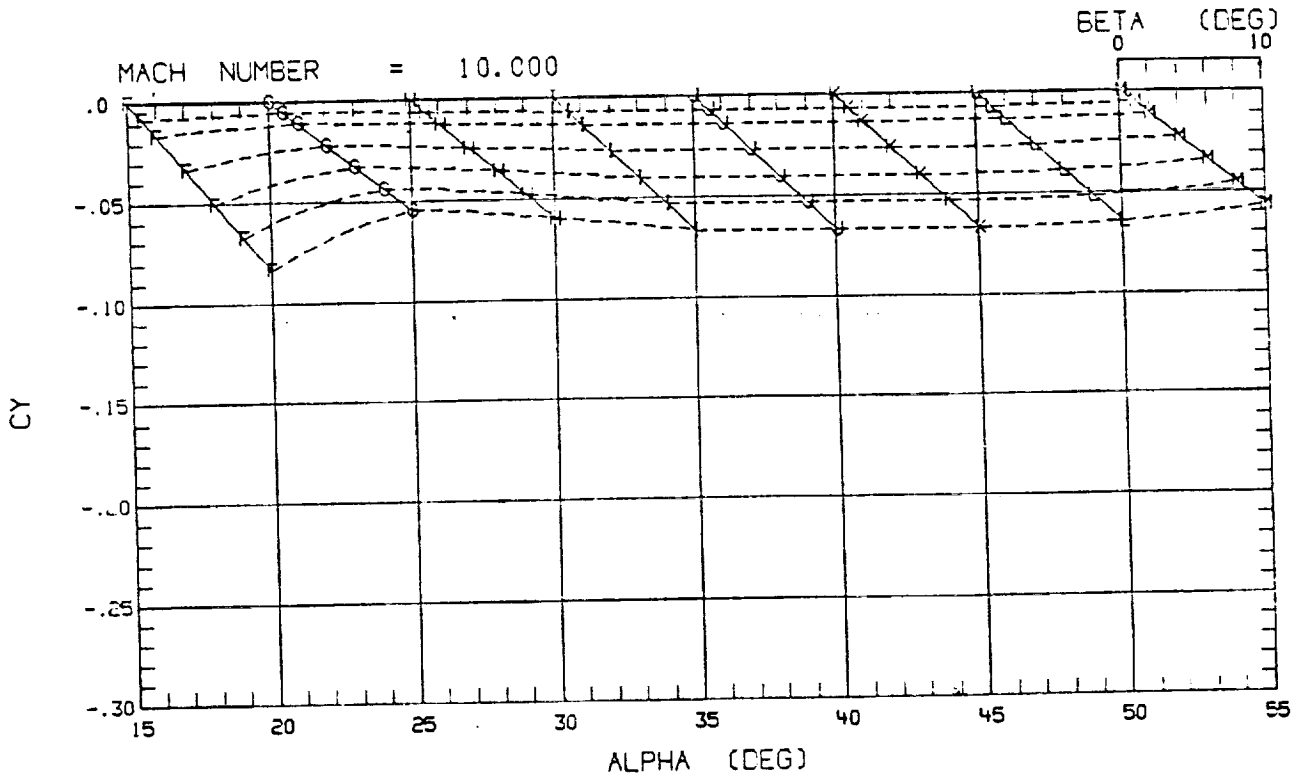


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01400	-0.01202	-0.01089	-0.01060	-0.00981	-0.00840	-0.00550	-0.00600
2.000	-0.02900	-0.02407	-0.02182	-0.02124	-0.02066	-0.01689	-0.01100	-0.01200
4.000	-0.05567	-0.04805	-0.04367	-0.04251	-0.04158	-0.03381	-0.02200	-0.02400
6.000	-0.08289	-0.07187	-0.06550	-0.06376	-0.06146	-0.05065	-0.03300	-0.03500
8.000	-0.10967	-0.09553	-0.08731	-0.08499	-0.08030	-0.06742	-0.04400	-0.04800
10.000	-0.13600	-0.11903	-0.10910	-0.10620	-0.09810	-0.08410	-0.05500	-0.06000

ENGINEER
DATE 10-3-05

FIGURE 4.2.1.1-22
BASIC SIDE FORCE COEFFICIENT



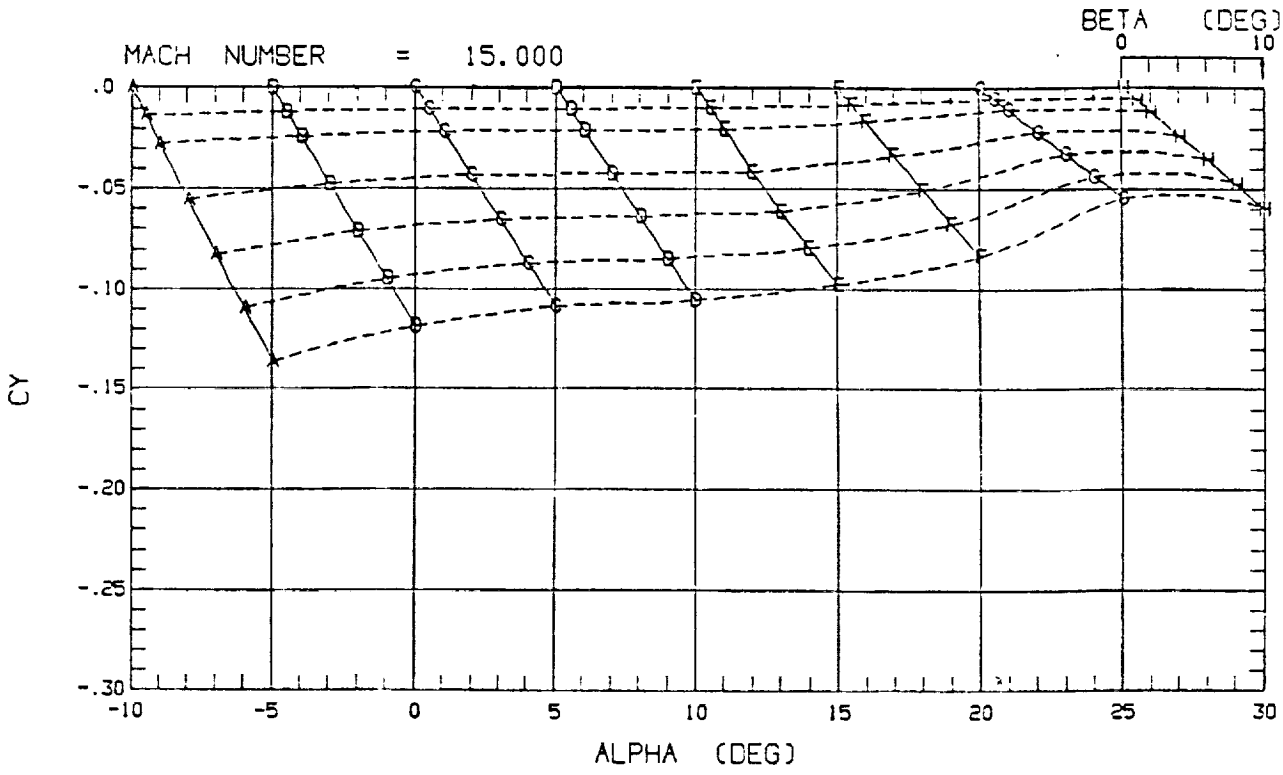
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00840	-0.00550	-0.00600	-0.00670	-0.00670	-0.00670	-0.00649	-0.00570
2.000	-0.01689	-0.01100	-0.01200	-0.01340	-0.01340	-0.01340	-0.01298	-0.01140
4.000	-0.03381	-0.02200	-0.02400	-0.02680	-0.02680	-0.02680	-0.02596	-0.02280
6.000	-0.05065	-0.03300	-0.03600	-0.04020	-0.04020	-0.04020	-0.03890	-0.03420
8.000	-0.06742	-0.04400	-0.04800	-0.05360	-0.05360	-0.05360	-0.05190	-0.04550
10.000	-0.08410	-0.05500	-0.06000	-0.06700	-0.06700	-0.06700	-0.06490	-0.05700

ENGINEER [illegible]
DATE 10-3-15

FIGURE 4.2.1.1-23
BASIC SIDE FORCE COEFFICIENT

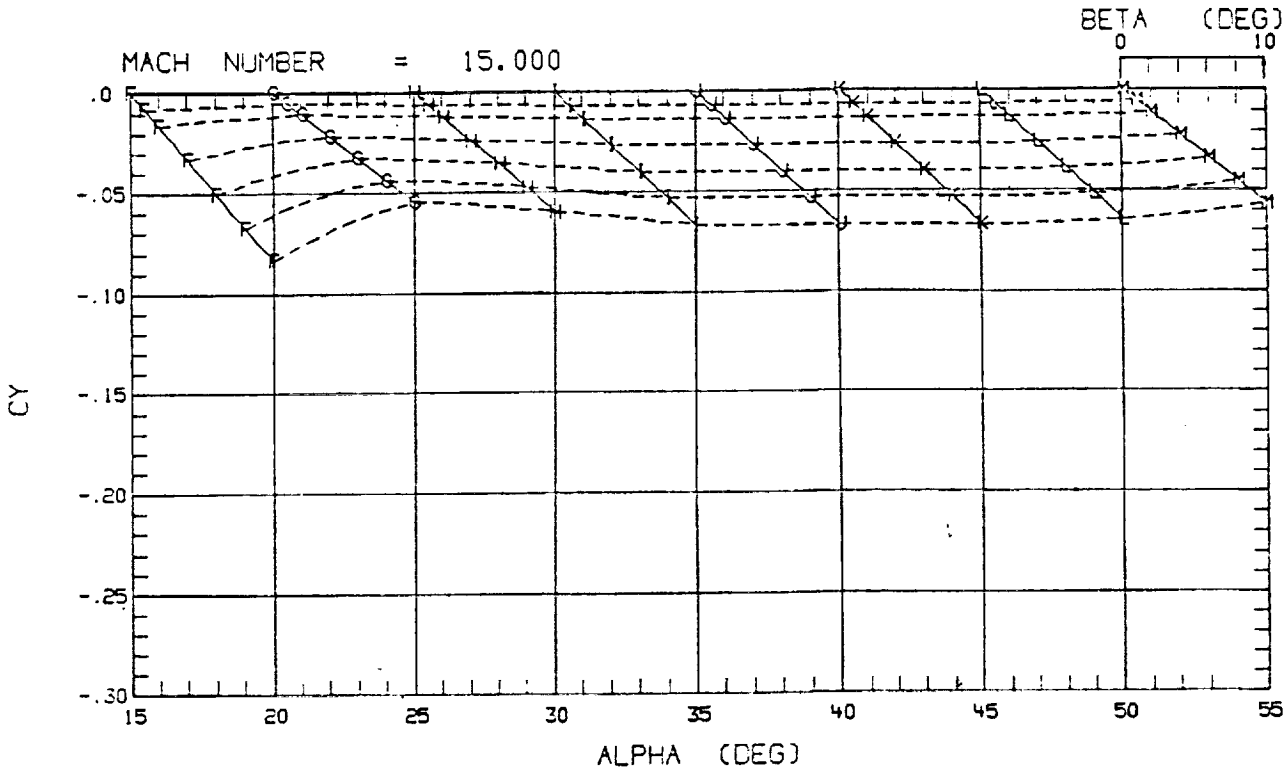


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01400	-0.01202	-0.01089	-0.01060	-0.00981	-0.00840	-0.00550	-0.00600
2.000	-0.02800	-0.02407	-0.02182	-0.02124	-0.02066	-0.01689	-0.01100	-0.01200
4.000	-0.05567	-0.04805	-0.04367	-0.04251	-0.04159	-0.03381	-0.02200	-0.02400
6.000	-0.08289	-0.07197	-0.06550	-0.06376	-0.06146	-0.05065	-0.03300	-0.03600
8.000	-0.10967	-0.09553	-0.08731	-0.08499	-0.08030	-0.06742	-0.04400	-0.04800
10.000	-0.13600	-0.11903	-0.10910	-0.10620	-0.09810	-0.08410	-0.05500	-0.06000

ENGINEER
DATE 10-3-78

FIGURE 4.2.1.1-24
. BASIC SIDE FORCE COEFFICIENT

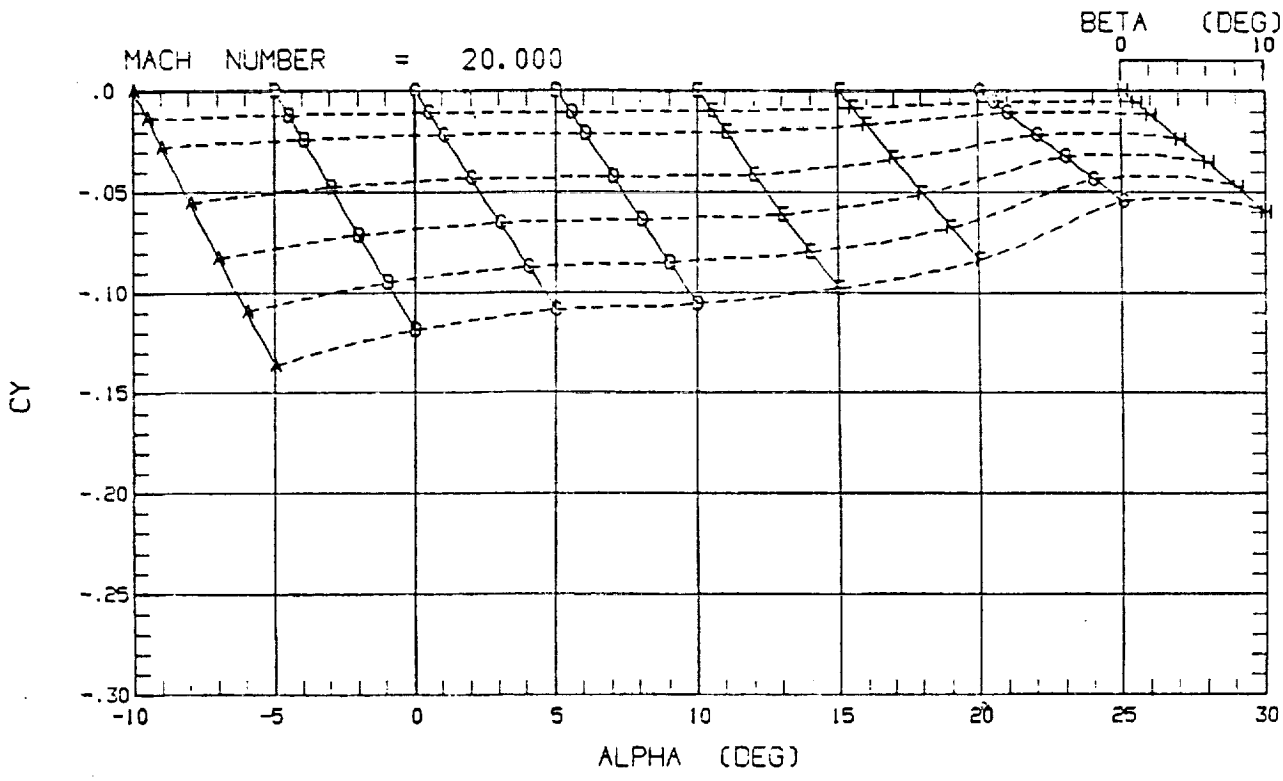


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00840	-0.00550	-0.00600	-0.00670	-0.00670	-0.00670	-0.00649	-0.00570
2.000	-0.01689	-0.01100	-0.01200	-0.01340	-0.01340	-0.01340	-0.01298	-0.01140
4.000	-0.03381	-0.02200	-0.02400	-0.02680	-0.02680	-0.02680	-0.02596	-0.02280
6.000	-0.05065	-0.03300	-0.03600	-0.04020	-0.04020	-0.04020	-0.03890	-0.03420
8.000	-0.06742	-0.04400	-0.04800	-0.05360	-0.05360	-0.05360	-0.05190	-0.04560
10.000	-0.08410	-0.05500	-0.06000	-0.06700	-0.06700	-0.06700	-0.06490	-0.05700

ENGINEER
DATE

FIGURE 4.2.1.1-25
BASIC SIDE FORCE COEFFICIENT

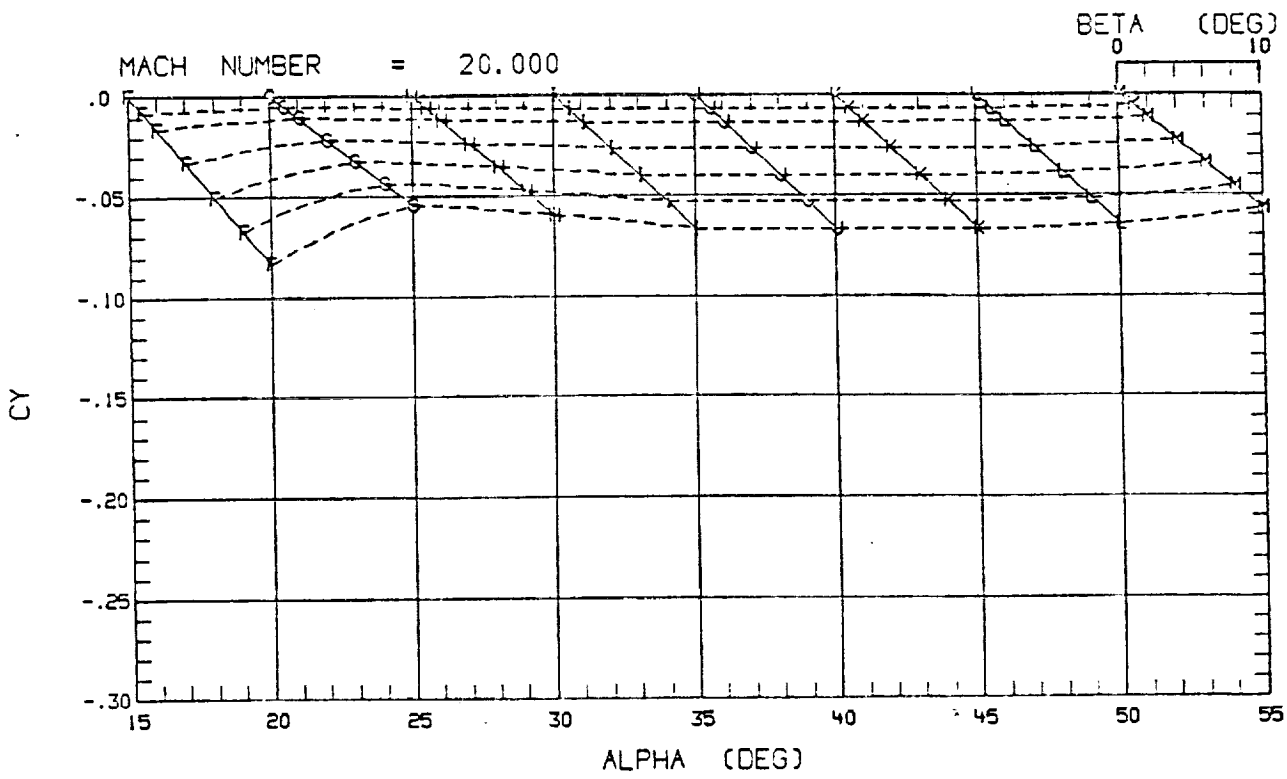


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1075.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.01400	-0.01202	-0.01089	-0.01060	-0.00981	-0.00840	-0.00550	-0.00600
2.000	-0.02800	-0.02407	-0.02182	-0.02124	-0.02066	-0.01689	-0.01100	-0.01200
4.000	-0.05567	-0.04805	-0.04367	-0.04251	-0.04158	-0.03381	-0.02200	-0.02400
6.000	-0.08289	-0.07187	-0.06550	-0.06376	-0.06146	-0.05065	-0.03300	-0.03600
8.000	-0.10967	-0.09553	-0.08731	-0.08499	-0.08030	-0.06742	-0.04400	-0.04800
10.000	-0.13600	-0.11903	-0.10910	-0.10620	-0.09810	-0.08410	-0.05500	-0.06000

ENGINEER
DATE 10-30-85

FIGURE 4.2.1.1-26
BASIC SIDE FORCE COEFFICIENT

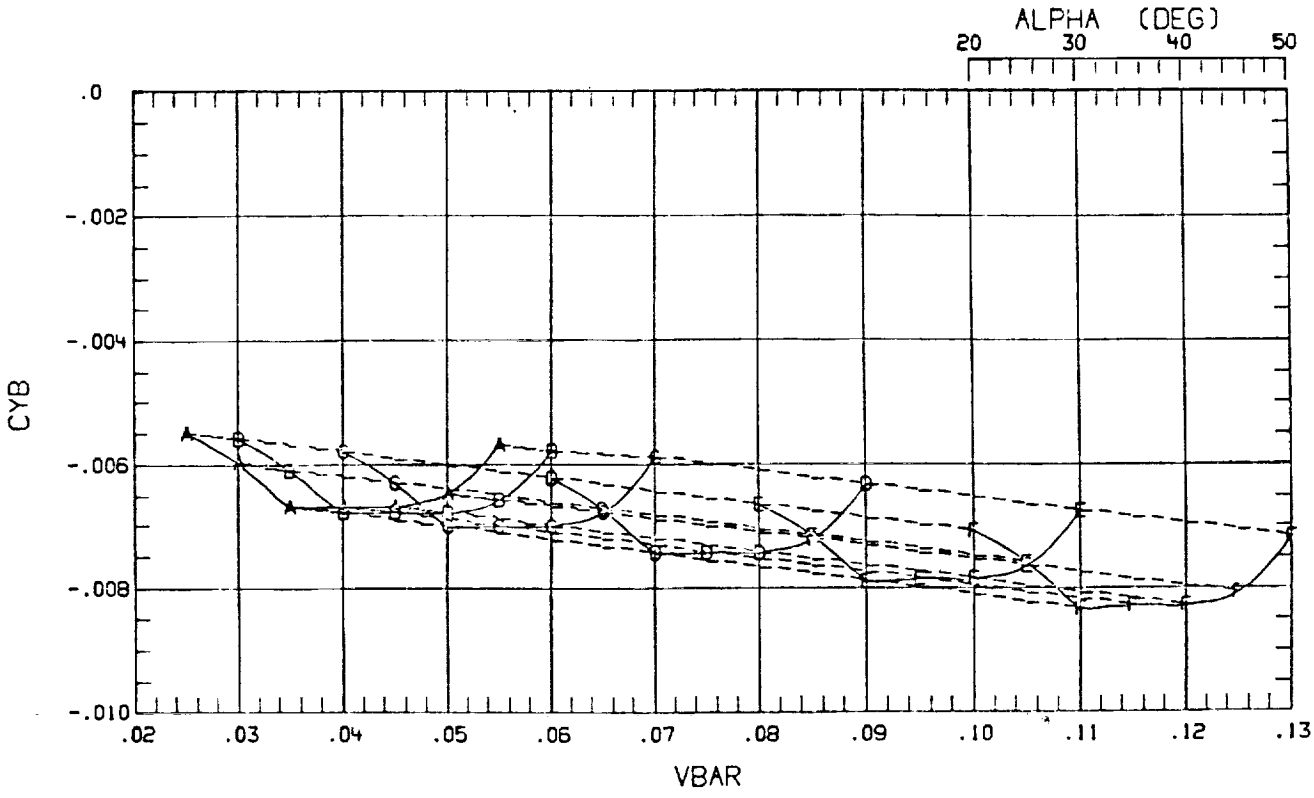


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC SIDE FORCE COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00840	-0.00550	-0.00600	-0.00670	-0.00670	-0.00670	-0.00649	-0.00570
2.000	-0.01689	-0.01100	-0.01200	-0.01340	-0.01340	-0.01340	-0.01298	-0.01140
4.000	-0.03381	-0.02200	-0.02400	-0.02680	-0.02680	-0.02680	-0.02596	-0.02280
6.000	-0.05065	-0.03300	-0.03600	-0.04020	-0.04020	-0.04020	-0.03890	-0.03420
8.000	-0.06742	-0.04400	-0.04800	-0.05360	-0.05360	-0.05360	-0.05190	-0.04560
10.000	-0.08410	-0.05500	-0.06000	-0.06700	-0.06700	-0.06700	-0.05490	-0.05700

ENGINEER
DATE 10-22-75

FIGURE 4.2.1.1-27
BASIC SIDE FORCE COEFFICIENT

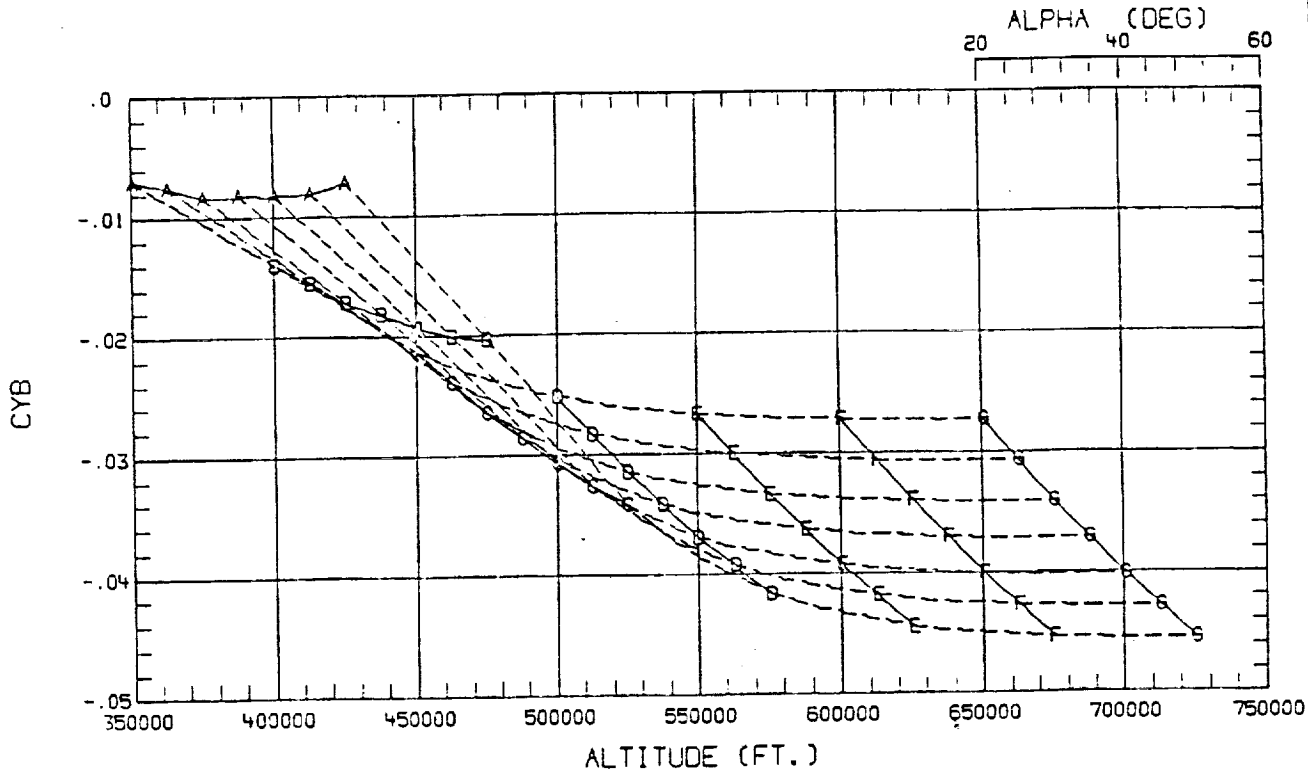


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005	0.010	0.020	0.040	0.060	0.080
	A	B	C	D	E	F
ALPHA (DEG)	VISCOUS SIDE FORCE DERIVATIVE					
20.000	-0.00550	-0.00561	-0.00582	-0.00625	-0.00668	-0.00711
25.000	-0.00500	-0.00611	-0.00632	-0.00675	-0.00718	-0.00761
30.000	-0.00670	-0.00681	-0.00703	-0.00747	-0.00791	-0.00835
35.000	-0.00670	-0.00681	-0.00702	-0.00745	-0.00788	-0.00831
40.000	-0.00670	-0.00681	-0.00702	-0.00745	-0.00788	-0.00831
45.000	-0.00649	-0.00660	-0.00681	-0.00724	-0.00767	-0.00810
50.000	-0.00570	-0.00581	-0.00581	-0.00634	-0.00677	-0.00720

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-28
BASIC SIDE FORCE COEFFICIENT



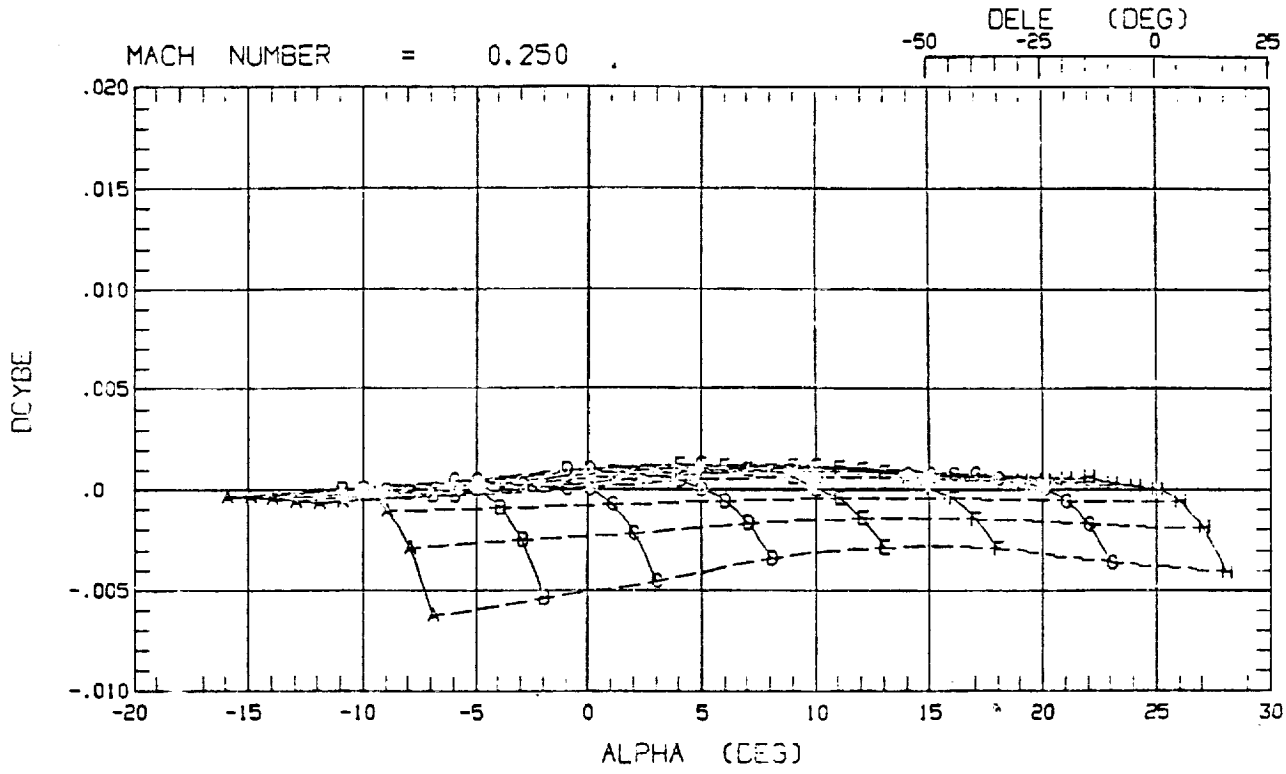
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALT. SIDE FORCE DERIVATIVE						
20.000	-0.00710	-0.01411	-0.02141	-0.02531	-0.02679	-0.02726	-0.02733
25.000	-0.00761	-0.01561	-0.02396	-0.02842	-0.03011	-0.03065	-0.03073
30.000	-0.00935	-0.01728	-0.02658	-0.03156	-0.03344	-0.03404	-0.03413
35.000	-0.00831	-0.01831	-0.02873	-0.03430	-0.03641	-0.03708	-0.03718
40.000	-0.00831	-0.01936	-0.03088	-0.03705	-0.03938	-0.04012	-0.04023
45.000	-0.00810	-0.02014	-0.03269	-0.03940	-0.04194	-0.04275	-0.04287
50.000	-0.00720	-0.02047	-0.03429	-0.04169	-0.04449	-0.04537	-0.04551

ENGINEER
DATE 10-[illegible]-78

FIGURE 4.2.1.1-29
BASIC SIDE FORCE COEFFICIENT

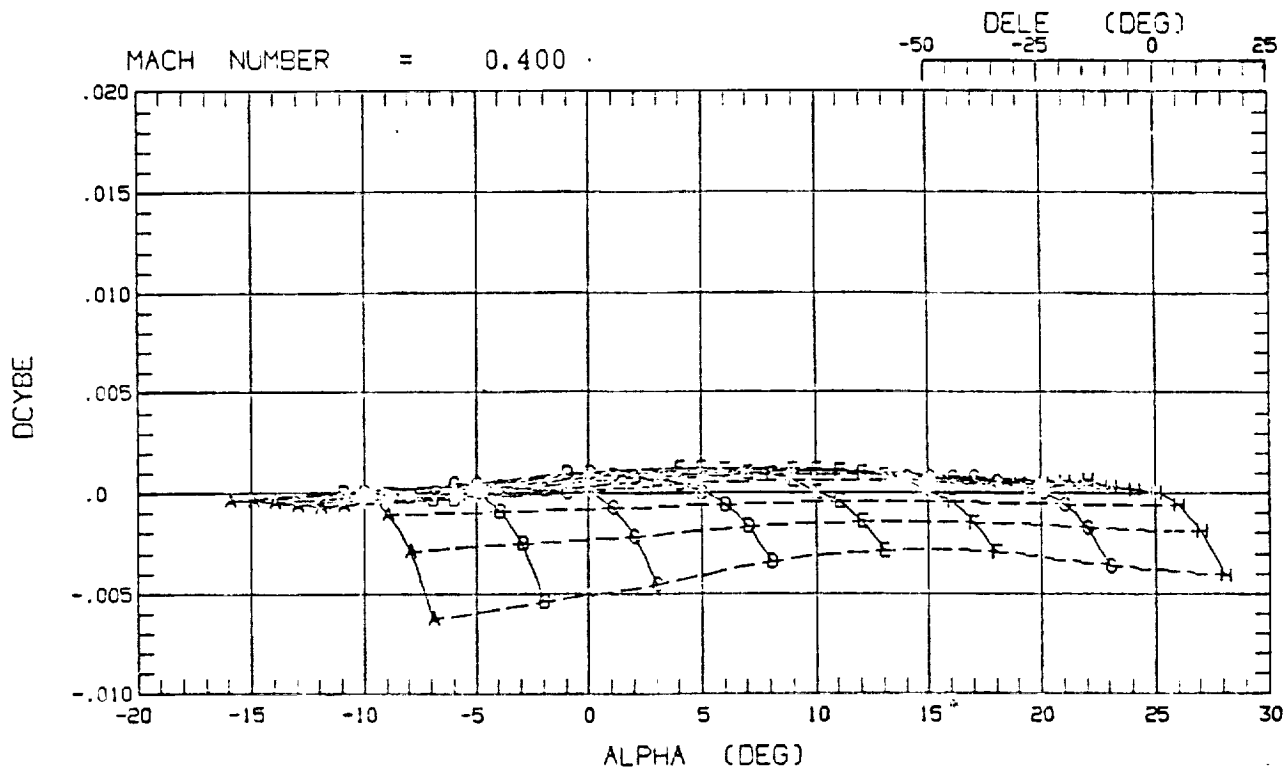


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	-0.00040	0.0	0.00040	0.00096	0.00120	0.00111	0.00070	0.00045
-25.000	-0.00040	0.0	0.00040	0.00096	0.00120	0.00111	0.00070	0.00045
-20.000	-0.00050	-0.00010	0.00030	0.00085	0.00110	0.00105	0.00070	0.00050
-15.000	-0.00060	-0.00020	0.00020	0.00074	0.00100	0.00099	0.00070	0.00055
-10.000	-0.00070	-0.00030	0.00010	0.00065	0.00090	0.00085	0.00050	0.00030
-5.000	-0.00060	-0.00030	0.0	0.00041	0.00060	0.00056	0.00030	0.00015
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00110	-0.00095	-0.00080	-0.00060	-0.00050	-0.00050	-0.00060	-0.00065
10.000	-0.00290	-0.00255	-0.00220	-0.00172	-0.00150	-0.00152	-0.00160	-0.00195
15.000	-0.00630	-0.00545	-0.00460	-0.00344	-0.00290	-0.00299	-0.00370	-0.00410

ENGINEER HP
DATE 10/31/78

FIGURE 4.2.1.1-30
EFFECT OF ELEVON



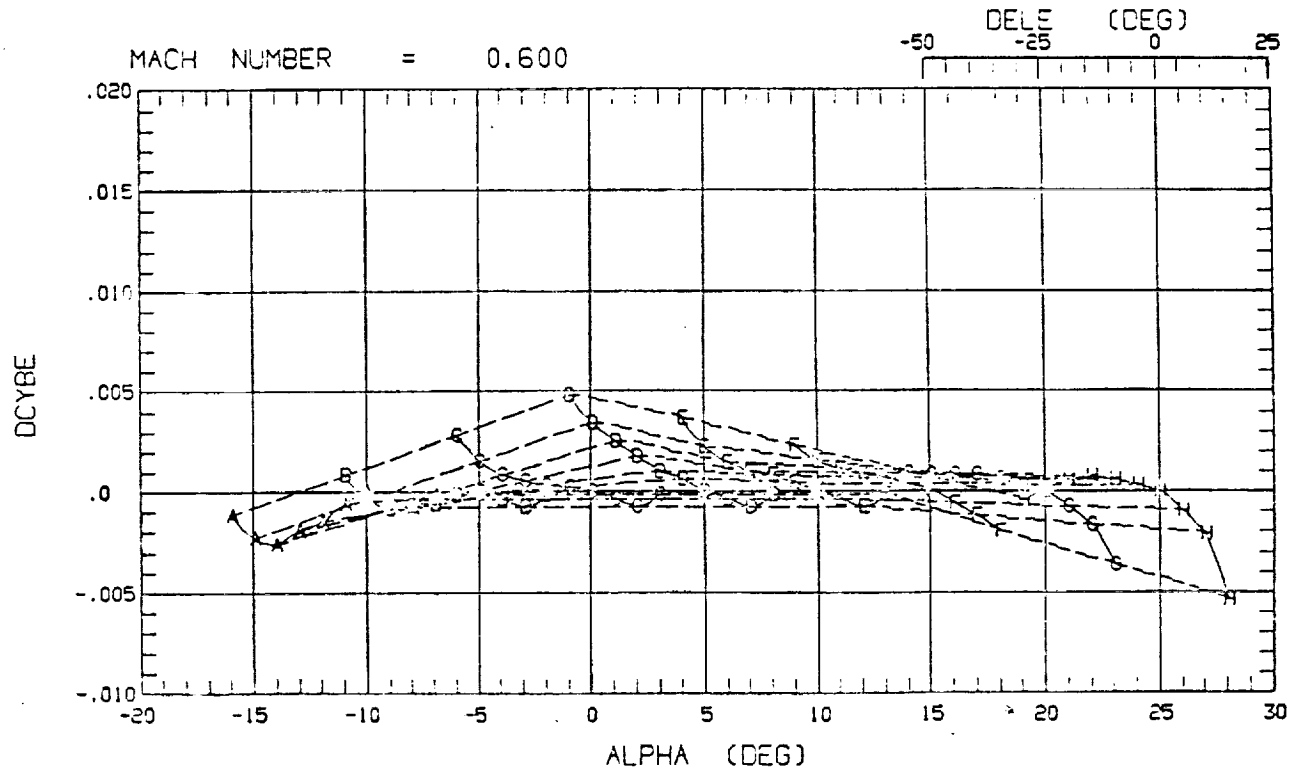
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	-0.00040	0.0	0.00040	0.00096	0.00120	0.00111	0.00070	0.00045
-25.000	-0.00040	0.0	0.00040	0.00096	0.00120	0.00111	0.00070	0.00045
-20.000	-0.00050	-0.00010	0.00030	0.00085	0.00110	0.00105	0.00070	0.00050
-15.000	-0.00060	-0.00020	0.00020	0.00074	0.00100	0.00099	0.00070	0.00055
-10.000	-0.00070	-0.00030	0.00010	0.00065	0.00090	0.00085	0.00050	0.00030
-5.000	-0.00060	-0.00030	0.0	0.00041	0.00060	0.00056	0.00030	0.00015
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00110	-0.00095	-0.00080	-0.00060	-0.00050	-0.00050	-0.00060	-0.00065
10.000	-0.00290	-0.00255	-0.00220	-0.00172	-0.00150	-0.00152	-0.00180	-0.00195
15.000	-0.00530	-0.00545	-0.00460	-0.00344	-0.00290	-0.00299	-0.00370	-0.00410

ENGINEER HP
DATE 10/27/78

FIGURE 4.2.1.1-31
EFFECT OF ELEVON



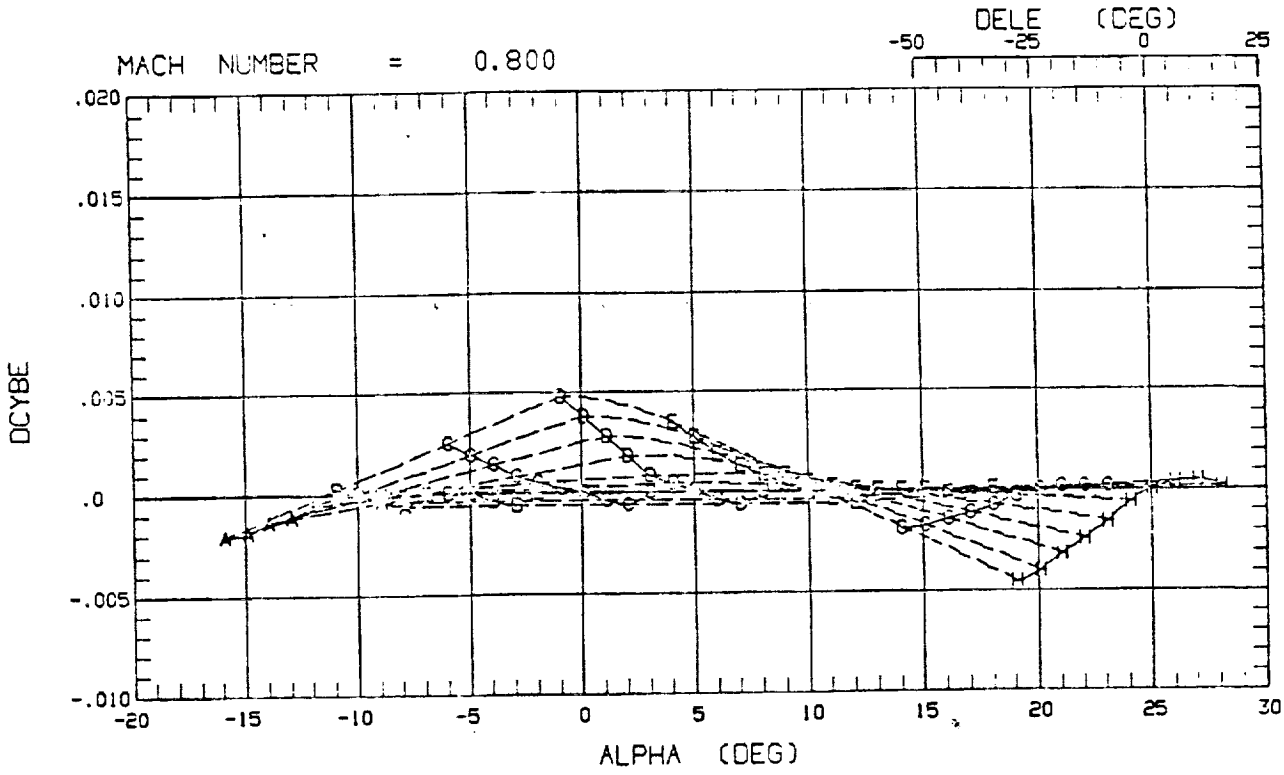
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	-0.00120	0.00060	0.00280	0.00480	0.00360	0.00225	0.00090	-0.00045
-25.000	-0.00230	-0.00040	0.00150	0.00340	0.00220	0.00150	0.00080	0.00010
-20.000	-0.00260	-0.00090	0.00080	0.00250	0.00140	0.00110	0.00080	0.00050
-15.000	-0.00190	-0.00070	0.00050	0.00170	0.00100	0.00090	0.00090	0.00070
-10.000	-0.00150	-0.00050	0.00030	0.00100	0.00080	0.00065	0.00060	0.00055
-5.000	-0.00060	-0.00020	0.00020	0.00060	0.00040	0.00035	0.00030	0.00025
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00040	-0.00040	-0.00040	-0.00040	-0.00040	-0.00060	-0.00080	-0.00100
10.000	-0.00080	-0.00080	-0.00080	-0.00080	-0.00080	-0.00125	-0.00170	-0.00215
15.000	-0.00020	-0.00020	-0.00020	-0.00020	-0.00020	-0.00290	-0.00370	-0.00540

ENGINEER HP
DATE 10/3/78

FIGURE 4.2.1.1-32
EFFECT OF ELEVON



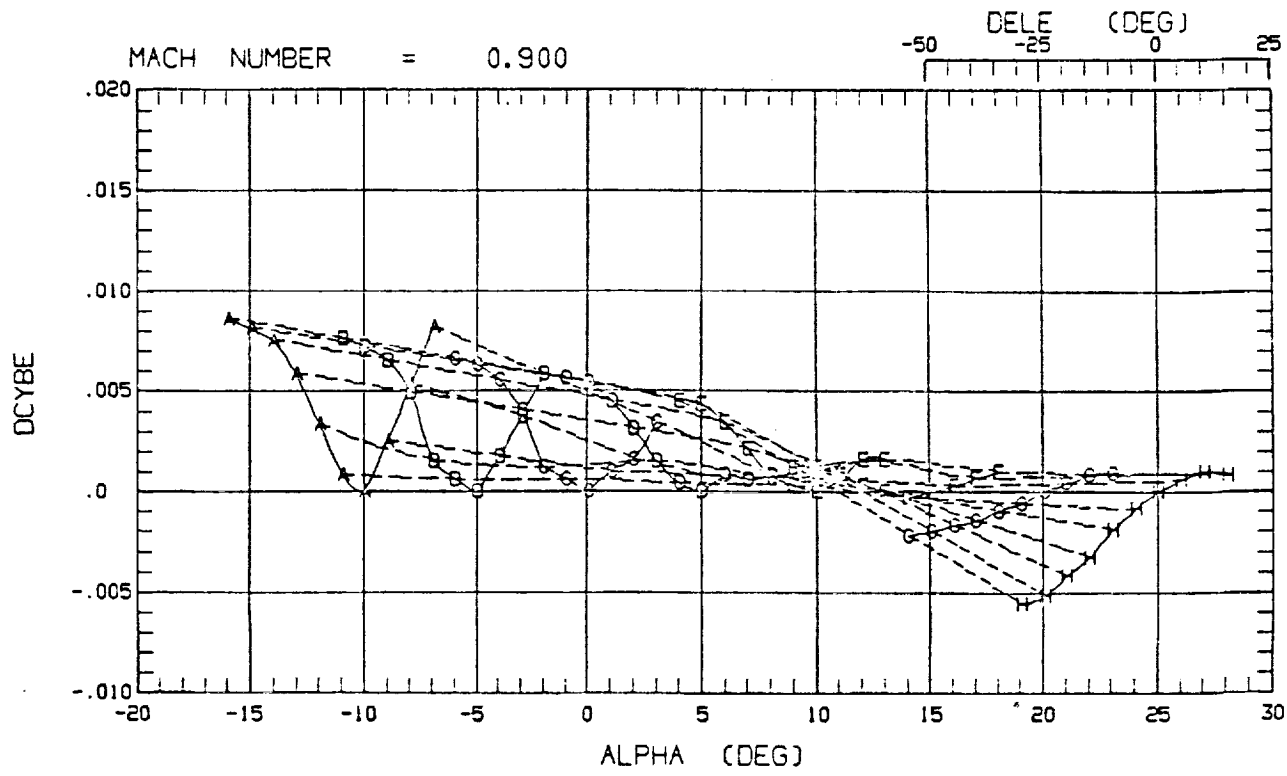
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	-0.00210	0.00020	0.00250	0.00480	0.00350	0.00080	-0.00190	-0.00460
-25.000	-0.00190	0.0	0.00190	0.00380	0.00270	0.00045	-0.00180	-0.00405
-20.000	-0.00140	0.0	0.00140	0.00290	0.00190	0.00020	-0.00150	-0.00320
-15.000	-0.00120	-0.00020	0.00080	0.00180	0.00130	0.00005	-0.00120	-0.00245
-10.000	-0.00050	0.0	0.00050	0.00090	0.00060	0.0	-0.00080	-0.00160
-5.000	-0.00020	0.0	0.00020	0.00040	0.00030	0.0	-0.00030	-0.00060
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00040	-0.00040	-0.00040	-0.00040	-0.00040	-0.00015	0.00010	0.00035
10.000	-0.00060	-0.00060	-0.00060	-0.00060	-0.00060	-0.00025	0.00010	0.00045
15.000	0.0	0.0	0.0	0.0	0.0	0.00005	0.00010	0.00015

ENGINEER JP
DATE 12.7.78

FIGURE 4.2.1.1-33
EFFECT OF ELEVON



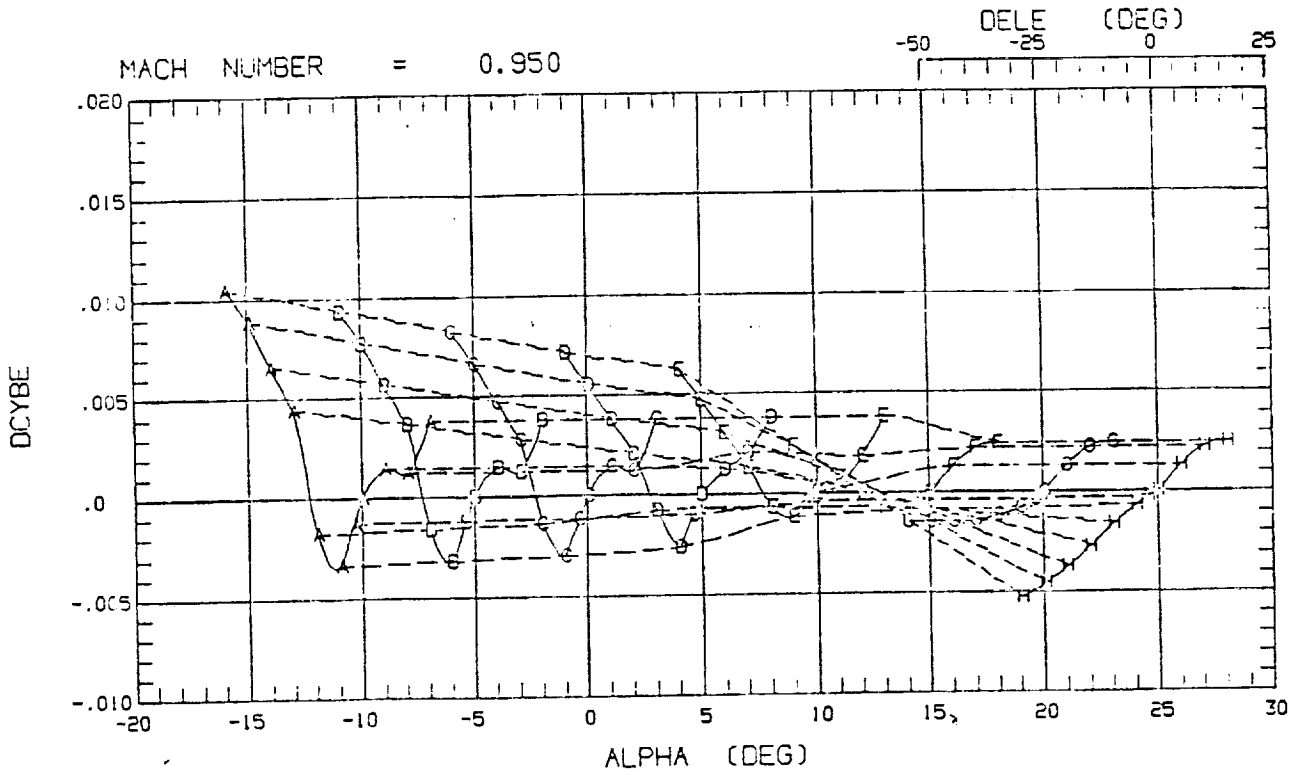
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	0.00680	0.00760	0.00660	0.00560	0.00450	0.00120	-0.00220	-0.00560
-25.000	0.00810	0.00720	0.00630	0.00540	0.00430	0.00120	-0.00200	-0.00520
-20.000	0.00750	0.00650	0.00550	0.00450	0.00340	0.00085	-0.00170	-0.00425
-15.000	0.00580	0.00490	0.00400	0.00310	0.00210	0.00030	-0.00150	-0.00330
-10.000	0.00330	0.00150	0.00120	0.00150	0.00070	-0.00005	-0.00100	-0.00195
-5.000	0.00080	0.00060	0.00060	0.00040	0.00030	-0.00030	-0.00060	-0.00090
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00250	0.00170	0.00100	0.00080	0.00060	0.00025	0.00040	0.00055
10.000	0.00530	0.00370	0.00160	0.00060	0.00160	0.00065	0.00080	0.00095
15.000	0.00820	0.00580	0.00340	0.00060	0.00160	0.00095	0.00090	0.00095

ENGINEER MP
DATE 10/2/78

FIGURE 4.2.1.1-34
EFFECT OF ELEVON



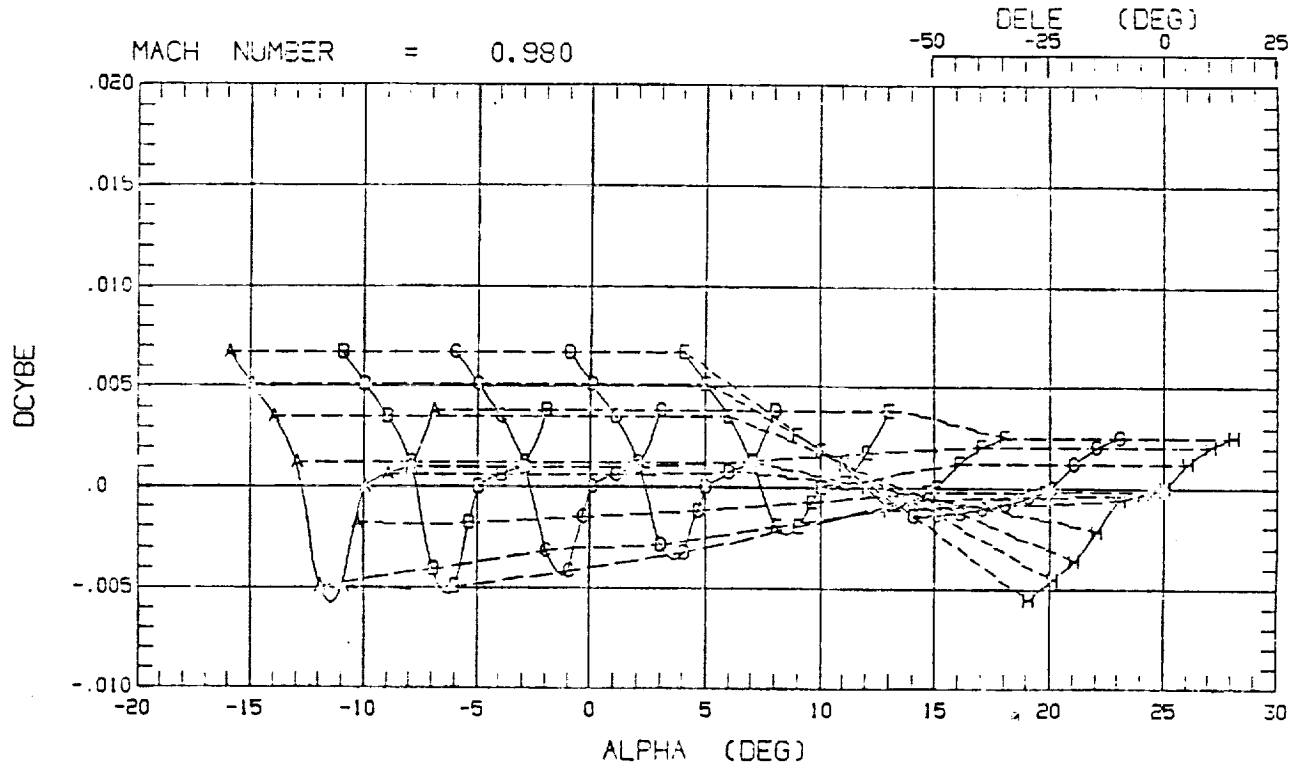
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	0.01040	0.00930	0.00820	0.00710	0.00620	0.00230	-0.00150	-0.00530
-25.000	0.00880	0.00770	0.00660	0.00550	0.00470	0.00160	-0.00150	-0.00460
-20.000	0.00650	0.00560	0.00470	0.00380	0.00300	0.00075	-0.00150	-0.00375
-15.000	0.00440	0.00360	0.00280	0.00200	0.00130	-0.00005	-0.00140	-0.00275
-10.000	-0.00180	-0.00160	-0.00140	-0.00080	-0.00070	-0.00075	-0.00120	-0.00165
-5.000	-0.00340	-0.00320	-0.00300	-0.00260	-0.00120	-0.00090	-0.00080	-0.00070
-2.000	-0.00130	-0.00122	-0.00115	-0.00099	-0.00045	-0.00042	-0.00037	-0.00029
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00140	0.00140	0.00140	0.00120	0.00030	0.00130	0.00130	0.00130
10.000	0.00120	0.00120	0.00120	0.00200	0.00160	0.00220	0.00220	0.00220
15.000	0.00380	0.00380	0.00380	0.00390	0.00360	0.00240	0.00340	0.00240

ENGINEER HP
DATE 10/2/78

FIGURE 4.2.1.1-35
EFFECT OF ELEVON



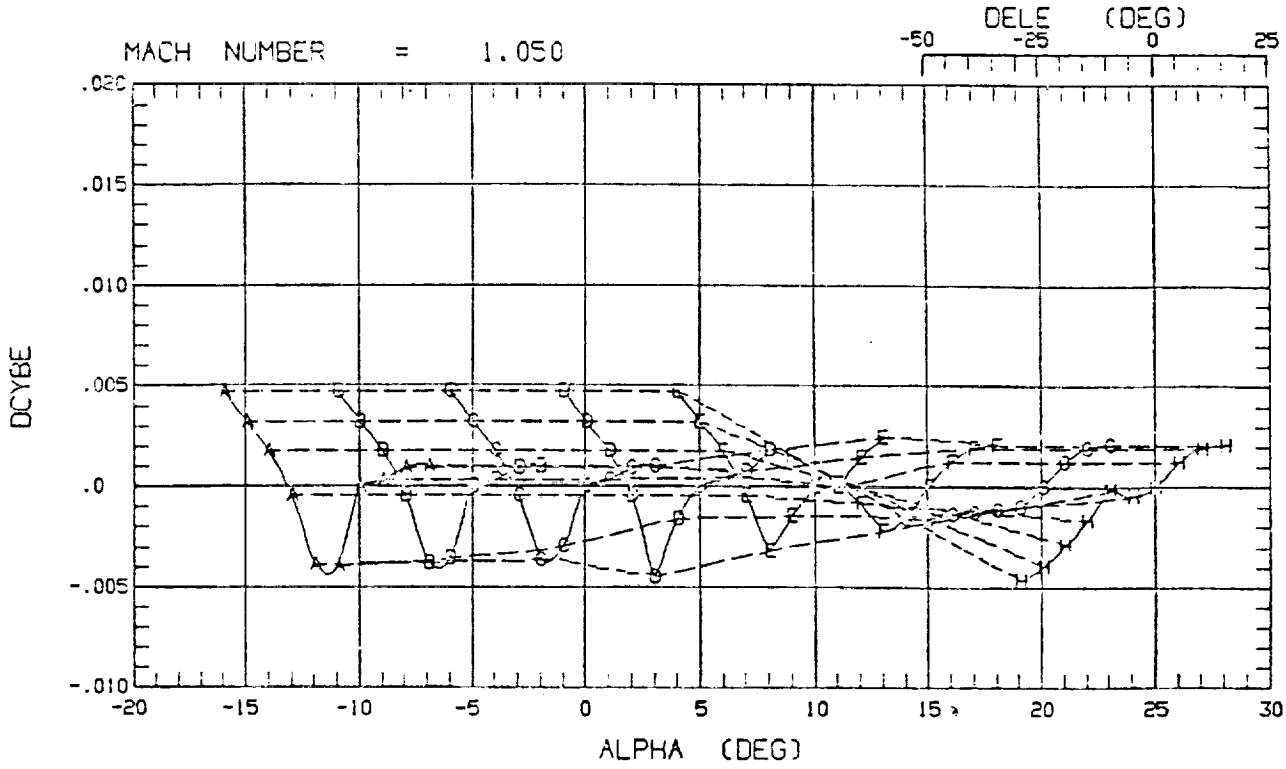
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1075.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	0.00670	0.00670	0.00670	0.00670	0.00670	0.00260	-0.00150	-0.00550
-25.000	0.00510	0.00510	0.00510	0.00510	0.00510	0.00180	-0.00140	-0.00460
-20.000	0.00350	0.00350	0.00350	0.00350	0.00350	0.00110	-0.00130	-0.00370
-15.000	0.00120	0.00120	0.00120	0.00120	0.00120	0.0	-0.00110	-0.00220
-10.000	-0.00500	-0.00410	-0.00320	-0.00290	-0.00200	-0.00115	-0.00090	-0.00085
-5.000	-0.00500	-0.00500	-0.00420	-0.00330	-0.00200	-0.00065	-0.00050	-0.00035
-2.000	-0.00169	-0.00183	-0.00158	-0.00125	-0.00075	-0.00029	-0.00022	-0.00015
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00060	0.00060	0.00060	0.00070	0.00020	0.00120	0.00120	0.00120
10.000	0.00100	0.00100	0.00100	0.00130	0.00170	0.00200	0.00200	0.00200
15.000	0.00380	0.00380	0.00380	0.00380	0.00380	0.00250	0.00250	0.00250

ENGINEER HP
DATE 11/2/89

FIGURE 4.2.1.1- 36
EFFECT OF ELEVON

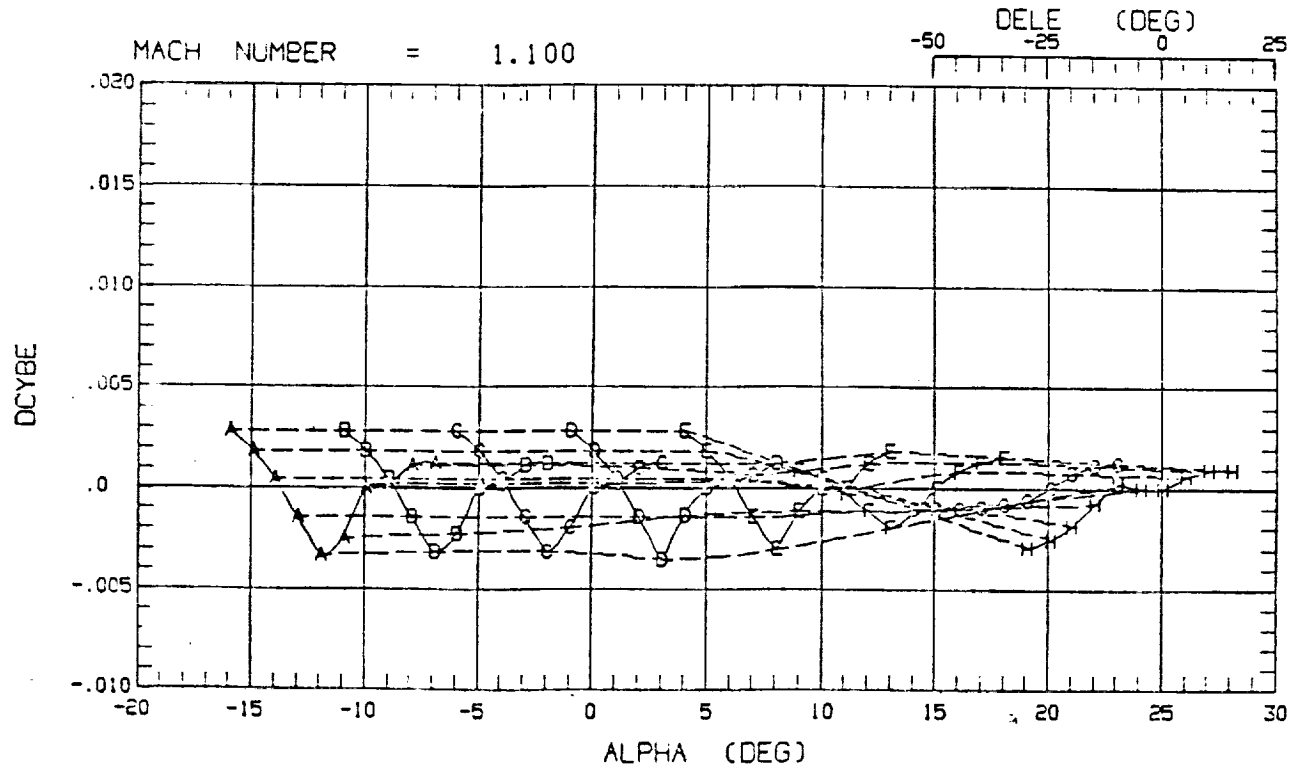


CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.550	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	0.00470	0.00470	0.00470	0.00470	0.00470	0.00150	-0.00160	-0.00470
-25.000	0.00320	0.00320	0.00320	0.00320	0.00320	0.00080	-0.00160	-0.00400
-20.000	0.00170	0.00170	0.00170	0.00170	0.00170	0.00015	-0.00140	-0.00295
-15.000	-0.00050	-0.00050	-0.00050	-0.00050	-0.00050	-0.00090	-0.00130	-0.00170
-10.000	-0.00390	-0.00380	-0.00370	-0.00450	-0.00320	-0.00220	-0.00120	-0.00020
-5.000	-0.00400	-0.00360	-0.00300	-0.00160	-0.00150	-0.00150	-0.00100	-0.00050
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00030	0.00030	0.00030	0.00040	0.0	0.00120	0.00120	0.00120
10.000	0.00090	0.00090	0.00090	0.00070	0.00140	0.00190	0.00190	0.00190
15.000	0.00100	0.00100	0.00100	0.00180	0.00240	0.00205	0.00205	0.00205

ENGINEER MP
DATE 10/3/78

FIGURE 4.2.1.1-37
EFFECT OF ELEVON



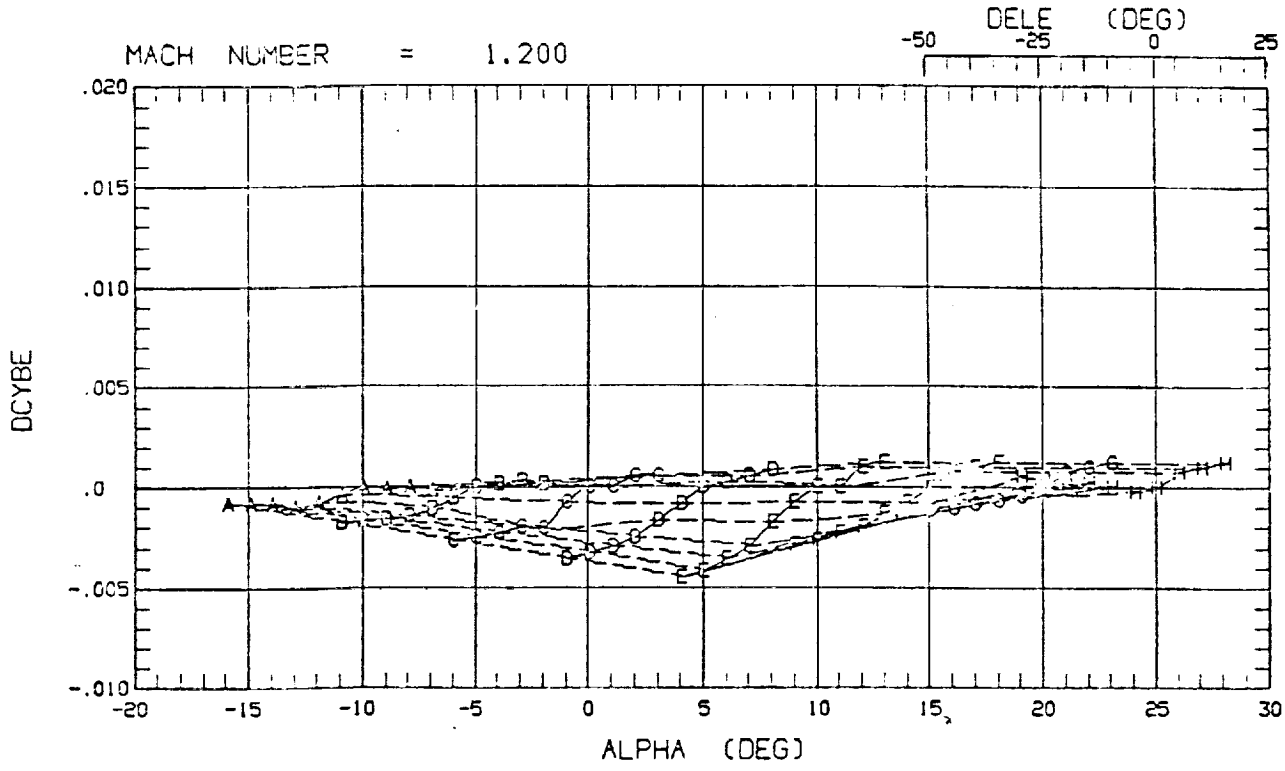
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XC = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YC = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZC = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	0.00280	0.00290	0.00280	0.00290	0.00280	0.00080	-0.00110	-0.00300
-25.000	0.00180	0.00180	0.00180	0.00180	0.00180	0.00040	-0.00110	-0.00260
-20.000	0.00040	0.00040	0.00040	0.00040	0.00040	-0.00030	-0.00110	-0.00190
-15.000	-0.00150	-0.00150	-0.00150	-0.00150	-0.00150	-0.00120	-0.00100	-0.00080
-10.000	-0.00340	-0.00320	-0.00320	-0.00360	-0.00310	-0.00200	-0.00090	0.00020
-5.000	-0.00250	-0.00230	-0.00200	-0.00140	-0.00120	-0.00120	-0.00060	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00020	0.00020	0.00020	0.00030	0.0	0.00085	0.00070	0.00055
10.000	0.00110	0.00110	0.00100	0.00060	0.00120	0.00130	0.00110	0.00090
15.000	0.00120	0.00120	0.00120	0.00120	0.00180	0.00150	0.00120	0.00090

ENGINEER HP
DATE 10/1/78

FIGURE 4.2.1.1- 38
EFFECT OF ELEVON



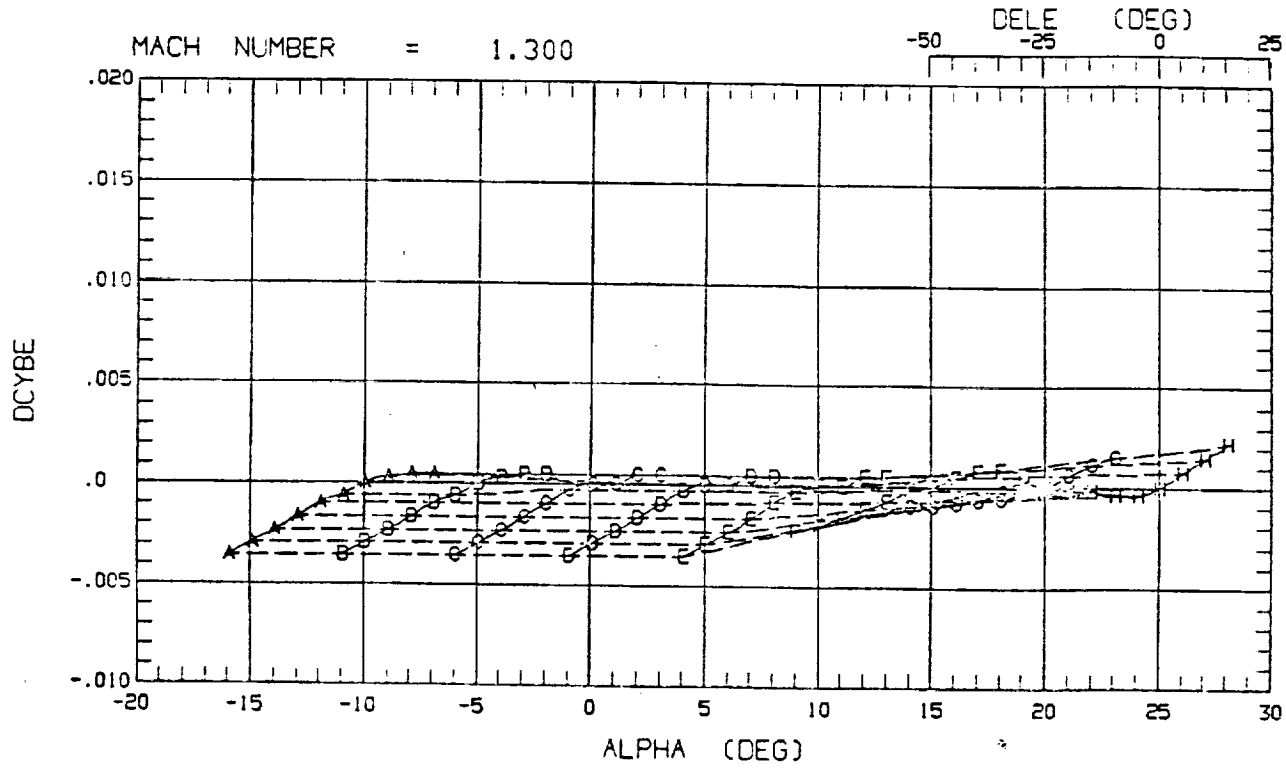
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	-0.00090	-0.00180	-0.00270	-0.00360	-0.00450	-0.00290	-0.00120	0.00050
-25.000	-0.00090	-0.00170	-0.00250	-0.00330	-0.00420	-0.00270	-0.00120	0.00030
-20.000	-0.00090	-0.00160	-0.00230	-0.00300	-0.00360	-0.00230	-0.00110	0.00010
-15.000	-0.00100	-0.00150	-0.00200	-0.00250	-0.00300	-0.00200	-0.00090	0.00020
-10.000	-0.00080	-0.00110	-0.00210	-0.00170	-0.00180	-0.00135	-0.00070	-0.00005
-5.000	-0.00040	-0.00055	-0.00080	-0.00085	-0.00080	-0.00075	-0.00050	-0.00025
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00010	0.00010	0.0	0.00020	0.0	0.00070	0.00070	0.00070
10.000	0.0	0.00025	0.00050	0.00050	0.00100	0.00100	0.00100	0.00100
15.000	-0.00020	0.00015	0.00050	0.00085	0.00120	0.00120	0.00120	0.00120

ENGINEER MD
DATE 10/8/28

FIGURE 4.2.1.1- 39
EFFECT OF ELEVON



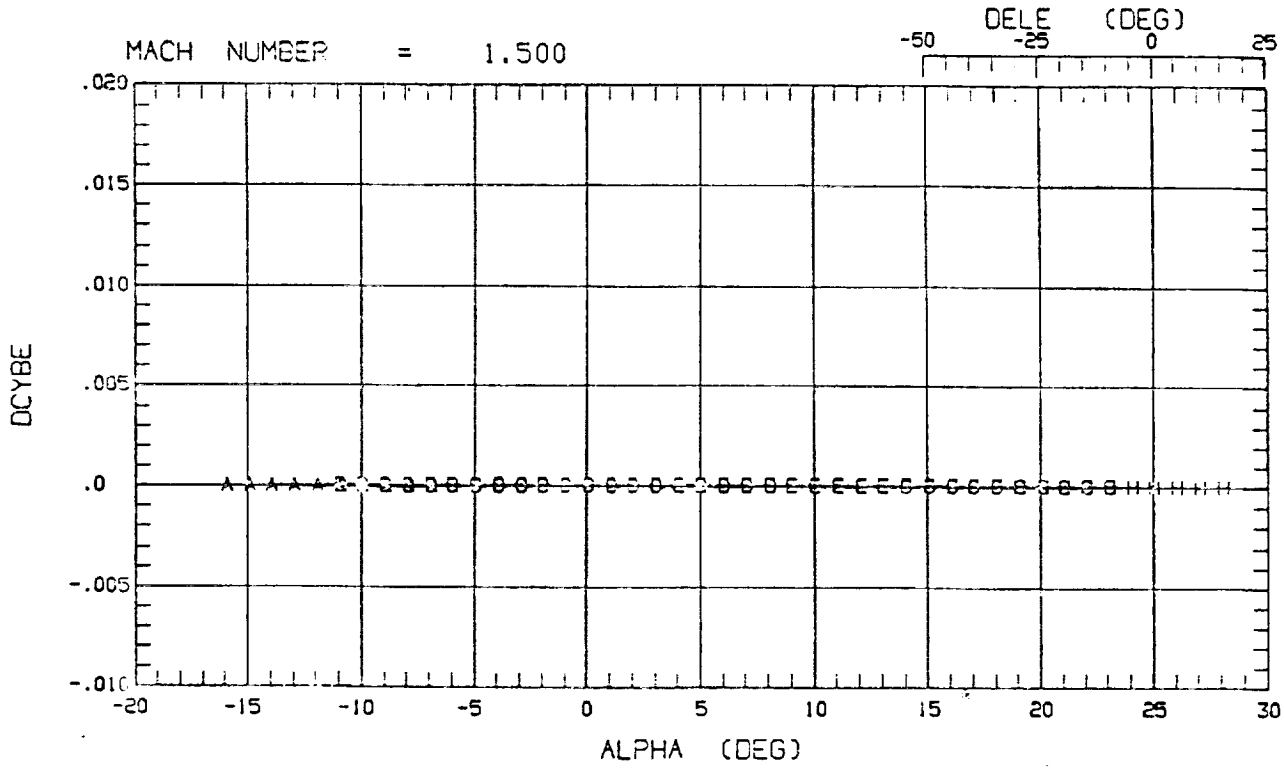
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	-0.00360	-0.00360	-0.00360	-0.00360	-0.00360	-0.00230	-0.00100	0.00030
-25.000	-0.00300	-0.00300	-0.00300	-0.00300	-0.00300	-0.00200	-0.00100	0.0
-20.000	-0.00240	-0.00240	-0.00240	-0.00240	-0.00240	-0.00160	-0.00090	-0.00020
-15.000	-0.00170	-0.00170	-0.00170	-0.00170	-0.00170	-0.00120	-0.00070	-0.00020
-10.000	-0.00100	-0.00100	-0.00100	-0.00100	-0.00090	-0.00080	-0.00060	-0.00040
-5.000	-0.00060	-0.00060	-0.00030	-0.00030	-0.00030	-0.00018	-0.00030	-0.00042
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00030	0.00030	0.0	0.0	0.0	0.00045	0.00060	0.00075
10.000	0.00040	0.00040	0.00040	0.00040	0.00040	0.00075	0.00110	0.00145
15.000	0.00040	0.00040	0.00040	0.00040	0.00040	0.00085	0.00150	0.00215

ENGINEER HP
DATE 7/27/78

FIGURE 4.2.1.1- 40
EFFECT OF ELEVON

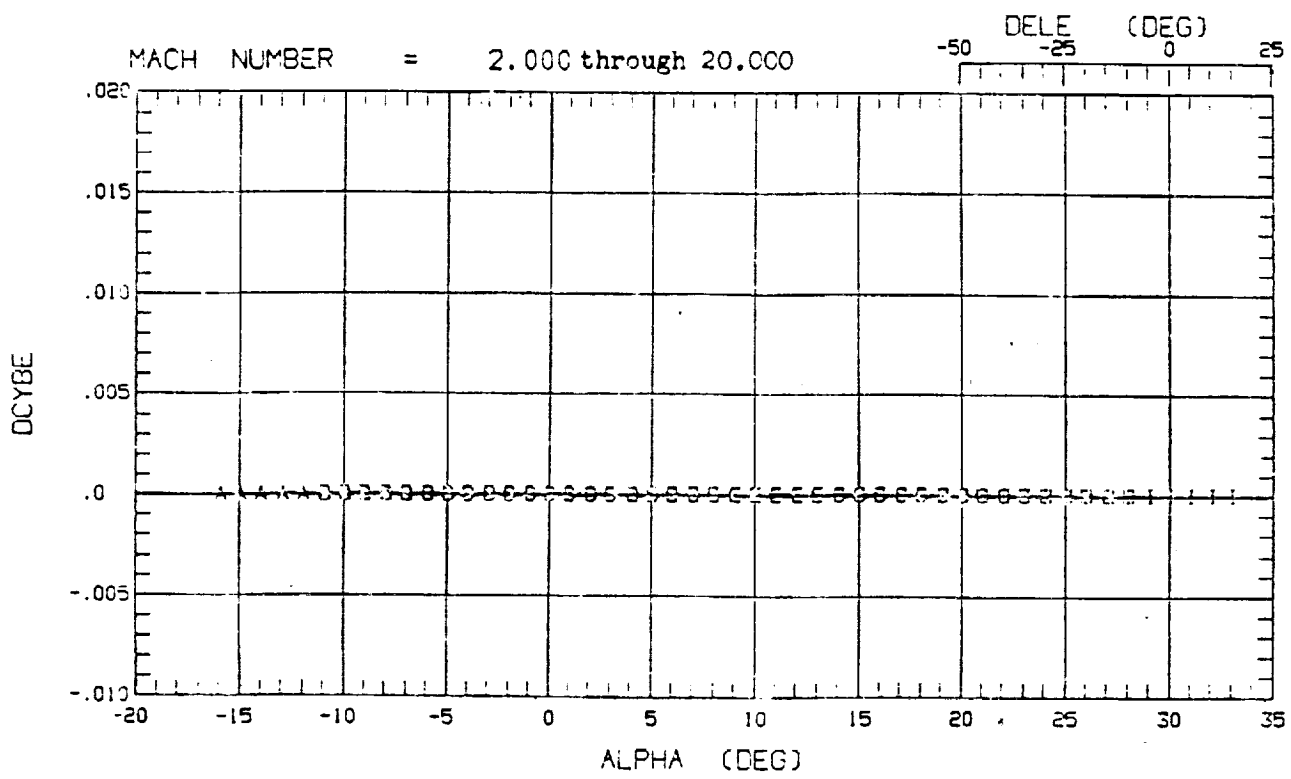


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON SIDE FORCE INCREMENT							
-30.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-20.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10-2-78

FIGURE 4.2.1.1-41
EFFECT OF ELEVON



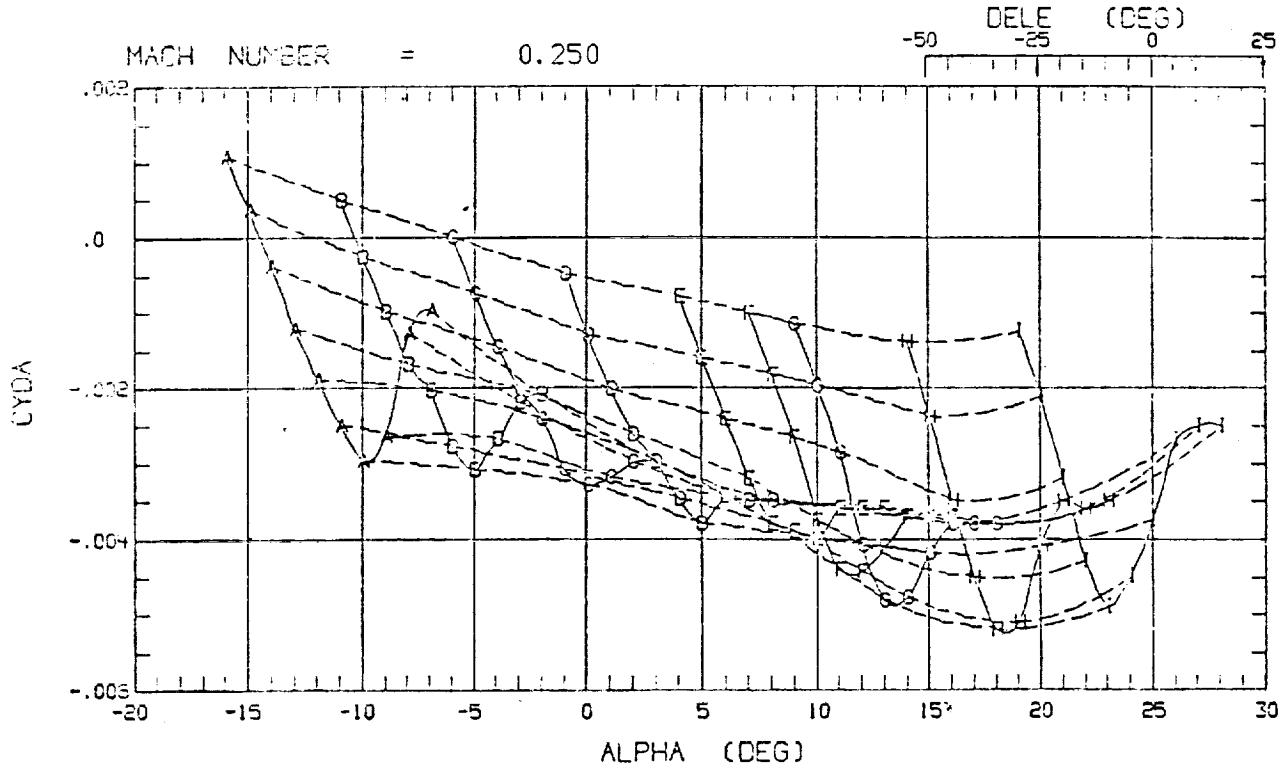
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YC = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	ELEVON SIDE FORCE INCREMENT								
-30.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-20.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/2/78

FIGURE 4.2.1.1- 42
EFFECT OF ELEVON



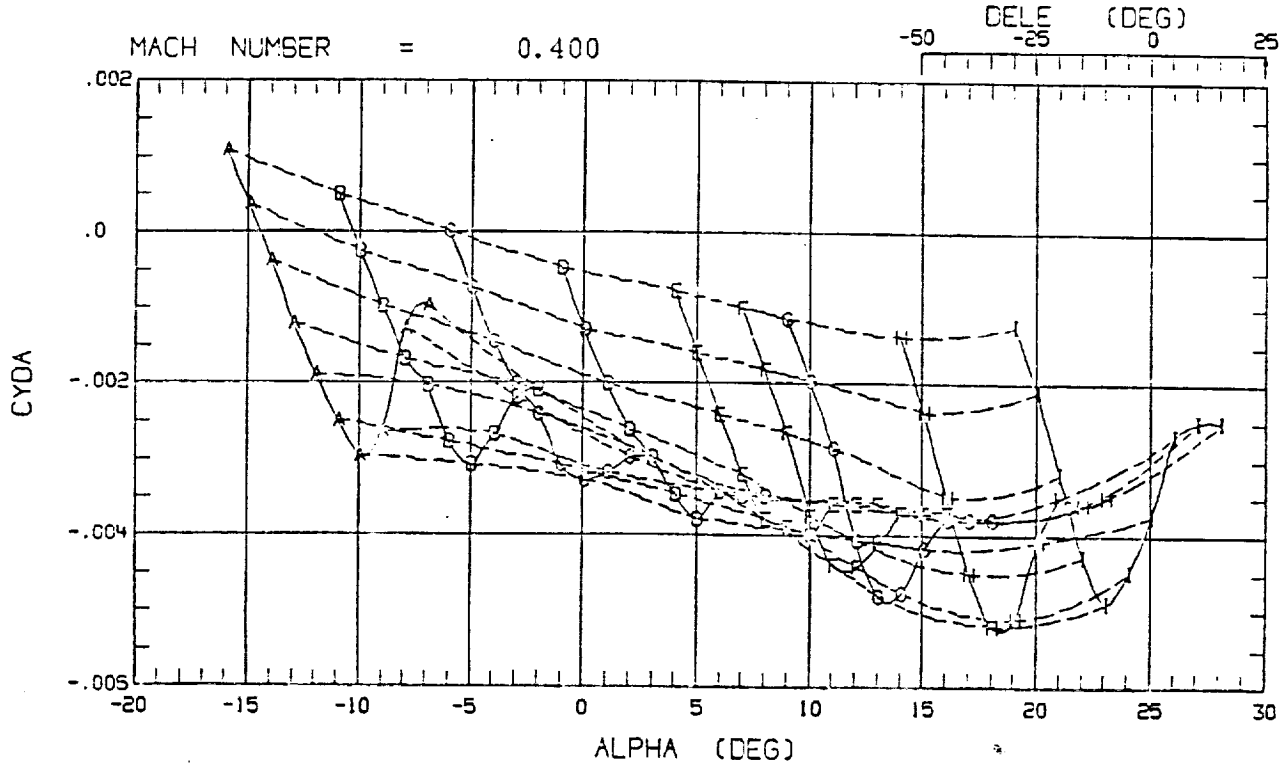
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	0.00106	0.00048	-0.00002	-0.00050	-0.00090	-0.00102	-0.00116	-0.00140	-0.00125
-25.000	0.00035	-0.00029	-0.00077	-0.00130	-0.00162	-0.00183	-0.00198	-0.00238	-0.00211
-20.000	-0.00040	-0.00100	-0.00147	-0.00203	-0.00242	-0.00268	-0.00299	-0.00350	-0.00320
-15.000	-0.00122	-0.00170	-0.00202	-0.00262	-0.00322	-0.00376	-0.00410	-0.00452	-0.00430
-10.000	-0.00190	-0.00205	-0.00242	-0.00300	-0.00380	-0.00442	-0.00482	-0.00520	-0.00490
-5.000	-0.00250	-0.00280	-0.00310	-0.00349	-0.00390	-0.00444	-0.00478	-0.00510	-0.00480
0.0	-0.00298	-0.00310	-0.00330	-0.00380	-0.00400	-0.00412	-0.00420	-0.00410	-0.00375
5.000	-0.00265	-0.00270	-0.00320	-0.00345	-0.00360	-0.00372	-0.00380	-0.00350	-0.00270
10.000	-0.00128	-0.00220	-0.00300	-0.00350	-0.00360	-0.00372	-0.00380	-0.00380	-0.00280
15.000	-0.00099	-0.00210	-0.00300	-0.00350	-0.00370	-0.00372	-0.00380	-0.00350	-0.00350

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-43
EFFECT OF AILERON



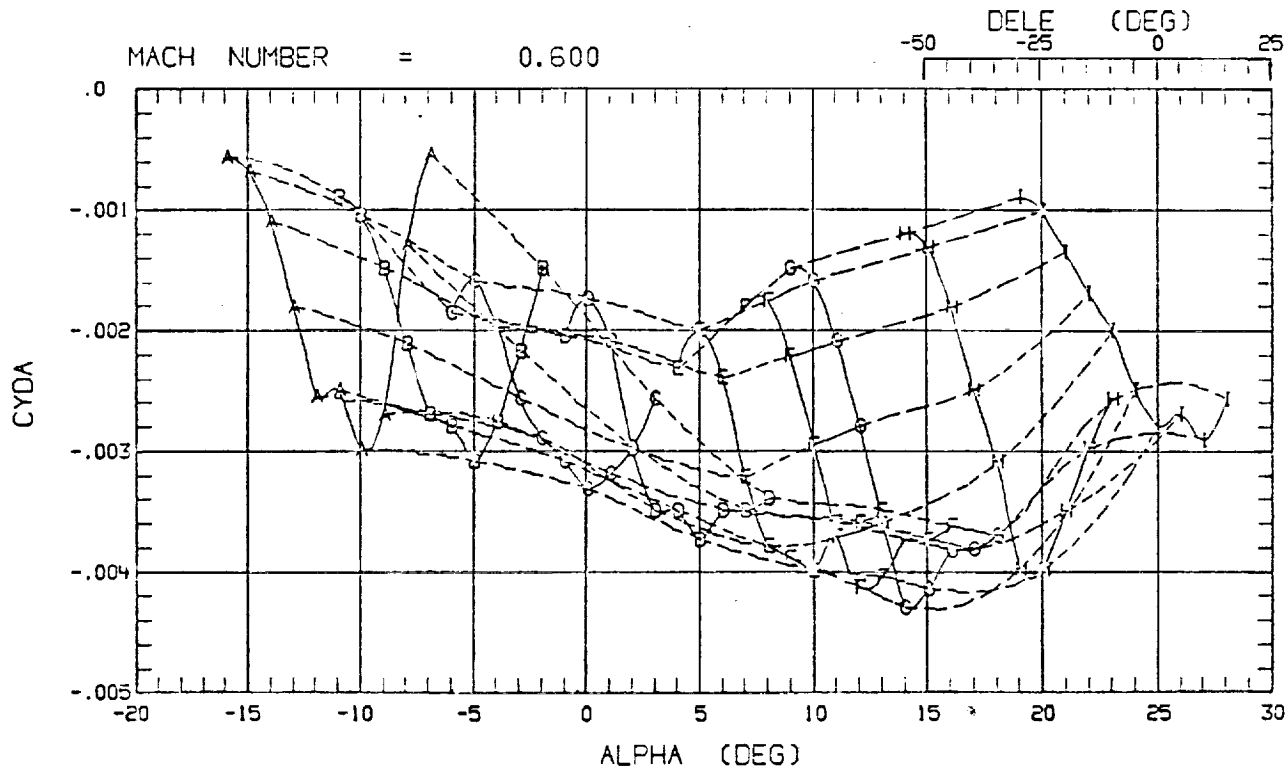
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	0.00106	0.00048	-0.00002	-0.00050	-0.00080	-0.00102	-0.00116	-0.00140	-0.00125
-25.000	0.00035	-0.00028	-0.00077	-0.00130	-0.00162	-0.00183	-0.00198	-0.00238	-0.00211
-20.000	-0.00040	-0.00100	-0.00147	-0.00203	-0.00242	-0.00268	-0.00283	-0.00350	-0.00320
-15.000	-0.00122	-0.00170	-0.00202	-0.00262	-0.00322	-0.00376	-0.00410	-0.00452	-0.00430
-10.000	-0.00190	-0.00205	-0.00242	-0.00300	-0.00380	-0.00442	-0.00482	-0.00520	-0.00490
-5.000	-0.00250	-0.00260	-0.00310	-0.00349	-0.00390	-0.00444	-0.00478	-0.00510	-0.00450
0.0	-0.00298	-0.00310	-0.00330	-0.00380	-0.00400	-0.00412	-0.00420	-0.00410	-0.00375
5.000	-0.00265	-0.00270	-0.00320	-0.00345	-0.00360	-0.00372	-0.00380	-0.00350	-0.00270
10.000	-0.00128	-0.00220	-0.00300	-0.00350	-0.00360	-0.00372	-0.00380	-0.00360	-0.00260
15.000	-0.00033	-0.00210	-0.00300	-0.00350	-0.00360	-0.00372	-0.00380	-0.00350	-0.00260

ENGINEER
DATE

FIGURE 4.2.1.1-44
EFFECT OF AILERON



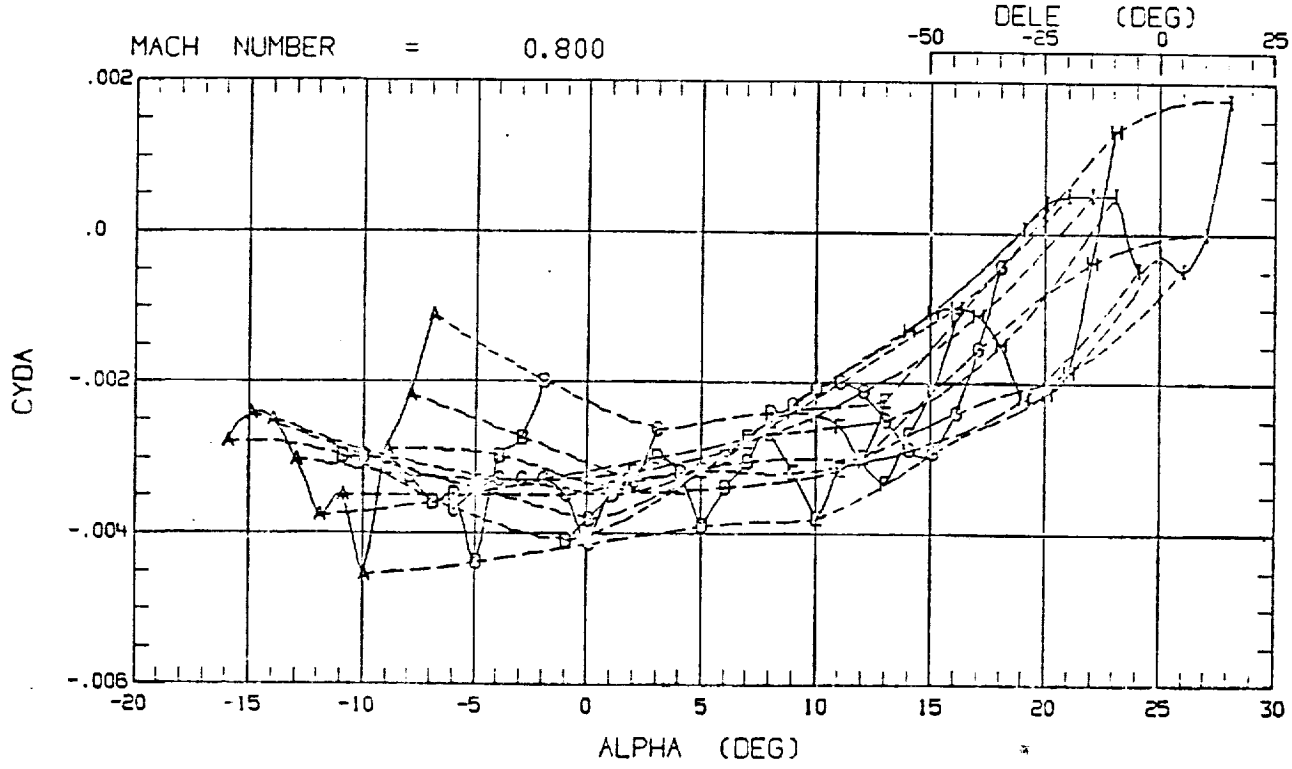
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.00 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00057	-0.00090	-0.00186	-0.00205	-0.00232	-0.00181	-0.00150	-0.00120	-0.00090
-25.000	-0.00069	-0.00105	-0.00160	-0.00175	-0.00200	-0.00176	-0.00160	-0.00132	-0.00102
-20.000	-0.00110	-0.00150	-0.00198	-0.00210	-0.00240	-0.00222	-0.00210	-0.00181	-0.00135
-15.000	-0.00182	-0.00212	-0.00258	-0.00300	-0.00322	-0.00295	-0.00280	-0.00250	-0.00170
-10.000	-0.00255	-0.00270	-0.00290	-0.00350	-0.00380	-0.00372	-0.00360	-0.00310	-0.00200
-5.000	-0.00250	-0.00260	-0.00310	-0.00350	-0.00390	-0.00414	-0.00430	-0.00398	-0.00250
0.0	-0.00300	-0.00310	-0.00333	-0.00375	-0.00400	-0.00405	-0.00415	-0.00399	-0.00260
5.000	-0.00270	-0.00277	-0.00320	-0.00350	-0.00360	-0.00374	-0.00383	-0.00350	-0.00270
10.000	-0.00130	-0.00218	-0.00298	-0.00350	-0.00360	-0.00374	-0.00382	-0.00298	-0.00232
15.000	-0.00055	-0.00160	-0.00268	-0.00340	-0.00350	-0.00383	-0.00370	-0.00268	-0.00268

ENGINEER
DATE 2-5-79

FIGURE 4.2.1.1-45
EFFECT OF AILERON



CONFIGURATION

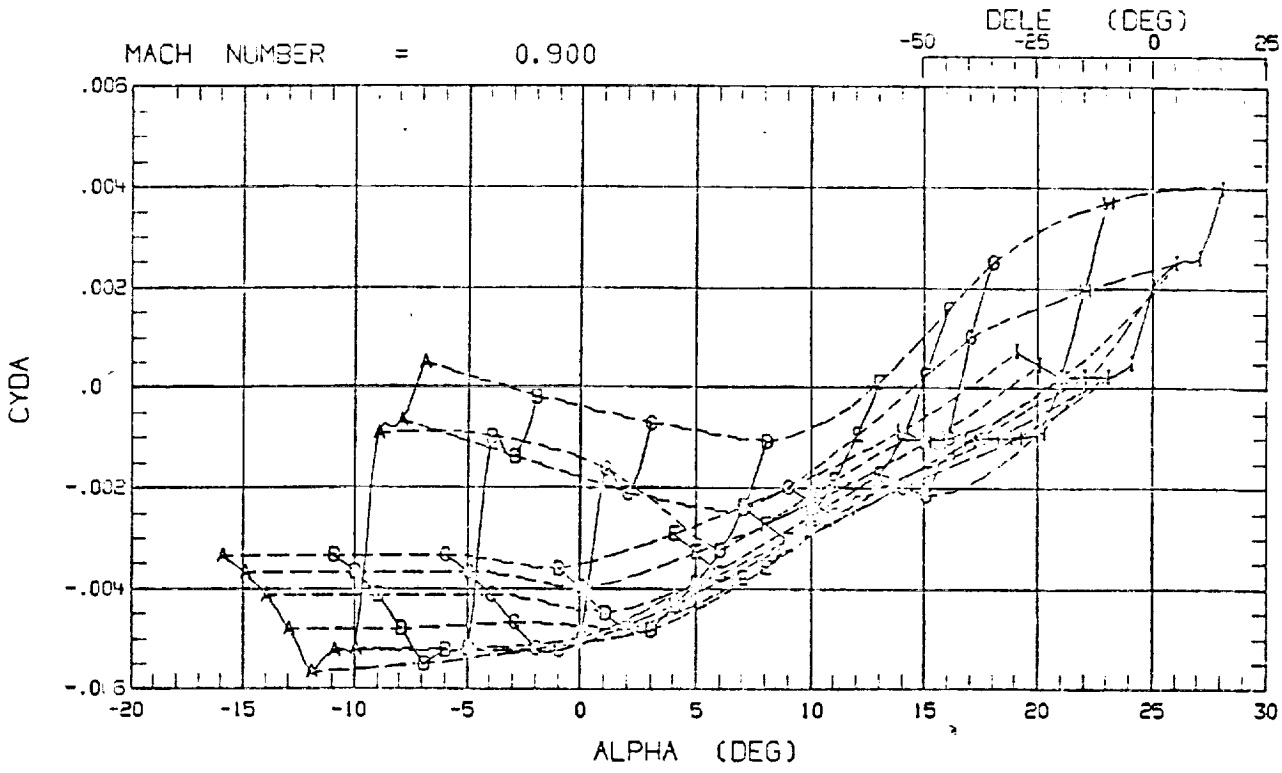
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00279	-0.00300	-0.00370	-0.00412	-0.00340	-0.00274	-0.00230	-0.00130	0.00006
-25.000	-0.00243	-0.00300	-0.00345	-0.00392	-0.00318	-0.00252	-0.00208	-0.00107	0.00040
-20.000	-0.00250	-0.00302	-0.00330	-0.00350	-0.00300	-0.00240	-0.00200	-0.00100	0.00050
-15.000	-0.00303	-0.00325	-0.00330	-0.00320	-0.00280	-0.00244	-0.00213	-0.00110	0.00050
-10.000	-0.00377	-0.00360	-0.00330	-0.00300	-0.00270	-0.00259	-0.00250	-0.00150	0.00050
-5.000	-0.00350	-0.00350	-0.00350	-0.00320	-0.00320	-0.00306	-0.00290	-0.00220	-0.00050
0.0	-0.00455	-0.00440	-0.00415	-0.00390	-0.00380	-0.00336	-0.00293	-0.00215	-0.00030
5.000	-0.00290	-0.00300	-0.00343	-0.00340	-0.00315	-0.00269	-0.00240	-0.00165	-0.00050
10.000	-0.00218	-0.00275	-0.00331	-0.00305	-0.00300	-0.00212	-0.00155	-0.00040	0.0
15.000	-0.00112	-0.00200	-0.00263	-0.00240	-0.00225	-0.00117	-0.00045	0.00135	0.00175

ENGINEER [illegible]
DATE 2-5-[illegible]

FIGURE 4.2.1.1-46
EFFECT OF AILERON

SD 72-SH-0060 IM



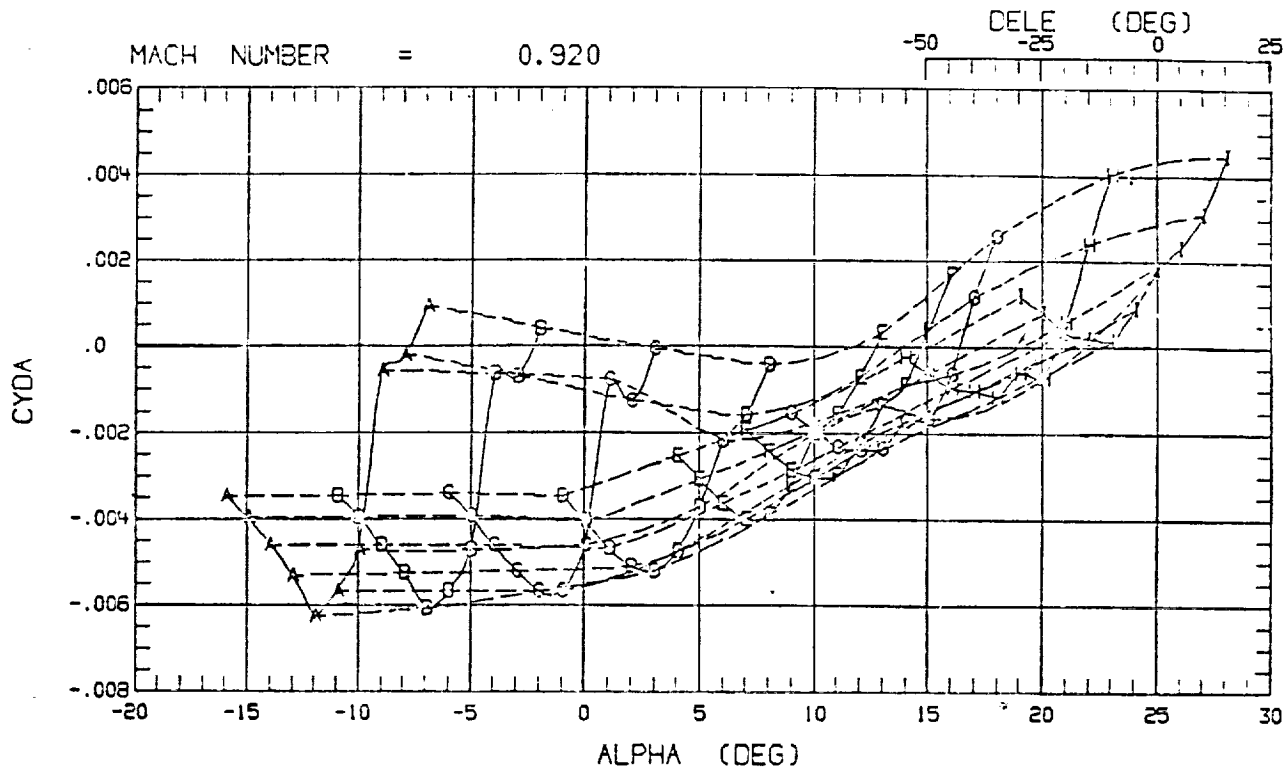
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00335	-0.00335	-0.00335	-0.00363	-0.00293	-0.00239	-0.00200	-0.00085	0.00072
-25.000	-0.00370	-0.00370	-0.00370	-0.00400	-0.00330	-0.00273	-0.00230	-0.00110	0.00045
-20.000	-0.00415	-0.00415	-0.00415	-0.00450	-0.00372	-0.00305	-0.00257	-0.00130	0.00020
-15.000	-0.00480	-0.00480	-0.00470	-0.00480	-0.00382	-0.00290	-0.00230	-0.00105	0.00020
-10.000	-0.00567	-0.00550	-0.00522	-0.00483	-0.00360	-0.00254	-0.00202	-0.00100	0.00030
-5.000	-0.00525	-0.00525	-0.00525	-0.00435	-0.00315	-0.00245	-0.00200	-0.00100	0.00050
0.0	-0.00520	-0.00520	-0.00500	-0.00390	-0.00255	-0.00175	-0.00215	-0.00090	0.00200
5.000	-0.00090	-0.00100	-0.00165	-0.00325	-0.00185	-0.00105	-0.00100	0.00020	0.00250
10.000	-0.00068	-0.00140	-0.00212	-0.00245	-0.00095	0.00024	0.00100	0.00195	0.00260
15.000	0.00050	-0.00020	-0.00072	-0.00110	0.00008	0.00156	0.00250	0.00370	0.00490

ENGINEER [illegible]
DATE 2-5-79

FIGURE 4.2.1.1-47
EFFECT OF AILERON

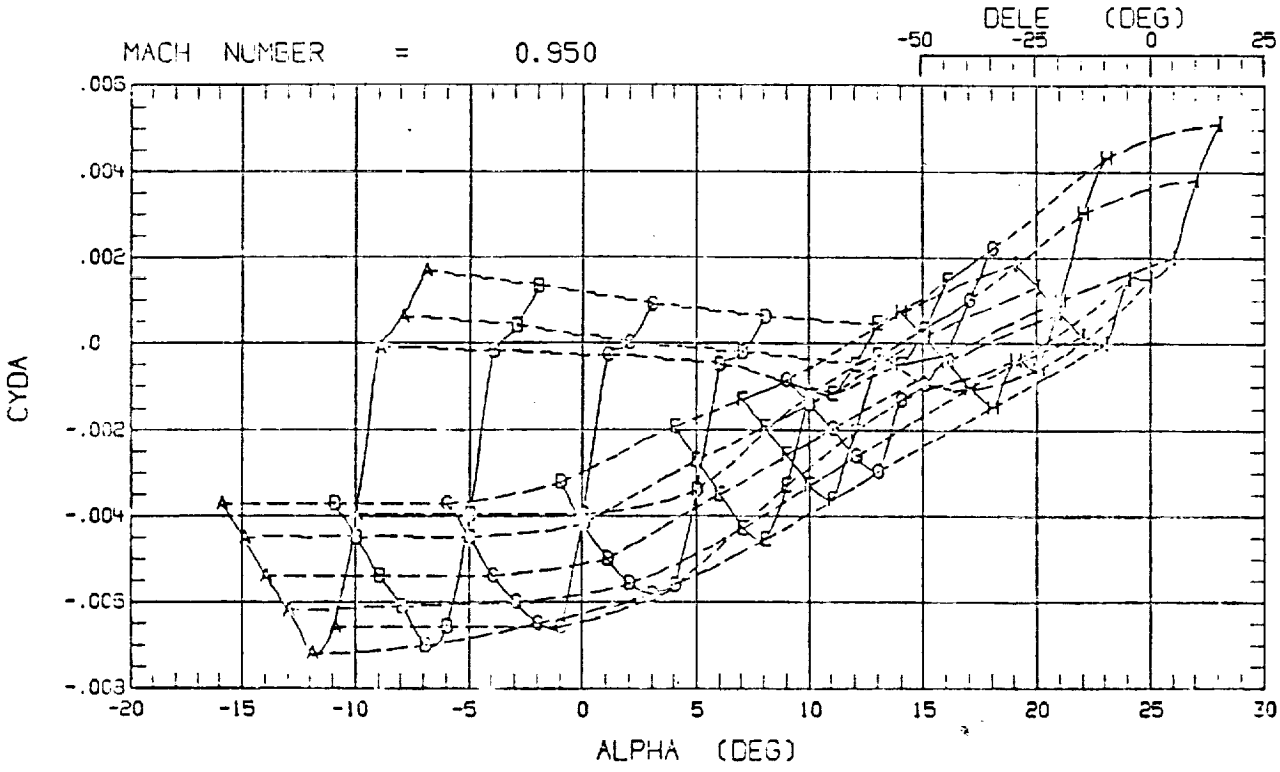


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 33.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00349	-0.00347	-0.00343	-0.00348	-0.00255	-0.00197	-0.00157	-0.00026	0.00115
-25.000	-0.00400	-0.00397	-0.00395	-0.00407	-0.00309	-0.00244	-0.00197	-0.00064	0.00077
-20.000	-0.00461	-0.00463	-0.00464	-0.00470	-0.00365	-0.00299	-0.00236	-0.00097	0.00030
-15.000	-0.00532	-0.00538	-0.00522	-0.00512	-0.00402	-0.00306	-0.00243	-0.00104	0.00019
-10.000	-0.00625	-0.00607	-0.00570	-0.00522	-0.00393	-0.00300	-0.00239	-0.00118	0.00013
-5.000	-0.00570	-0.00570	-0.00570	-0.00478	-0.00319	-0.00229	-0.00174	-0.00060	0.00089
0.0	-0.00474	-0.00474	-0.00461	-0.00372	-0.00203	-0.00140	-0.00169	-0.00074	0.00162
5.000	-0.00056	-0.00066	-0.00080	-0.00221	-0.00153	-0.00090	-0.00066	0.00056	0.00232
10.000	-0.00023	-0.00071	-0.00130	-0.00160	-0.00072	0.00040	0.00112	0.00239	0.00309
15.000	0.00092	0.00040	-0.00009	-0.00044	0.00032	0.00168	0.00255	0.00401	0.00444

ENGINEER [illegible]
DATE 2-23-78

FIGURE 4.2.1.1-48
EFFECT OF AILERON



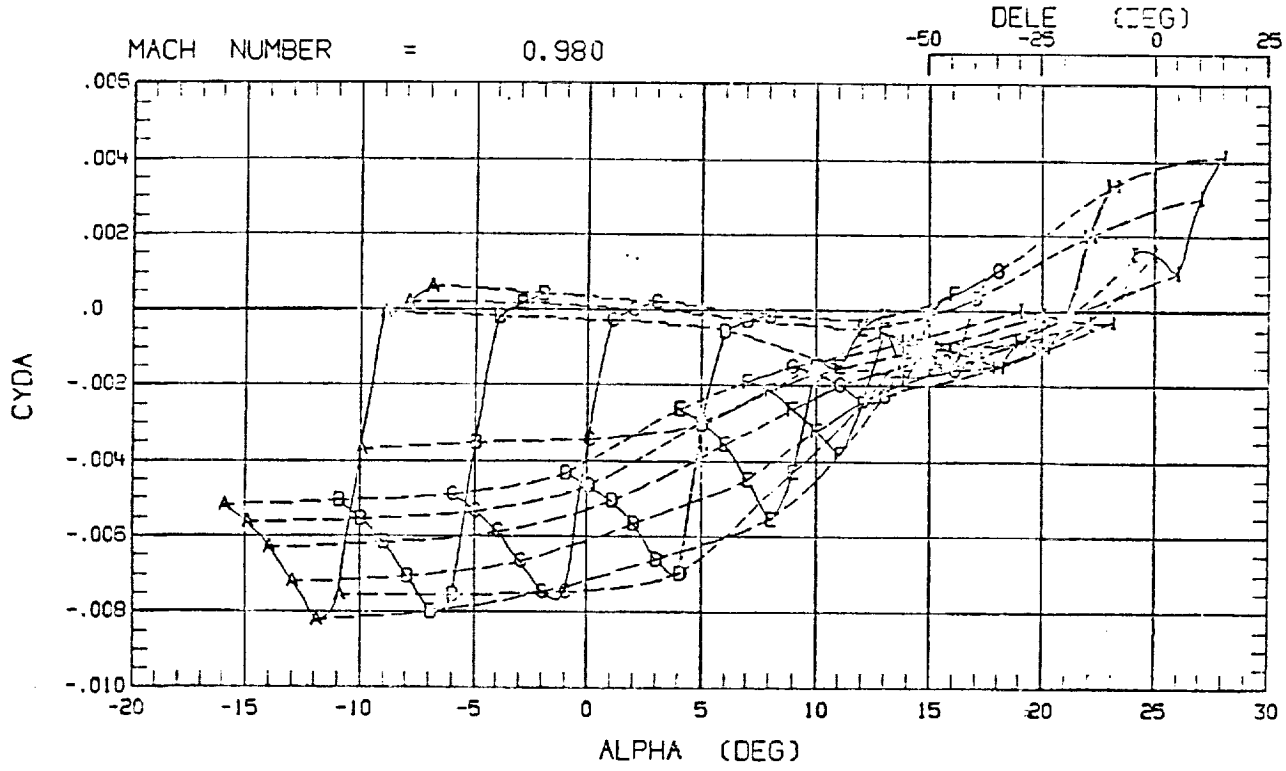
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00372	-0.00372	-0.00372	-0.00325	-0.00195	-0.00131	-0.00087	0.00070	0.00165
-25.000	-0.00450	-0.00450	-0.00450	-0.00420	-0.00273	-0.00196	-0.00143	0.00012	0.00130
-20.000	-0.00540	-0.00540	-0.00540	-0.00500	-0.00352	-0.00261	-0.00200	-0.00043	0.00070
-15.000	-0.00620	-0.00610	-0.00601	-0.00560	-0.00430	-0.00331	-0.00265	-0.00102	0.00018
-10.000	-0.00720	-0.00700	-0.00650	-0.00583	-0.00457	-0.00363	-0.00300	-0.00148	0.0
-5.000	-0.00657	-0.00657	-0.00657	-0.00562	-0.00330	-0.00205	-0.00133	-0.00040	0.00150
0.0	-0.00400	-0.00400	-0.00400	-0.00340	-0.00120	-0.00030	-0.00093	-0.00060	0.00150
5.000	-0.00010	-0.00020	-0.00030	-0.00052	-0.00118	-0.00050	-0.00025	0.00100	0.00200
10.000	0.00060	0.00038	0.0	-0.00023	-0.00050	0.00032	0.00100	0.00300	0.00360
15.000	0.00165	0.00130	0.00090	0.00060	0.00047	0.00144	0.00220	0.00430	0.00510

ENGINEER [illegible]
DATE 2-5-79

FIGURE 4.2.1.1-49
EFFECT OF AILERON



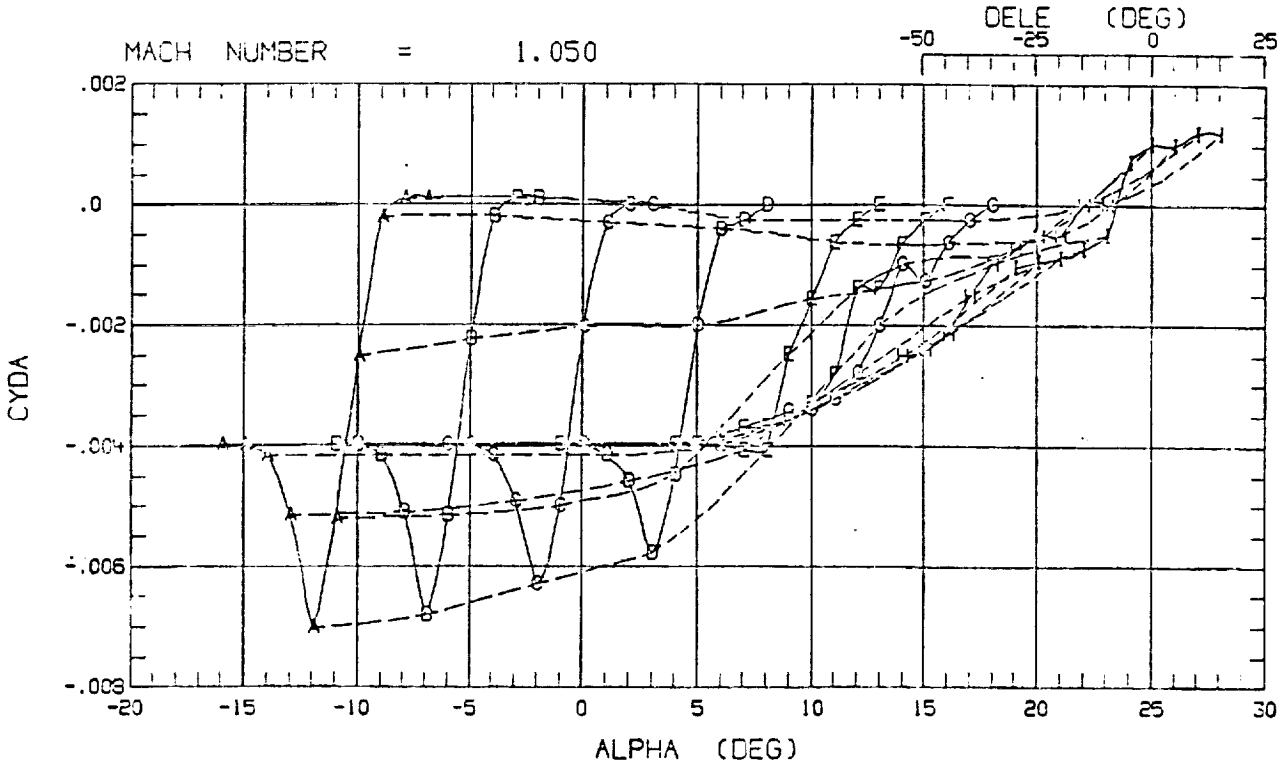
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00520	-0.00510	-0.00492	-0.00435	-0.00265	-0.00191	-0.00152	-0.00083	0.0
-25.000	-0.00565	-0.00557	-0.00538	-0.00470	-0.00300	-0.00216	-0.00170	-0.00093	-0.00012
-20.000	-0.00630	-0.00620	-0.00591	-0.00510	-0.00360	-0.00264	-0.00200	-0.00110	-0.00023
-15.000	-0.00720	-0.00707	-0.00669	-0.00570	-0.00450	-0.00322	-0.00241	-0.00129	-0.00033
-10.000	-0.00820	-0.00800	-0.00750	-0.00661	-0.00553	-0.00384	-0.00230	-0.00150	-0.00030
-5.000	-0.00755	-0.00755	-0.00750	-0.00700	-0.00470	-0.00350	-0.00110	-0.00082	0.00150
0.0	-0.00370	-0.00355	-0.00345	-0.00305	-0.00150	-0.00080	-0.00140	-0.00100	0.00150
5.000	-0.00010	-0.00020	-0.00030	-0.00057	-0.00150	-0.00120	-0.00160	-0.00018	0.00100
10.000	0.00020	0.00015	0.0	-0.00030	-0.00050	-0.00012	0.00032	0.00250	0.00300
15.000	0.00060	0.00040	0.00018	-0.00017	-0.00018	0.00043	0.00105	0.00334	0.00410

ENGINEER [signature]
DATE 2-5-79

FIGURE 4.2.1.1-50
EFFECT OF AILERON



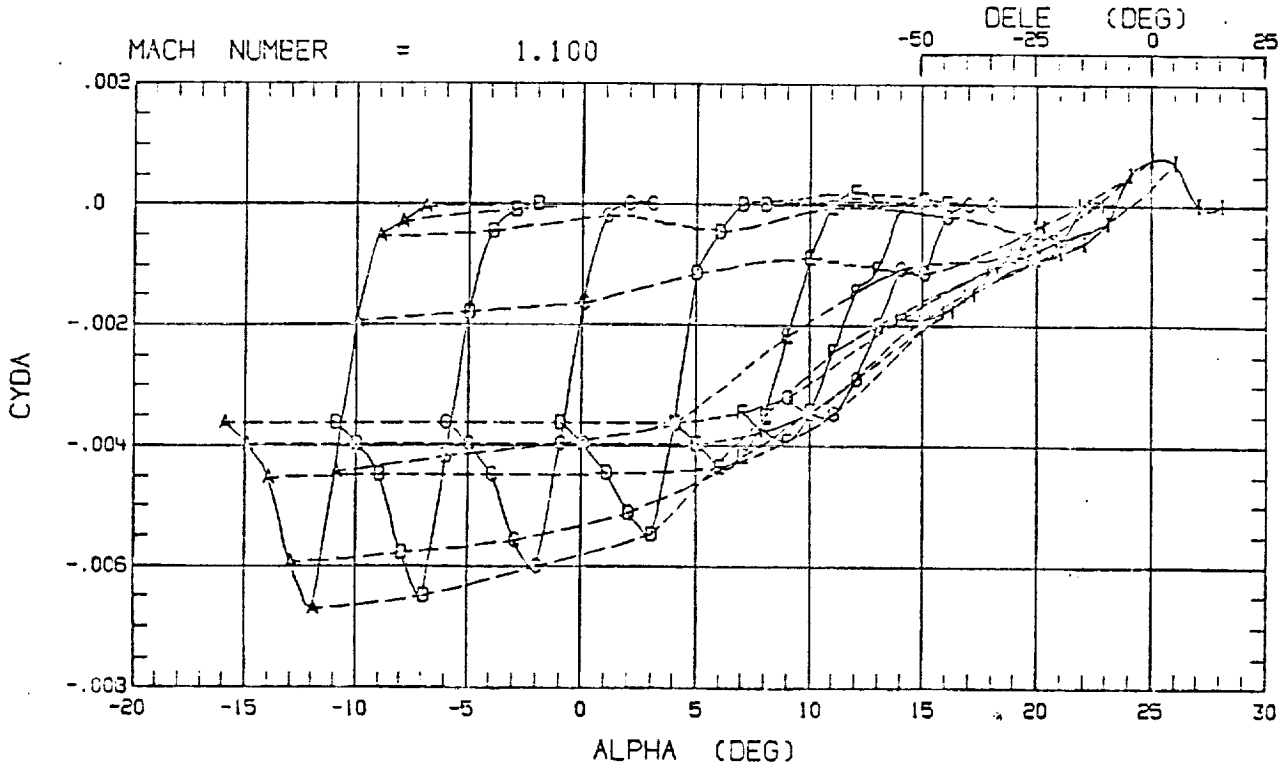
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00400	-0.00400	-0.00400	-0.00400	-0.00400	-0.00371	-0.00343	-0.00253	-0.00105
-25.000	-0.00400	-0.00400	-0.00400	-0.00400	-0.00400	-0.00369	-0.00340	-0.00242	-0.00095
-20.000	-0.00418	-0.00418	-0.00418	-0.00418	-0.00400	-0.00359	-0.00322	-0.00215	-0.00090
-15.000	-0.00515	-0.00510	-0.00493	-0.00480	-0.00408	-0.00331	-0.00280	-0.00152	-0.00075
-10.000	-0.00700	-0.00680	-0.00630	-0.00580	-0.00410	-0.00282	-0.00200	-0.00100	-0.00050
-5.000	-0.00730	-0.00515	-0.00500	-0.00450	-0.00250	-0.00141	-0.00100	-0.00075	0.00070
0.0	-0.00252	-0.00225	-0.00203	-0.00202	-0.00153	-0.00140	-0.00127	-0.00050	0.00100
5.000	-0.00020	-0.00020	-0.00030	-0.00040	-0.00063	-0.00067	-0.00065	-0.00050	0.00038
10.000	0.00010	0.00010	0.0	-0.00025	-0.00025	-0.00025	-0.00025	0.0	0.00120
15.000	0.00010	0.00010	0.0	0.0	0.0	0.0	0.0	0.0	0.00130

ENGINEER [signature]
DATE 2-15-77

FIGURE 4.2.1.1-51
EFFECT OF AILERON



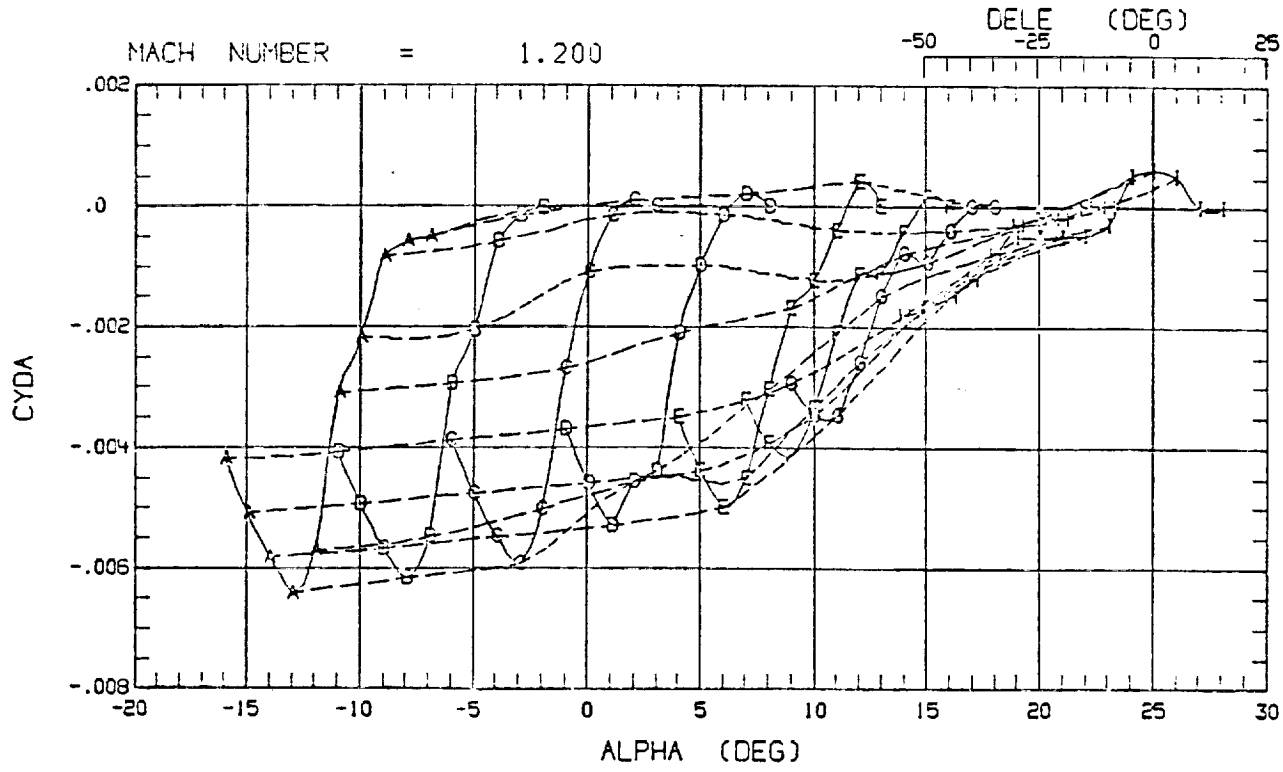
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00363	-0.00363	-0.00363	-0.00363	-0.00363	-0.00345	-0.00320	-0.00190	-0.00095
-25.000	-0.00398	-0.00398	-0.00398	-0.00398	-0.00398	-0.00377	-0.00348	-0.00190	-0.00090
-20.000	-0.00454	-0.00450	-0.00450	-0.00448	-0.00438	-0.00394	-0.00348	-0.00177	-0.00080
-15.000	-0.00595	-0.00580	-0.00558	-0.00512	-0.00420	-0.00344	-0.00290	-0.00150	-0.00063
-10.000	-0.00670	-0.00650	-0.00602	-0.00550	-0.00350	-0.00245	-0.00200	-0.00107	-0.00030
-5.000	-0.00445	-0.00420	-0.00398	-0.00365	-0.00220	-0.00145	-0.00108	-0.00080	0.00050
0.0	-0.00195	-0.00180	-0.00165	-0.00115	-0.00030	-0.00107	-0.00115	-0.00037	0.00075
5.000	-0.00053	-0.00045	-0.00020	-0.00045	-0.00005	-0.00010	-0.00020	-0.00060	0.00070
10.000	-0.00030	-0.00010	0.0	0.0	0.00020	0.00008	0.0	0.0	0.0
15.000	-0.00005	0.0	0.0	0.0	0.00005	0.00002	0.0	0.0	0.0

ENGINEER G³
DATE 2-5-79

FIGURE 4.2.1.1-52
EFFECT OF AILERON



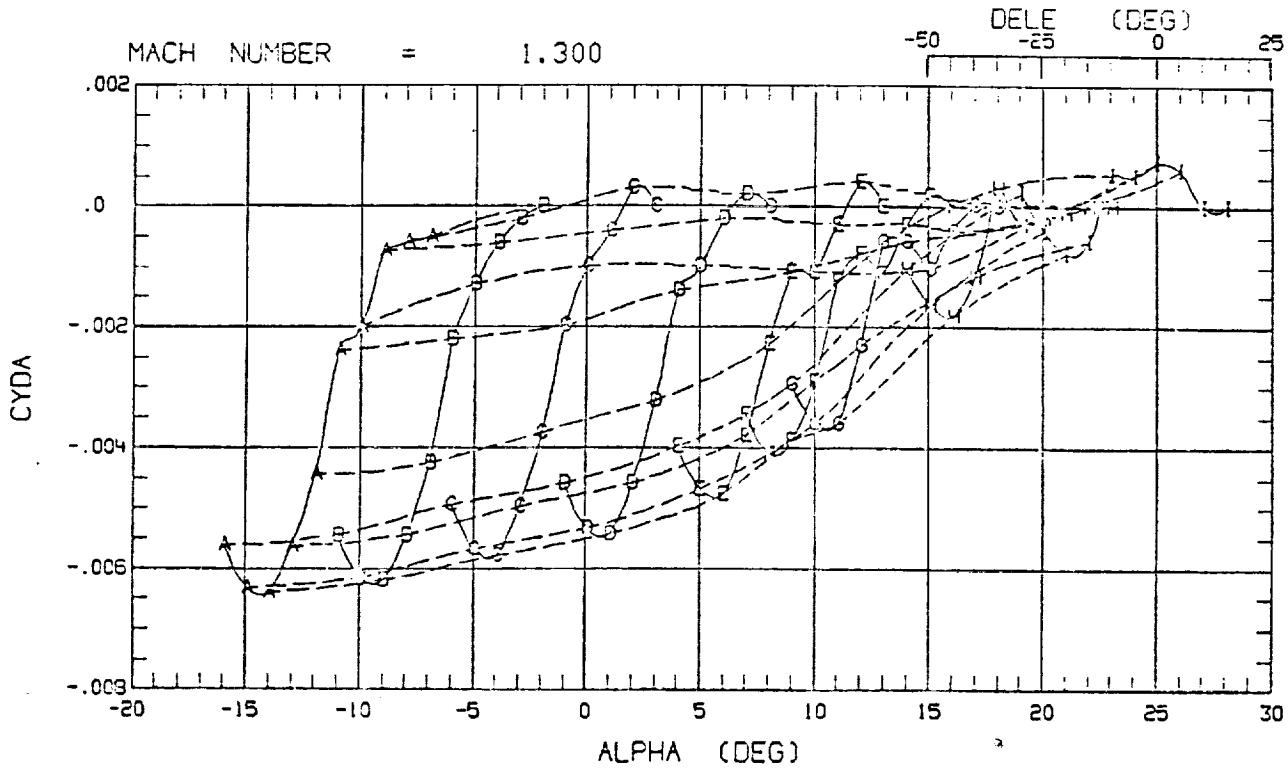
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	EW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00420	-0.00410	-0.00390	-0.00370	-0.00350	-0.00323	-0.00295	-0.00160	-0.00050
-25.000	-0.00510	-0.00495	-0.00477	-0.00460	-0.00440	-0.00394	-0.00347	-0.00168	-0.00050
-20.000	-0.00593	-0.00570	-0.00550	-0.00530	-0.00500	-0.00415	-0.00347	-0.00150	-0.00050
-15.000	-0.00642	-0.00618	-0.00595	-0.00458	-0.00452	-0.00335	-0.00260	-0.00122	-0.00048
-10.000	-0.00572	-0.00550	-0.00502	-0.00440	-0.00305	-0.00211	-0.00150	-0.00060	-0.00030
-5.000	-0.00310	-0.00295	-0.00270	-0.00210	-0.00170	-0.00115	-0.00080	-0.00032	0.00050
0.0	-0.00218	-0.00205	-0.00110	-0.00100	-0.00125	-0.00113	-0.00095	-0.00018	0.00060
5.000	-0.00083	-0.00060	-0.00015	-0.00015	-0.00040	-0.00043	-0.00040	-0.00020	0.00050
10.000	-0.00060	-0.00017	0.00010	0.00020	0.00040	0.00015	0.0	0.0	0.0
15.000	-0.00052	-0.00003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE 2-5-79

FIGURE 4.2.1.1- 53
EFFECT OF AILERON



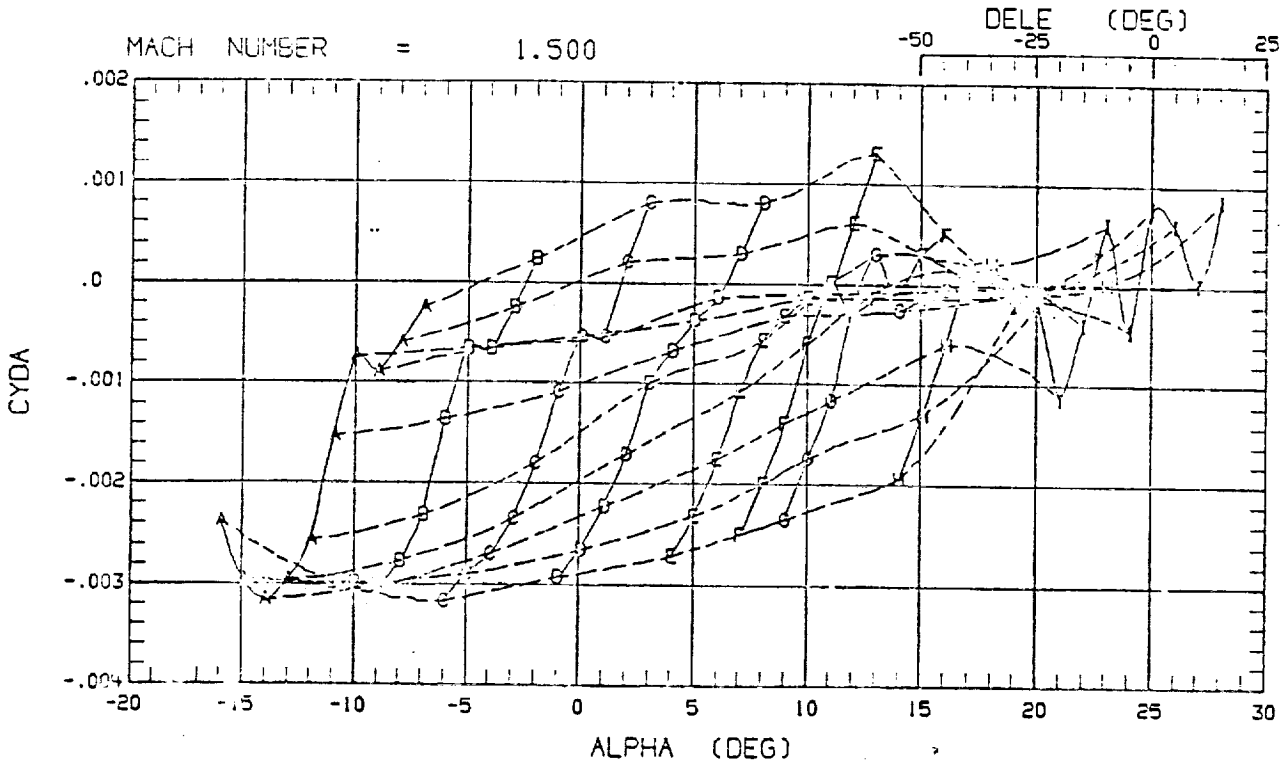
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00582	-0.00545	-0.00495	-0.00460	-0.00400	-0.00345	-0.00395	-0.00105	0.00022
-25.000	-0.00632	-0.00616	-0.00568	-0.00534	-0.00469	-0.00411	-0.00330	-0.00165	-0.00040
-20.000	-0.00640	-0.00621	-0.00580	-0.00544	-0.00478	-0.00390	-0.00360	-0.00183	-0.00090
-15.000	-0.00563	-0.00545	-0.00493	-0.00460	-0.00380	-0.00290	-0.00232	-0.00116	-0.00060
-10.000	-0.00445	-0.00428	-0.00375	-0.00323	-0.00230	-0.00126	-0.00060	0.00030	0.00053
-5.000	-0.00240	-0.00222	-0.00198	-0.00140	-0.00110	-0.00080	-0.00060	-0.00030	0.00050
0.0	-0.00202	-0.00130	-0.00100	-0.00100	-0.00110	-0.00111	-0.00105	-0.00020	0.00072
5.000	-0.00075	-0.00062	-0.00042	-0.00020	-0.00030	-0.00030	-0.00040	-0.00010	0.00060
10.000	-0.00060	-0.00020	0.00030	0.00020	0.00040	0.00017	0.00003	0.0	0.0
15.000	-0.00062	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE 2-5-79

FIGURE 4.2.1.1-54
EFFEC OF AILERON



CONFIGURATION

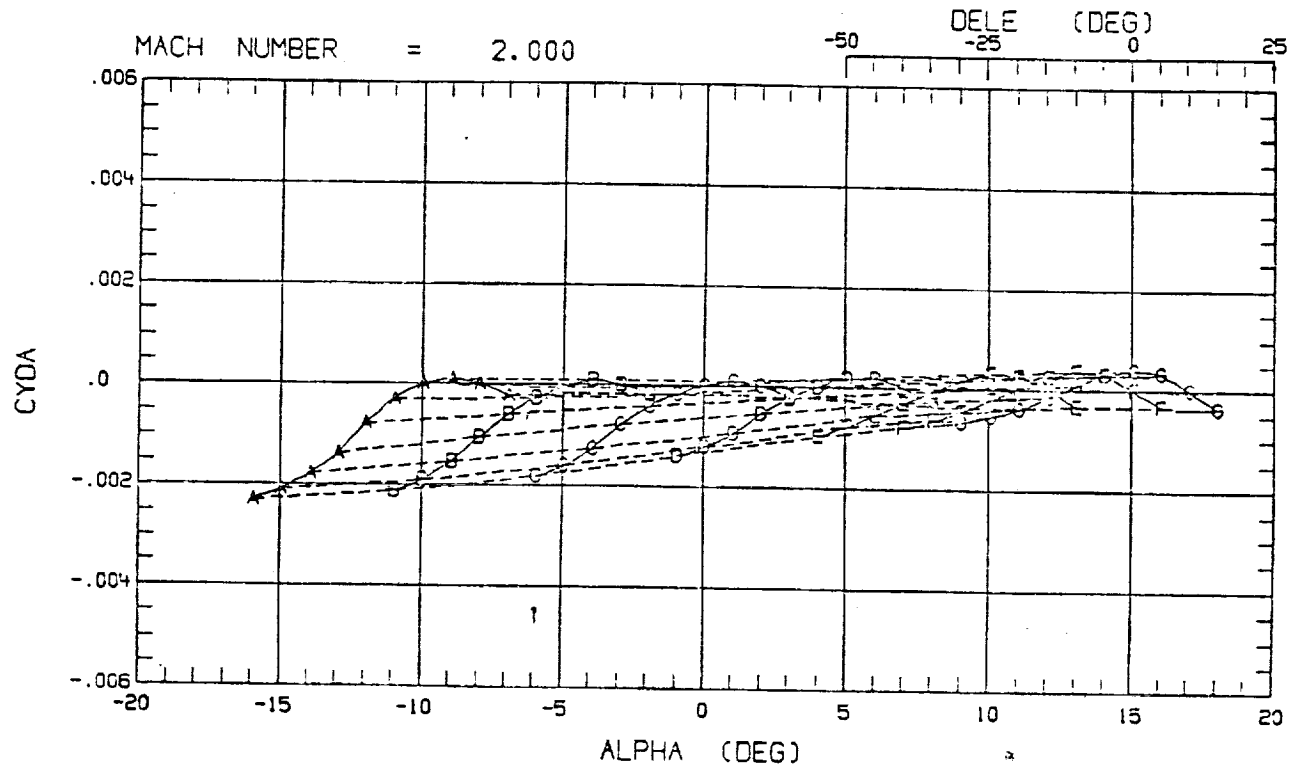
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00239	-0.00300	-0.00318	-0.00294	-0.00272	-0.00250	-0.00235	-0.00195	-0.00021
-25.000	-0.00296	-0.00300	-0.00290	-0.00286	-0.00232	-0.00200	-0.00174	-0.00130	-0.00020
-20.000	-0.00317	-0.00302	-0.00271	-0.00224	-0.00176	-0.00140	-0.00117	-0.00051	-0.00113
-15.000	-0.00297	-0.00278	-0.00235	-0.00171	-0.00103	-0.00060	-0.00022	0.00015	-0.00040
-10.000	-0.00357	-0.00232	-0.00180	-0.00100	-0.00057	0.0	0.00030	0.00020	0.00060
-5.000	-0.00153	-0.00137	-0.00109	-0.00068	-0.00033	-0.00030	-0.00027	-0.00012	-0.00047
0.0	-0.00074	-0.00066	-0.00054	-0.00033	-0.00015	-0.00015	-0.00015	-0.00005	0.00077
5.000	-0.00090	-0.00066	-0.00055	-0.00015	-0.00010	-0.00008	-0.00005	0.0	0.00060
10.000	-0.00060	-0.00026	0.00020	0.00030	0.00060	0.00030	0.00003	0.0	0.0
15.000	-0.00036	0.00024	0.00080	0.00080	0.00170	0.00050	0.00010	0.0	0.00085

ENGINEER [illegible]
DATE 2-5-79

FIGURE 4.2.1.1- 55
EFFECT OF AILERON

SD72-SH-CCCC 1M

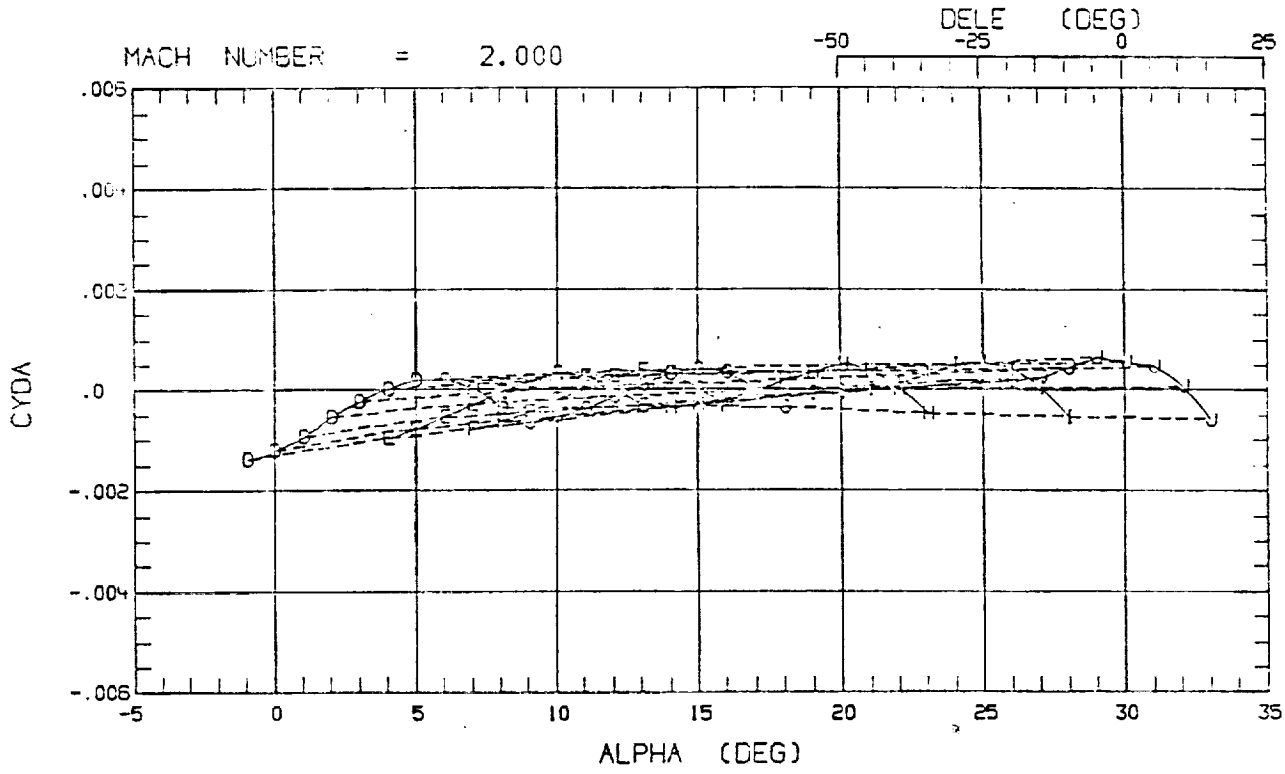


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1250.3 IN.

	ALPHA (DEG)						
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE						
-30.000	-0.00230	-0.00214	-0.00184	-0.00141	-0.00098	-0.00079	-0.00067
-25.000	-0.00210	-0.00191	-0.00162	-0.00122	-0.00078	-0.00065	-0.00056
-20.000	-0.00180	-0.00155	-0.00127	-0.00095	-0.00056	-0.00046	-0.00039
-15.000	-0.00140	-0.00108	-0.00080	-0.00055	-0.00029	-0.00020	-0.00015
-10.000	-0.00080	-0.00061	-0.00042	-0.00023	-0.00006	0.00004	0.00010
-5.000	-0.00030	-0.00027	-0.00017	0.00001	0.00016	0.00024	0.00029
0.0	0.0	-0.00006	0.0	0.00018	0.00031	0.00037	0.00041
5.000	0.00010	0.00008	0.00010	0.00017	0.00025	0.00029	0.00032
10.000	0.00001	0.00001	0.00001	0.0	0.00001	0.0	0.0
15.000	-0.00022	-0.00017	-0.00022	-0.00036	-0.00035	-0.00035	-0.00036

ENGINEER
DATE

FIGURE 4.2.1.1-56
AILERON SIDE FORCE DERIVATIVE (/DEG.)



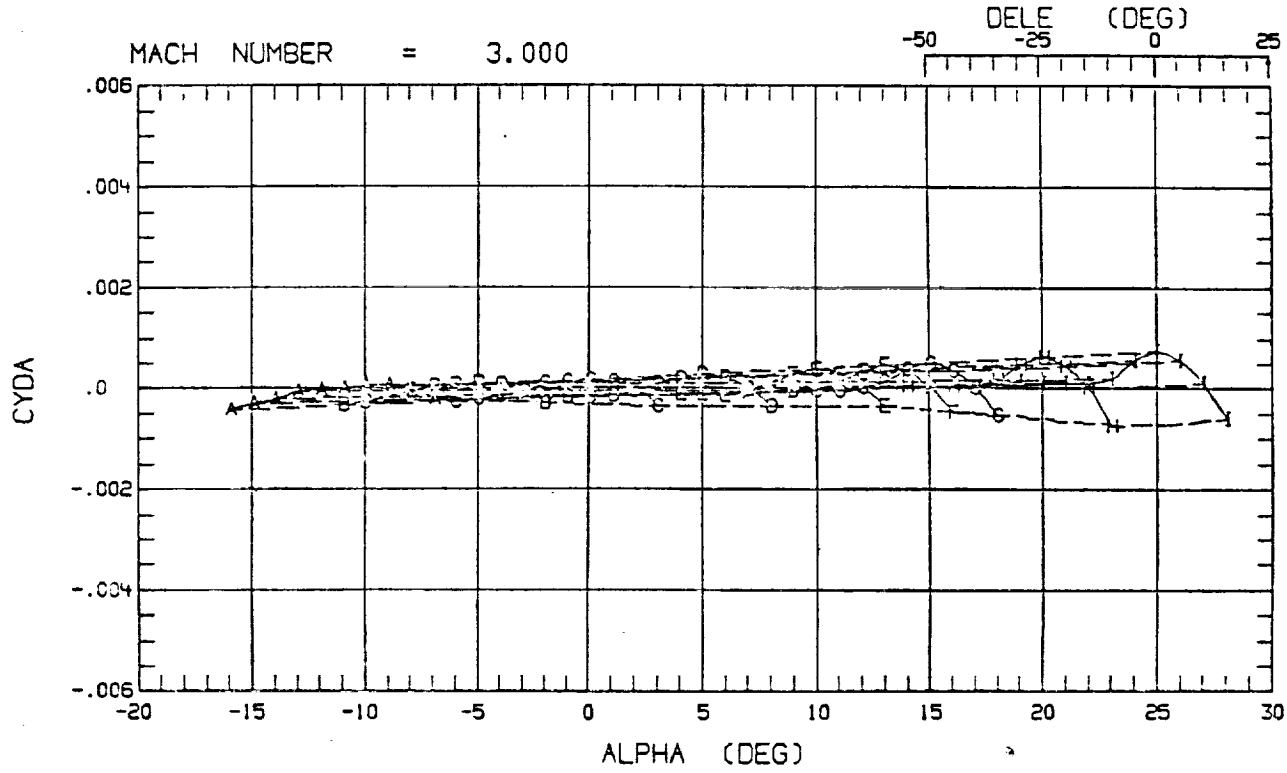
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I	30.000 J
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE						
-30.000	-0.00141	-0.00098	-0.00079	-0.00067	-0.00037	-0.00009	0.00019
-25.000	-0.00122	-0.00078	-0.00065	-0.00056	-0.00030	-0.00007	0.00016
-20.000	-0.00085	-0.00056	-0.00046	-0.00039	-0.00020	-0.00001	0.00018
-15.000	-0.00055	-0.00029	-0.00020	-0.00015	-0.00003	0.00011	0.00025
-10.000	-0.00023	-0.00006	0.00004	0.00010	0.00017	0.00030	0.00043
-5.000	0.00001	0.00016	0.00024	0.00029	0.00034	0.00049	0.00064
0.0	0.00018	0.00031	0.00037	0.00041	0.00048	0.00051	0.00054
5.000	0.00017	0.00025	0.00029	0.00032	0.00037	0.00041	0.00045
10.000	0.0	0.00001	0.0	0.0	0.00001	0.00003	0.00005
15.000	-0.00036	-0.00035	-0.00035	-0.00036	-0.00048	-0.00054	-0.00060

ENGINEER
DATE

FIGURE 4.2.1.1-57
AILERON SIDE FORCE DERIVATIVE (/DEG.)



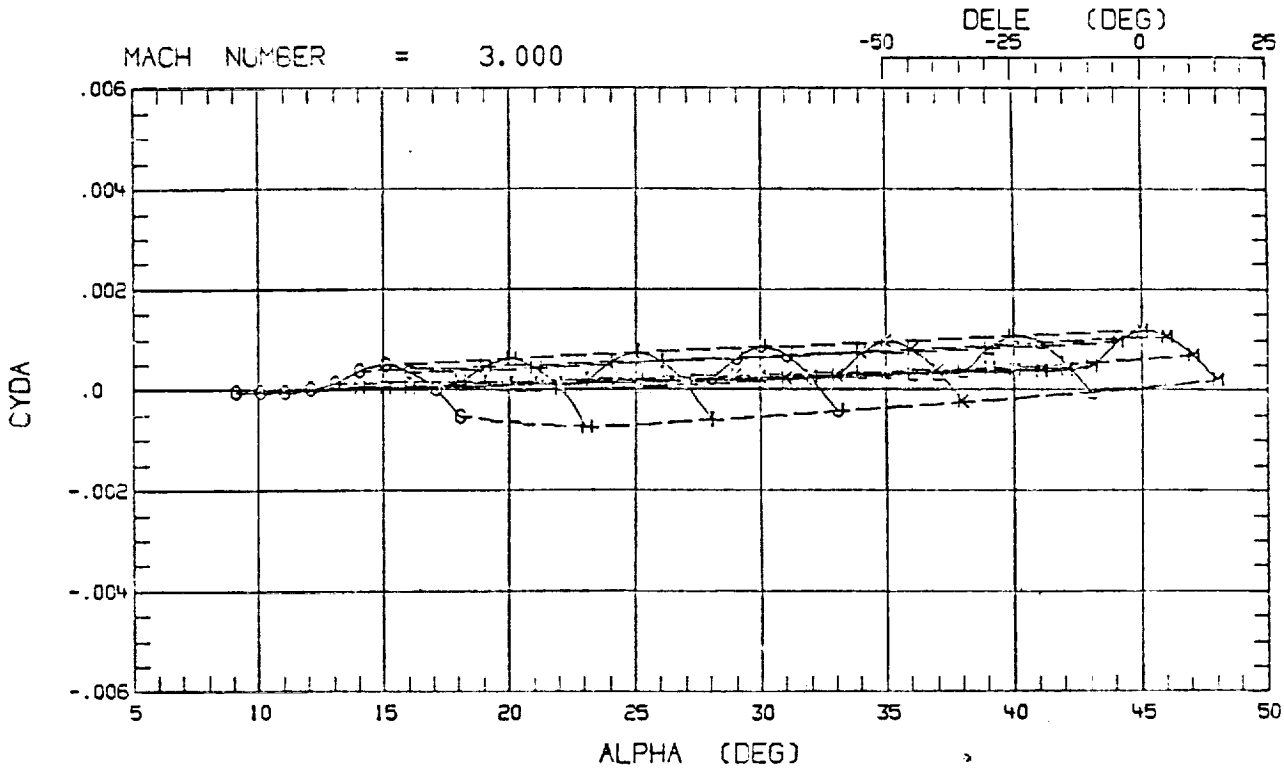
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00044	-0.00034	-0.00025	-0.00019	-0.00013	-0.00009	-0.00006	0.00002	0.00011
-25.000	-0.00031	-0.00026	-0.00022	-0.00017	-0.00013	-0.00008	-0.00005	0.00002	0.00009
-20.000	-0.00021	-0.00018	-0.00016	-0.00015	-0.00014	-0.00009	-0.00005	0.00004	0.00009
-15.000	-0.00007	-0.00007	-0.00007	-0.00006	-0.00004	-0.00002	-0.00001	0.00004	0.00010
-10.000	-0.00002	0.00004	0.00008	0.00009	0.00011	0.00012	0.00013	0.00015	0.00018
-5.000	0.0	0.00005	0.00011	0.00019	0.00023	0.00033	0.00037	0.00046	0.00054
0.0	0.00005	0.00008	0.00015	0.00026	0.00038	0.00045	0.00049	0.00061	0.00072
5.000	0.00005	0.00007	0.00012	0.00020	0.00028	0.00032	0.00035	0.00043	0.00055
10.000	-0.00003	-0.00002	-0.00001	0.00001	0.00002	0.00001	0.0	-0.00001	0.00009
15.000	-0.00021	-0.00031	-0.00037	-0.00037	-0.00037	-0.00048	-0.00055	-0.00075	-0.00061

ENGINEER _____
DATE _____

FIGURE 4.2.1.1-58
AILERON SIDE FORCE DERIVATIVE (/DEG.)



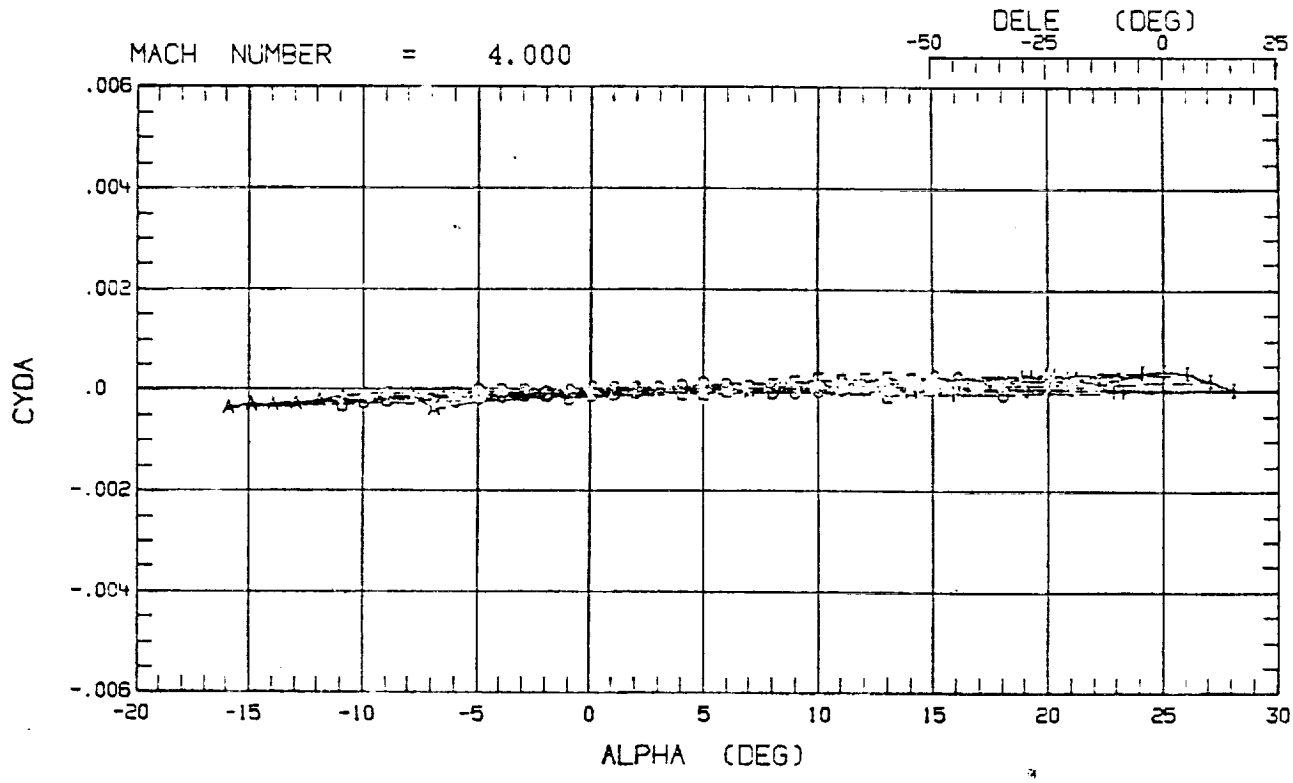
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE						
-30.000	-0.00006	0.00002	0.00011	0.00020	0.00028	0.00035	0.00042
-25.000	-0.00005	0.00002	0.00009	0.00017	0.00025	0.00032	0.00040
-20.000	-0.00005	0.00004	0.00009	0.00014	0.00021	0.00029	0.00038
-15.000	-0.00001	0.00004	0.00010	0.00016	0.00023	0.00031	0.00039
-10.000	0.00013	0.00015	0.00018	0.00021	0.00027	0.00036	0.00046
-5.000	0.00037	0.00046	0.00054	0.00062	0.00072	0.00082	0.00094
0.0	0.00049	0.00061	0.00072	0.00084	0.00095	0.00106	0.00117
5.000	0.00035	0.00043	0.00055	0.00068	0.00080	0.00093	0.00105
10.000	0.0	-0.00001	0.00009	0.00022	0.00036	0.00051	0.00068
15.000	-0.00056	-0.00075	-0.00061	-0.00044	-0.00025	-0.00005	0.00017

ENGINEER
DATE

FIGURE 4.2.1.1-59
AILERON SIDE FORCE DERIVATIVE (/DEG.)



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00036	-0.00029	-0.00023	-0.00017	-0.00010	-0.00007	-0.00006	-0.00003	0.00001
-25.000	-0.00031	-0.00024	-0.00018	-0.00013	-0.00008	-0.00005	-0.00004	-0.00001	0.00003
-20.000	-0.00029	-0.00022	-0.00016	-0.00010	-0.00004	-0.00002	-0.00001	0.00001	0.00004
-15.000	-0.00027	-0.00019	-0.00012	-0.00006	-0.00001	0.00002	0.00004	0.00009	0.00011
-10.000	-0.00022	-0.00016	-0.00009	-0.00001	0.00006	0.00009	0.00011	0.00016	0.00021
-5.000	-0.00015	-0.00012	-0.00007	0.00003	0.00013	0.00017	0.00019	0.00026	0.00033
0.0	-0.00010	-0.00006	0.0	0.00009	0.00018	0.00022	0.00024	0.00030	0.00036
5.000	-0.00008	-0.00005	0.0	0.00007	0.00015	0.00018	0.00020	0.00025	0.00032
10.000	-0.00013	-0.00005	0.0	0.00002	0.00004	0.00006	0.00007	0.00012	0.00018
15.000	-0.00039	-0.00013	0.0	-0.00005	-0.00011	-0.00009	-0.00008	-0.00004	0.0

ENGINEER_____
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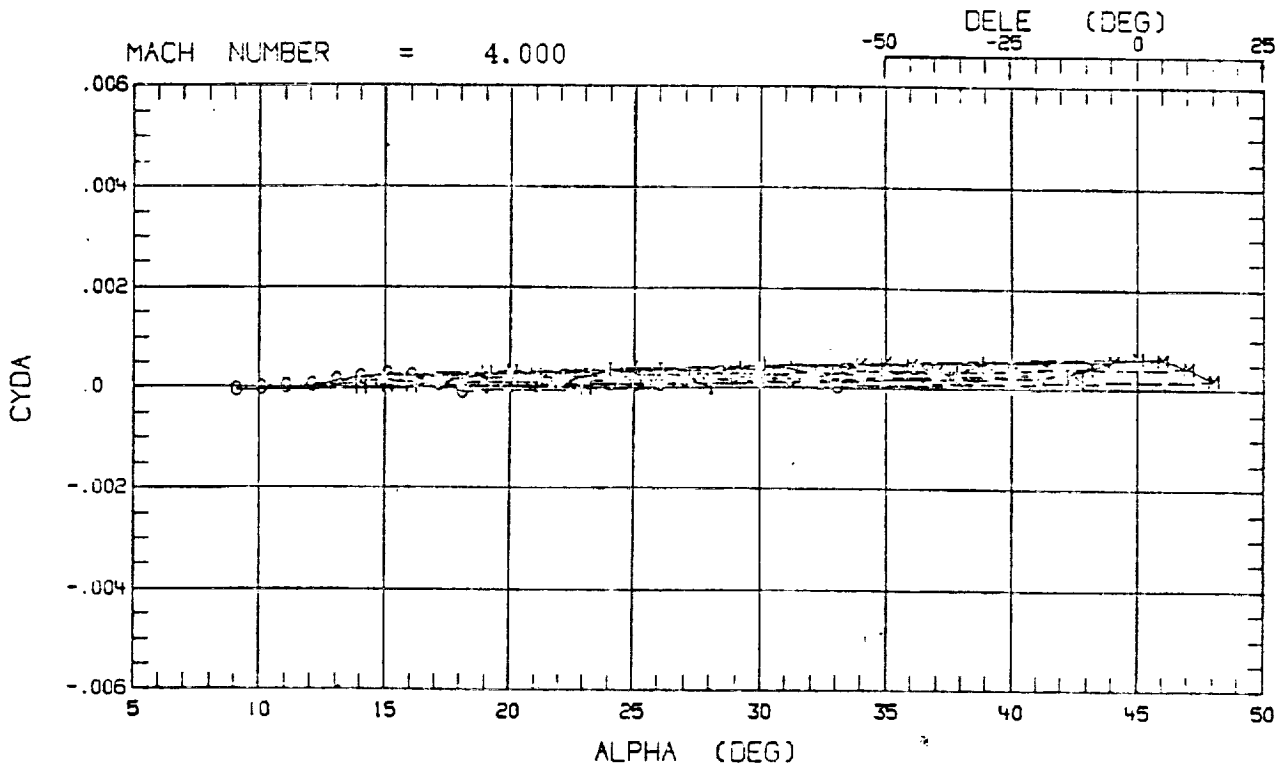
FIGURE 4.2.1.1-60
AILERON SIDE FORCE DERIVATIVE (/DEG.)

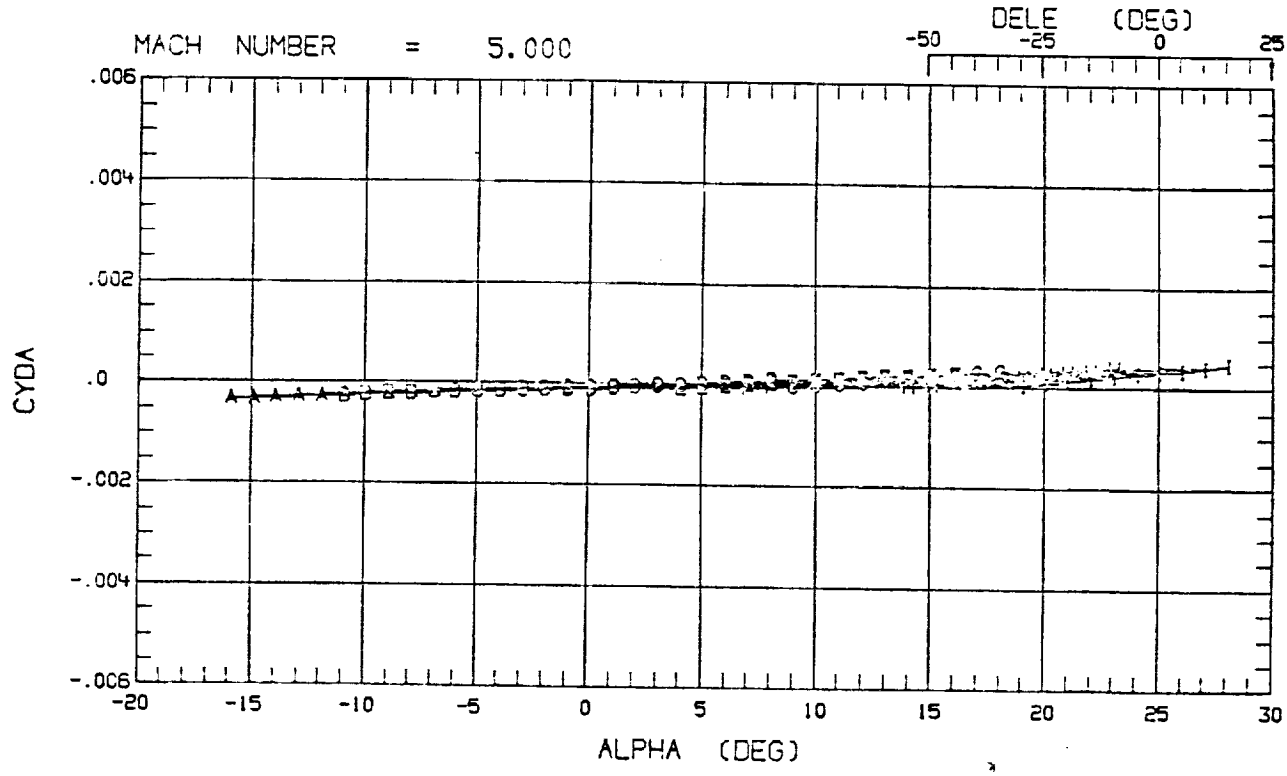


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE						
-30.000	-0.00006	-0.00003	0.00001	0.00005	0.00010	0.00017	0.00024
-25.000	-0.00004	-0.00001	0.00003	0.00007	0.00011	0.00016	0.00021
-20.000	-0.00001	0.00001	0.00004	0.00007	0.00011	0.00016	0.00022
-15.000	0.00004	0.00009	0.00011	0.00014	0.00018	0.00022	0.00028
-10.000	0.00011	0.00016	0.00021	0.00026	0.00031	0.00035	0.00040
-5.000	0.00019	0.00026	0.00033	0.00041	0.00047	0.00052	0.00056
0.0	0.00024	0.00030	0.00036	0.00043	0.00049	0.00056	0.00062
5.000	0.00020	0.00025	0.00032	0.00040	0.00047	0.00053	0.00058
10.000	0.00007	0.00012	0.00018	0.00025	0.00031	0.00037	0.00042
15.000	-0.00008	-0.00004	0.0	0.00004	0.00008	0.00013	0.00018

ENGINEER
DATE 9-25-78

FIGURE 4.2.1.1-61
AILERON SIDE FORCE DERIVATIVE (/DEG.)



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00034	-0.00026	-0.00019	-0.00013	-0.00008	-0.00006	-0.00004	0.0	0.00004
-25.000	-0.00032	-0.00024	-0.00017	-0.00011	-0.00005	-0.00002	0.0	0.00004	0.00008
-20.000	-0.00030	-0.00022	-0.00015	-0.00008	-0.00002	0.00002	0.00004	0.00009	0.00013
-15.000	-0.00029	-0.00021	-0.00014	-0.00006	0.00001	0.00005	0.00007	0.00013	0.00017
-10.000	-0.00026	-0.00019	-0.00012	-0.00004	0.00004	0.00008	0.00011	0.00017	0.00022
-5.000	-0.00024	-0.00017	-0.00010	-0.00002	0.00007	0.00012	0.00015	0.00022	0.00026
0.0	-0.00022	-0.00015	-0.00008	0.00001	0.00010	0.00015	0.00018	0.00026	0.00031
5.000	-0.00020	-0.00014	-0.00007	0.00003	0.00013	0.00019	0.00022	0.00030	0.00035
10.000	-0.00018	-0.00012	-0.00005	0.00005	0.00016	0.00022	0.00026	0.00035	0.00041
15.000	-0.00016	-0.00011	-0.00003	0.00008	0.00019	0.00025	0.00029	0.00039	0.00045

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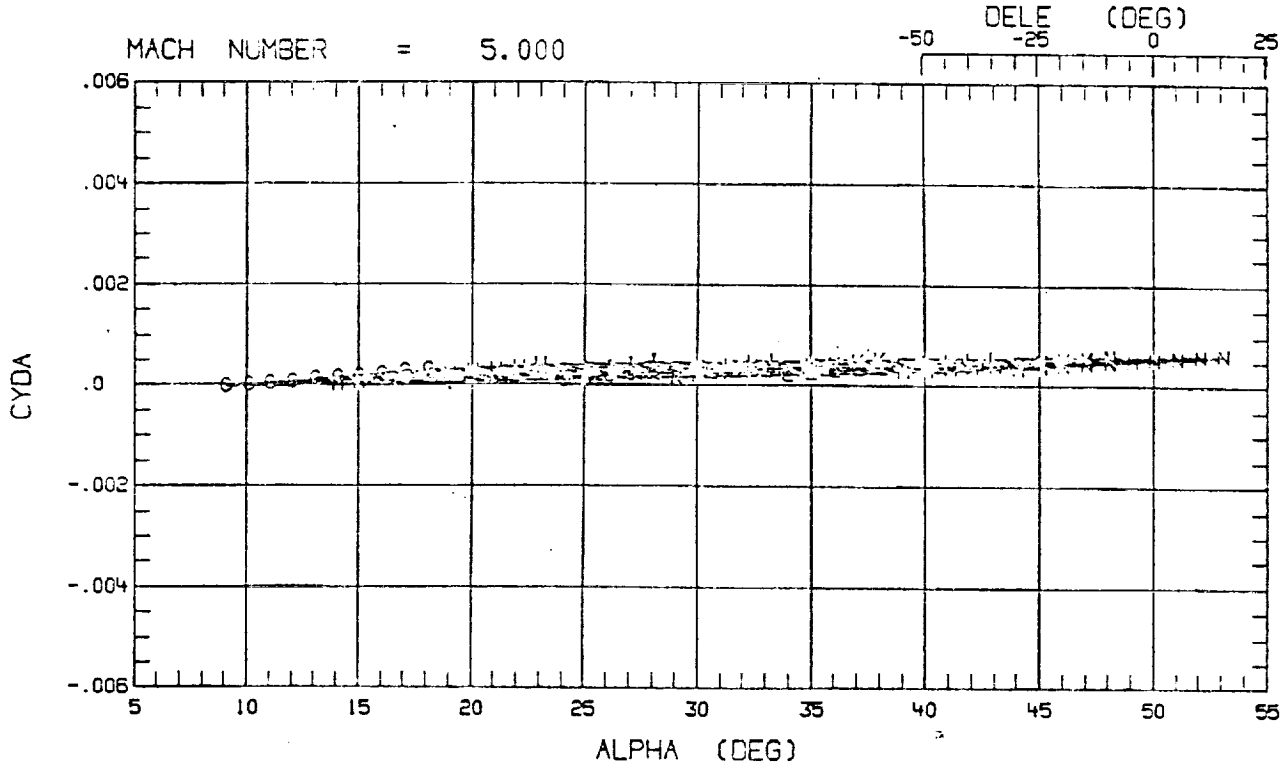
FIGURE 4.2.1.1-62
AILERON SIDE FORCE DERIVATIVE (/DEG.)



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = SL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE							
-30.000	-0.00004	0.0	0.00004	0.00009	0.00014	0.00021	0.00027	0.00035
-25.000	0.0	0.00004	0.00008	0.00013	0.00018	0.00024	0.00031	0.00038
-20.000	0.00004	0.00009	0.00013	0.00018	0.00023	0.00029	0.00035	0.00041
-15.000	0.00007	0.00013	0.00017	0.00022	0.00027	0.00032	0.00037	0.00043
-10.000	0.00011	0.00017	0.00022	0.00027	0.00032	0.00037	0.00041	0.00046
-5.000	0.00015	0.00022	0.00026	0.00031	0.00035	0.00040	0.00044	0.00049
0.0	0.00018	0.00026	0.00031	0.00036	0.00040	0.00045	0.00048	0.00052
5.000	0.00022	0.00030	0.00035	0.00040	0.00044	0.00048	0.00051	0.00054
10.000	0.00026	0.00035	0.00041	0.00045	0.00049	0.00052	0.00055	0.00057
15.000	0.00029	0.00039	0.00045	0.00049	0.00053	0.00056	0.00058	0.00060

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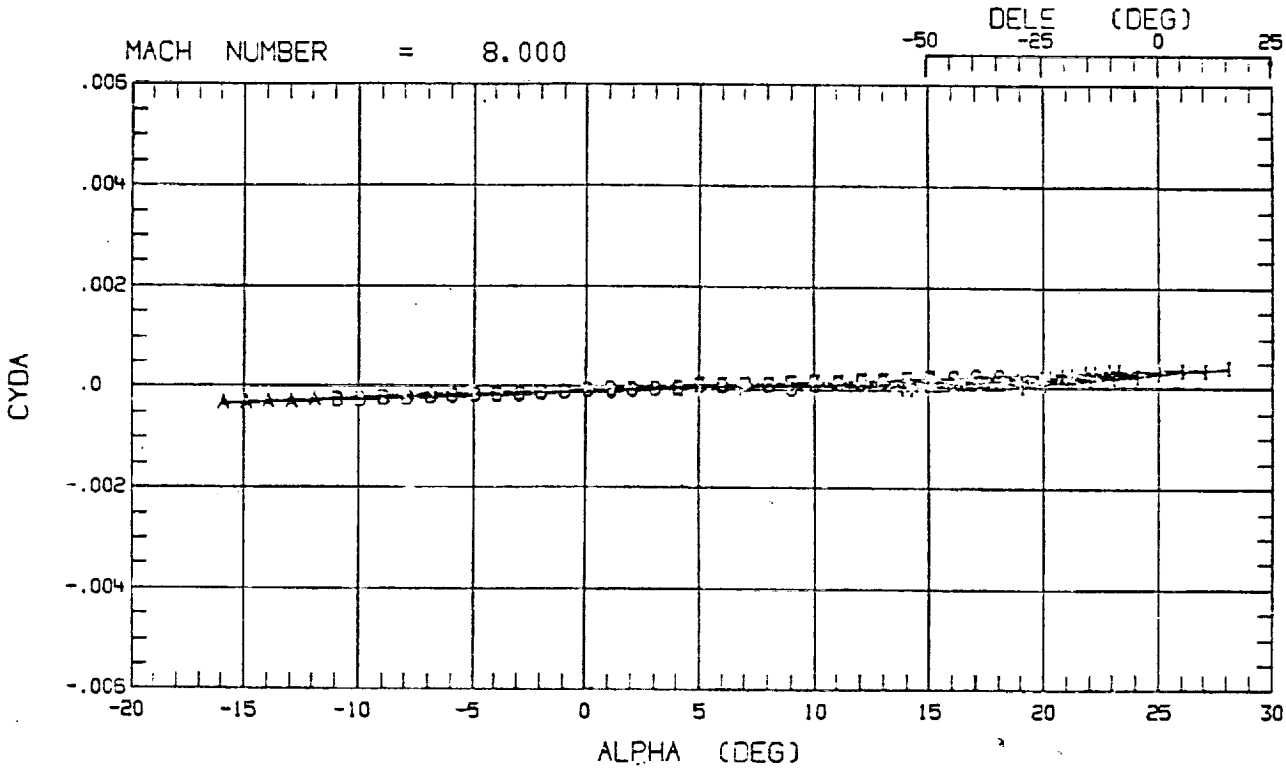
FIGURE 4.2.1.1-63
AILERON SIDE FORCE DERIVATIVE (/DEG.)



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00034	-0.00028	-0.00021	-0.00013	-0.00006	-0.00006	-0.00006	-0.00006	0.0
-25.000	-0.00032	-0.00026	-0.00019	-0.00008	0.00002	0.00002	0.00002	0.00002	0.00007
-20.000	-0.00030	-0.00024	-0.00017	-0.00006	0.00004	0.00005	0.00005	0.00006	0.00009
-15.000	-0.00029	-0.00024	-0.00017	-0.00007	0.00004	0.00005	0.00006	0.00009	0.00015
-10.000	-0.00028	-0.00022	-0.00015	-0.00006	0.00003	0.00006	0.00008	0.00013	0.00018
-5.000	-0.00025	-0.00019	-0.00012	-0.00003	0.00005	0.00008	0.00010	0.00016	0.00022
0.0	-0.00022	-0.00017	-0.00010	-0.00001	0.00008	0.00012	0.00014	0.00020	0.00026
5.000	-0.00020	-0.00017	-0.00011	0.0	0.00010	0.00015	0.00018	0.00025	0.00032
10.000	-0.00018	-0.00014	-0.00008	0.00002	0.00012	0.00017	0.00021	0.00030	0.00035
15.000	-0.00016	-0.00012	-0.00006	0.00003	0.00012	0.00018	0.00022	0.00032	0.00039

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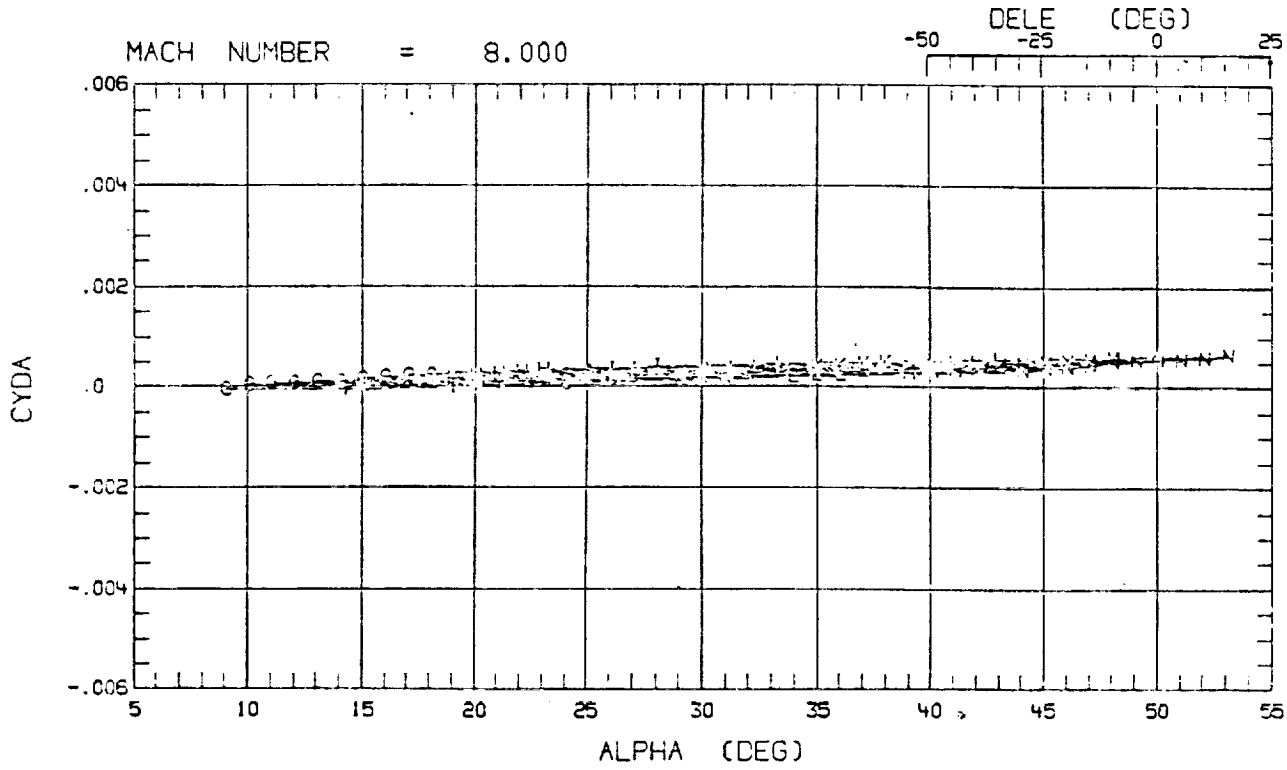
FIGURE 4.2.1.1-64
AILERON SIDE FORCE DERIVATIVE (/DEG.)



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	G	H	I	J	K	L	M	N
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE							
-30.000	-0.00006	-0.00006	0.0	0.00007	0.00013	0.00020	0.00026	0.00032
-25.000	0.00002	0.00002	0.00007	0.00012	0.00018	0.00024	0.00030	0.00037
-20.000	0.00005	0.00006	0.00009	0.00014	0.00019	0.00025	0.00032	0.00039
-15.000	0.00006	0.00009	0.00015	0.00021	0.00027	0.00033	0.00038	0.00044
-10.000	0.00008	0.00013	0.00018	0.00024	0.00030	0.00036	0.00042	0.00049
-5.000	0.00010	0.00016	0.00022	0.00028	0.00034	0.00040	0.00045	0.00051
0.0	0.00014	0.00020	0.00026	0.00033	0.00039	0.00044	0.00049	0.00054
5.000	0.00018	0.00025	0.00032	0.00038	0.00043	0.00048	0.00052	0.00056
10.000	0.00021	0.00030	0.00035	0.00040	0.00045	0.00049	0.00054	0.00058
15.000	0.00022	0.00032	0.00039	0.00045	0.00050	0.00055	0.00059	0.00063

ENGINEER_____
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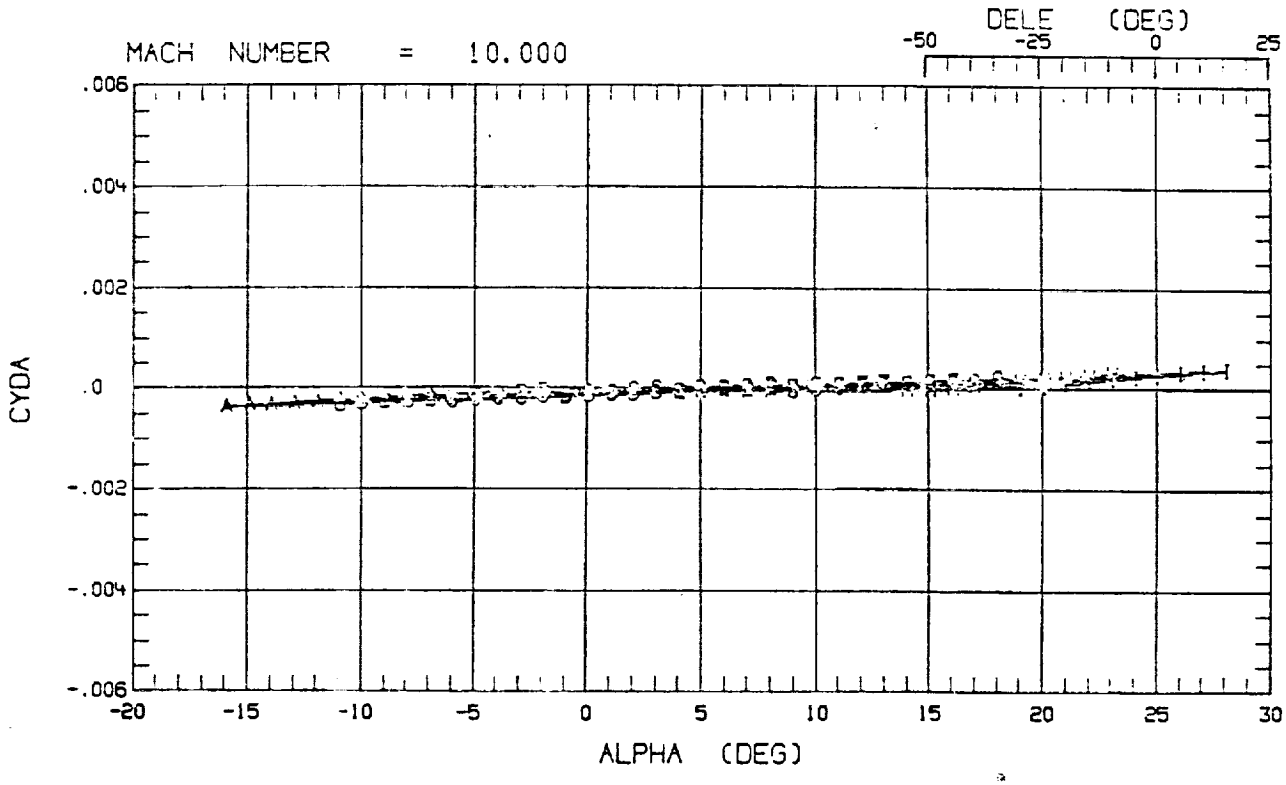
FIGURE 4.2.1.1-65
AILERON SIDE FORCE DERIVATIVE (/DEG.)



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL .0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00038	-0.00033	-0.00027	-0.00018	-0.00009	-0.00007	-0.00006	-0.00004	0.00001
-25.000	-0.00035	-0.00031	-0.00025	-0.00016	-0.00007	-0.00005	-0.00004	-0.00002	0.00004
-20.000	-0.00032	-0.00029	-0.00022	-0.00013	-0.00004	-0.00002	-0.00001	0.00001	0.00008
-15.000	-0.00029	-0.00026	-0.00020	-0.00011	-0.00002	0.0	0.00002	0.00006	0.00013
-10.000	-0.00026	-0.00023	-0.00017	-0.00008	0.00001	0.00004	0.00006	0.00011	0.00017
-5.000	-0.00023	-0.00020	-0.00014	-0.00005	0.00003	0.00006	0.00008	0.00014	0.00022
0.0	-0.00023	-0.00016	-0.00009	-0.00001	0.00006	0.00010	0.00013	0.00019	0.00025
5.000	-0.00020	-0.00015	-0.00009	-0.00001	0.00006	0.00010	0.00013	0.00021	0.00029
10.000	-0.00017	-0.00010	-0.00004	0.00002	0.00009	0.00013	0.00016	0.00024	0.00033
15.000	-0.00014	-0.00006	0.00001	0.00006	0.00011	0.00015	0.00020	0.00029	0.00037

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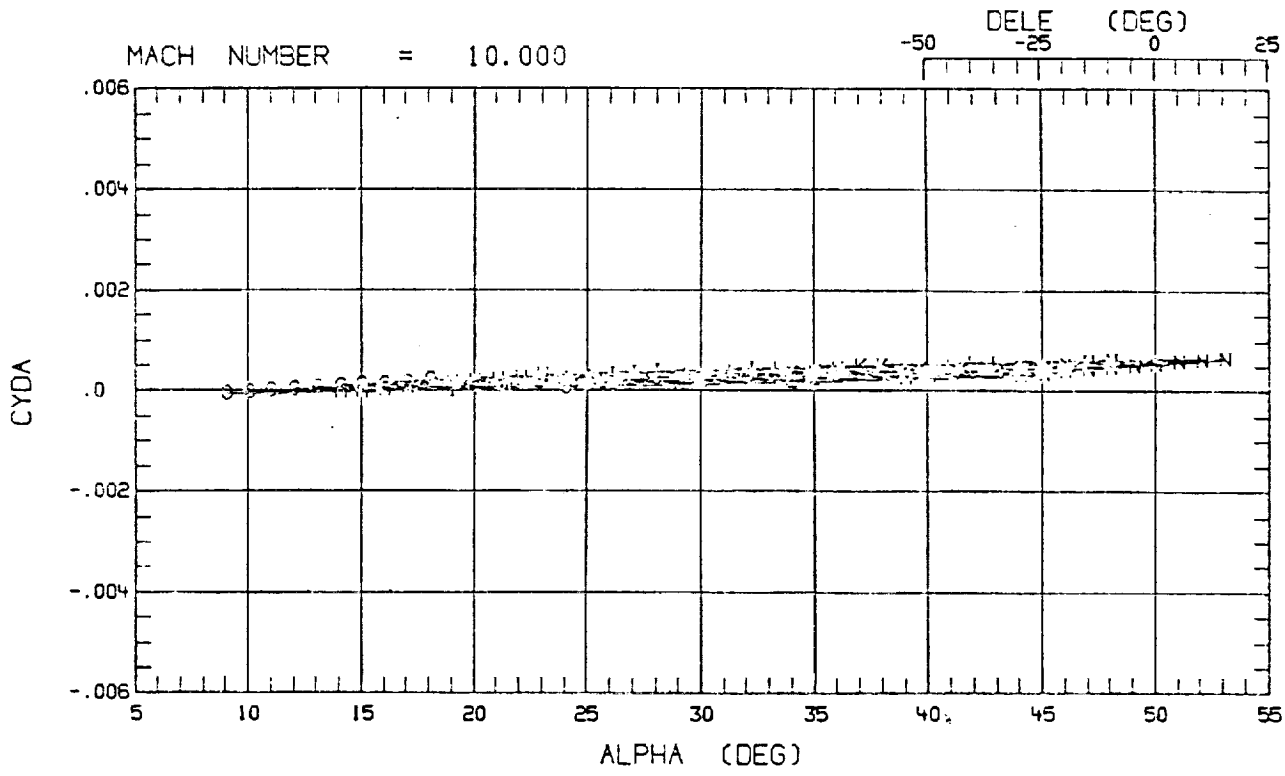
FIGURE 4.2.1.1-66
AILERON SIDE FORCE DERIVATIVE (/DEG.)



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE							
-30.000	-0.00006	-0.00004	0.00001	0.00006	0.00011	0.00017	0.00023	0.00029
-25.000	-0.00004	-0.00002	0.00004	0.00011	0.00017	0.00023	0.00029	0.00034
-20.000	-0.00001	0.00001	0.00008	0.00016	0.00023	0.00029	0.00034	0.00039
-15.000	0.00002	0.00006	0.00013	0.00021	0.00028	0.00034	0.00039	0.00044
-10.000	0.00006	0.00011	0.00017	0.00024	0.00030	0.00036	0.00041	0.00046
-5.000	0.00008	0.00014	0.00022	0.00029	0.00035	0.00041	0.00045	0.00049
0.0	0.00013	0.00019	0.00025	0.00031	0.00037	0.00042	0.00047	0.00052
5.000	0.00013	0.00021	0.00029	0.00037	0.00043	0.00049	0.00053	0.00057
10.000	0.00016	0.00024	0.00033	0.00042	0.00049	0.00054	0.00058	0.00060
15.000	0.00020	0.00029	0.00037	0.00044	0.00050	0.00056	0.00061	0.00065

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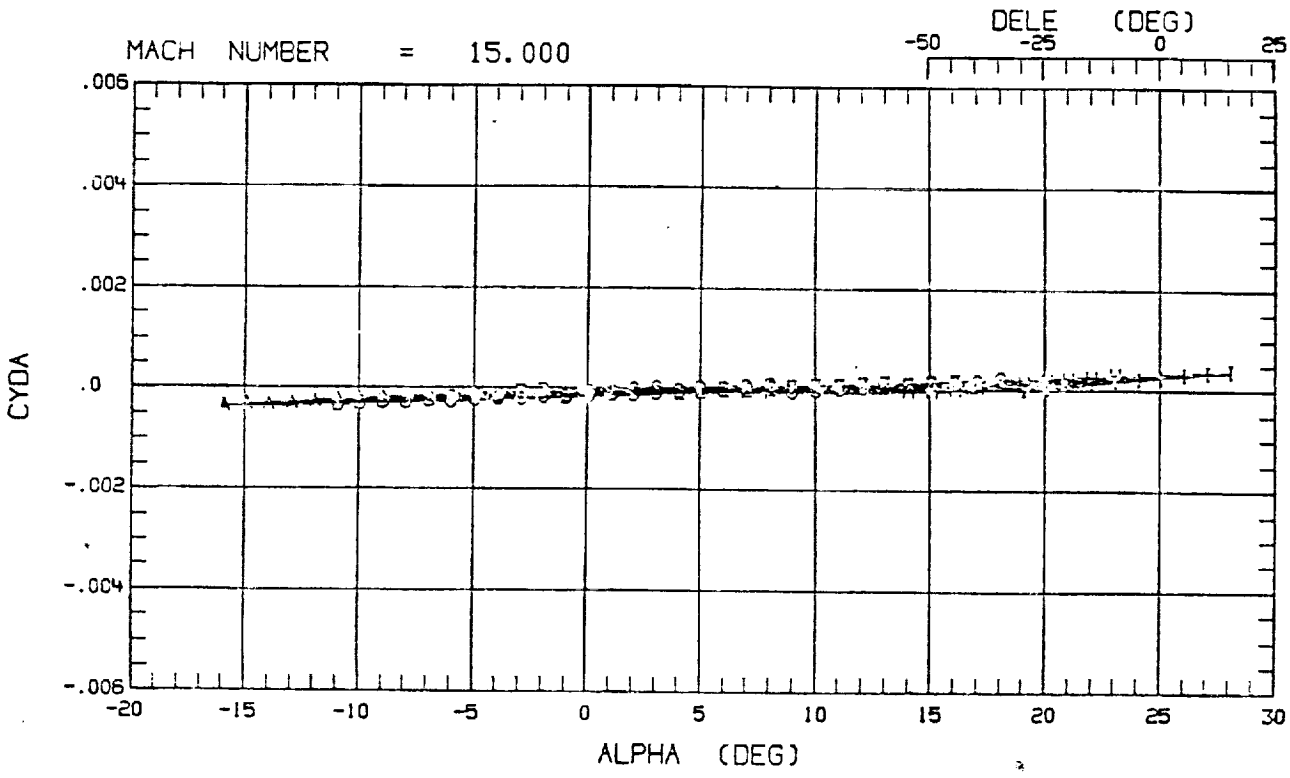
FIGURE 4.2.1.1-67
AILERON SIDE FORCE DERIVATIVE (/DEG.)



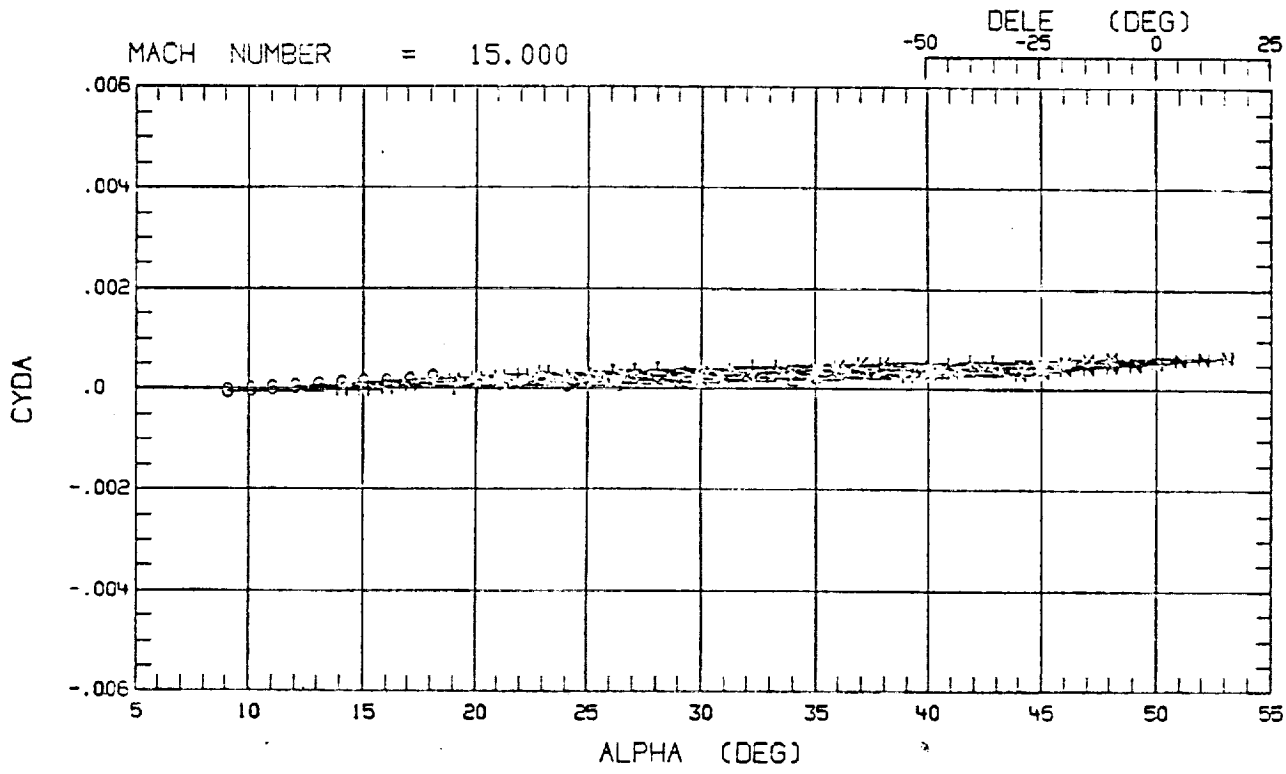
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00038	-0.00033	-0.00027	-0.00018	-0.00009	-0.00007	-0.00006	-0.00004	0.00001
-25.000	-0.00035	-0.00031	-0.00025	-0.00016	-0.00007	-0.00005	-0.00004	-0.00002	0.00004
-20.000	-0.00032	-0.00028	-0.00022	-0.00013	-0.00004	-0.00002	-0.00001	0.00001	0.00008
-15.000	-0.00029	-0.00026	-0.00020	-0.00011	-0.00002	0.0	0.00002	0.00006	0.00013
-10.000	-0.00026	-0.00023	-0.00017	-0.00008	0.00001	0.00004	0.00006	0.00011	0.00017
-5.000	-0.00023	-0.00020	-0.00014	-0.00005	0.00003	0.00006	0.00008	0.00014	0.00022
0.0	-0.00023	-0.00016	-0.00009	-0.00001	0.00006	0.00010	0.00013	0.00019	0.00025
5.000	-0.00020	-0.00015	-0.00009	-0.00001	0.00006	0.00010	0.00013	0.00021	0.00029
10.000	-0.00017	-0.00010	-0.00004	0.00002	0.00009	0.00013	0.00016	0.00024	0.00033
15.000	-0.00014	-0.00006	0.00001	0.00006	0.00011	0.00016	0.00020	0.00029	0.00037

ENGINEER_____
DATE_____

FIGURE 4.2.1.1-68
AILERON SIDE FORCE DERIVATIVE (/DEG.)



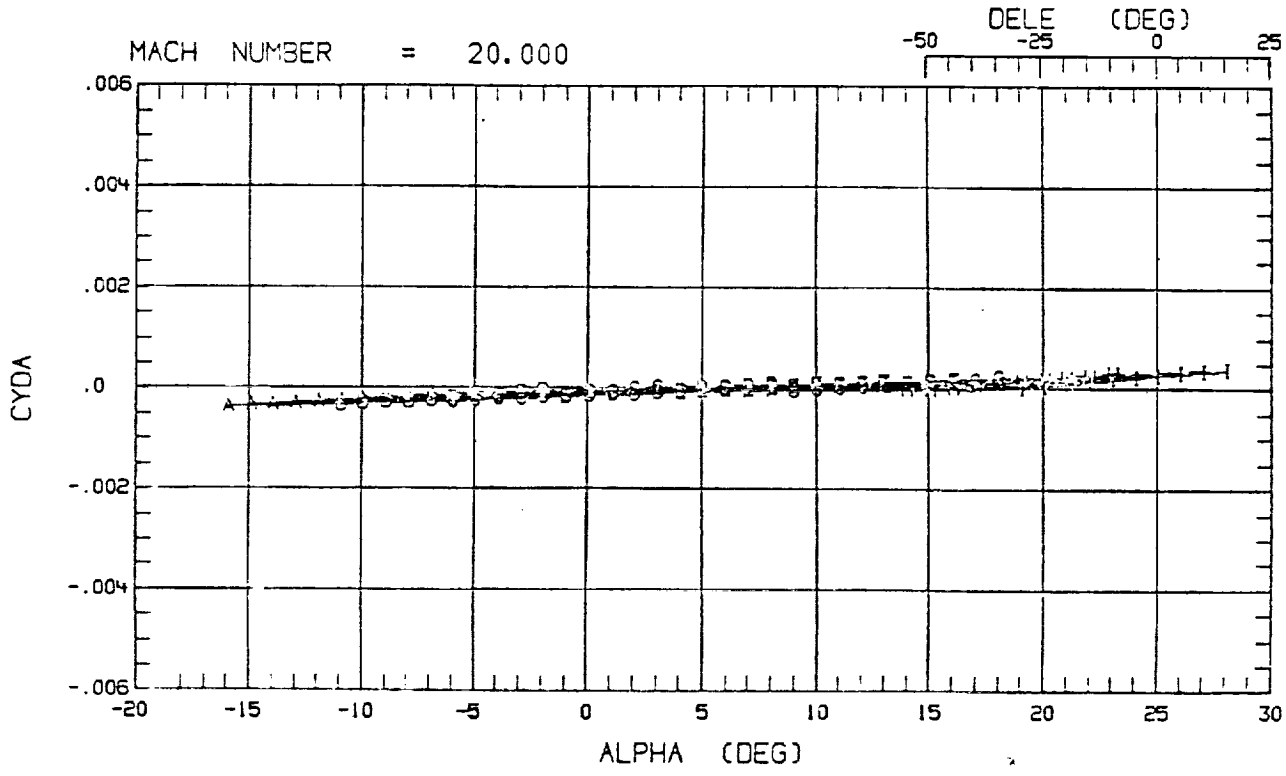
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE							
-30.000	-0.00006	-0.00004	0.00001	0.00006	0.00011	0.00017	0.00023	0.00029
-25.000	-0.00004	-0.00002	0.00004	0.00011	0.00017	0.00023	0.00029	0.00034
-20.000	-0.00001	0.00001	0.00008	0.00016	0.00023	0.00029	0.00034	0.00039
-15.000	0.00002	0.00006	0.00013	0.00021	0.00028	0.00034	0.00039	0.00044
-10.000	0.00006	0.00011	0.00017	0.00024	0.00030	0.00036	0.00041	0.00046
-5.000	0.00008	0.00014	0.00022	0.00029	0.00035	0.00041	0.00045	0.00049
0.0	0.00013	0.00019	0.00025	0.00031	0.00037	0.00042	0.00047	0.00052
5.000	0.00013	0.00021	0.00029	0.00037	0.00043	0.00049	0.00053	0.00057
10.000	0.00016	0.00024	0.00033	0.00042	0.00049	0.00054	0.00058	0.00060
15.000	0.00020	0.00029	0.00037	0.00044	0.00050	0.00056	0.00061	0.00065

ENGINEER
DATE

FIGURE 4.2.1.1-69
AILERON SIDE FORCE DERIVATIVE (/DEG.)



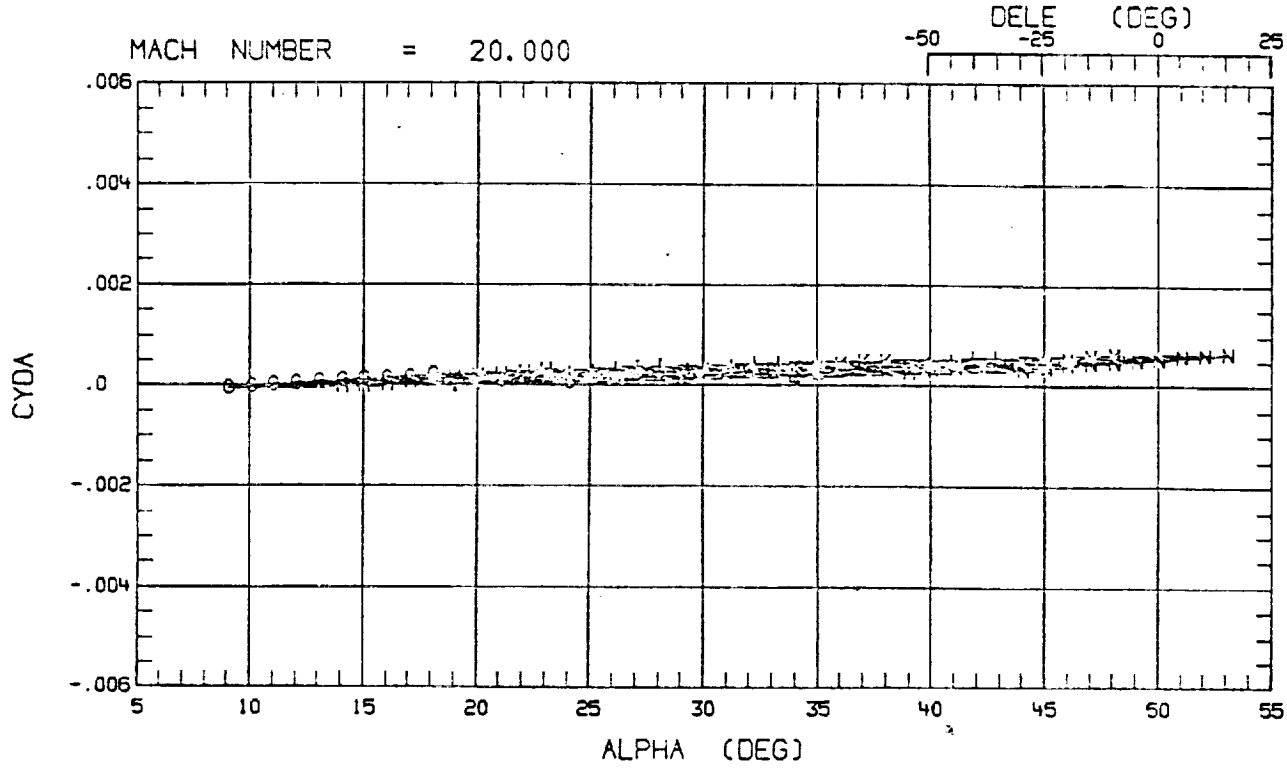
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE								
-30.000	-0.00038	-0.00033	-0.00027	-0.00018	-0.00009	-0.00007	-0.00006	-0.00004	0.00001
-25.000	-0.00035	-0.00031	-0.00025	-0.00016	-0.00007	-0.00005	-0.00004	-0.00002	0.00004
-20.000	-0.00032	-0.00028	-0.00022	-0.00013	-0.00004	-0.00002	-0.00001	0.00001	0.00008
-15.000	-0.00029	-0.00026	-0.00020	-0.00011	-0.00002	0.0	0.00002	0.00006	0.00013
-10.000	-0.00026	-0.00023	-0.00017	-0.00008	0.00001	0.00004	0.00006	0.00011	0.00017
-5.000	-0.00023	-0.00020	-0.00014	-0.00005	0.00003	0.00006	0.00008	0.00014	0.00022
0.0	-0.00023	-0.00016	-0.00009	-0.00001	0.00006	0.00010	0.00013	0.00019	0.00025
5.000	-0.00020	-0.00015	-0.00009	-0.00001	0.00006	0.00010	0.00013	0.00021	0.00029
10.000	-0.00017	-0.00010	-0.00004	0.00002	0.00009	0.00013	0.00016	0.00024	0.00033
15.000	-0.00014	-0.00006	0.00001	0.00006	0.00011	0.00016	0.00020	0.00029	0.00037

ENGINEER
DATE

FIGURE 4.2.1.1-70
AILERON SIDE FORCE DERIVATIVE (/DEG.)



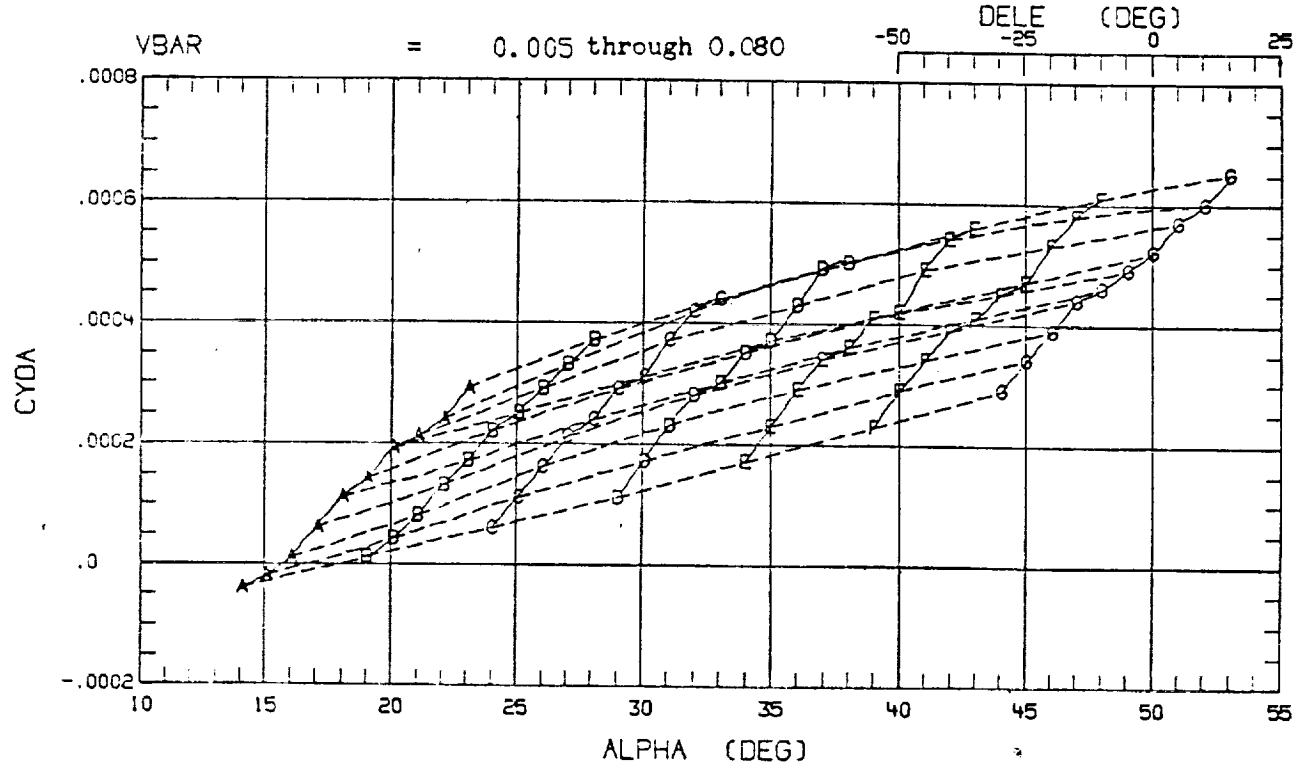
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE							
-30.000	-0.00006	-0.00004	0.00001	0.00006	0.00011	0.00017	0.00023	0.00029
-25.000	-0.00004	-0.00002	0.00004	0.00011	0.00017	0.00023	0.00029	0.00034
-20.000	-0.00001	0.00001	0.00008	0.00016	0.00023	0.00029	0.00034	0.00039
-15.000	0.00002	0.00006	0.00013	0.00021	0.00028	0.00034	0.00039	0.00044
-10.000	0.00006	0.00011	0.00017	0.00024	0.00030	0.00036	0.00041	0.00046
-5.000	0.00008	0.00014	0.00022	0.00029	0.00035	0.00041	0.00045	0.00049
0.0	0.00013	0.00019	0.00025	0.00031	0.00037	0.00042	0.00047	0.00052
5.000	0.00013	0.00021	0.00029	0.00037	0.00043	0.00049	0.00053	0.00057
10.000	0.00016	0.00024	0.00033	0.00042	0.00049	0.00054	0.00058	0.00060
15.000	0.00020	0.00029	0.00037	0.00044	0.00050	0.00056	0.00061	0.00065

ENGINEER_____
DATE_____

FIGURE 4.2.1.1-71
AILERON SIDE FORCE DERIVATIVE (/DEG.)



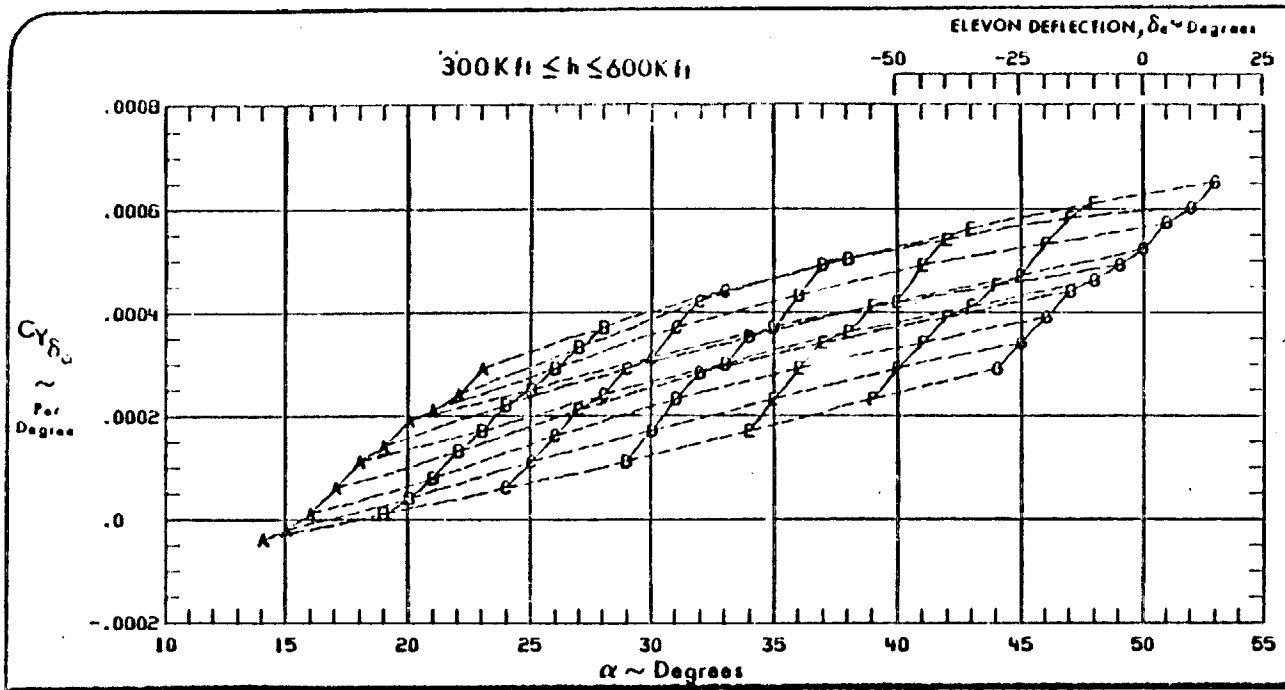
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELE (DEG)	AILERON SIDE FORCE DERIVATIVE						
-30.000	-0.00004	0.00001	0.00006	0.00011	0.00017	0.00023	0.00029
-25.000	-0.00002	0.00004	0.00011	0.00017	0.00023	0.00029	0.00034
-20.000	0.00001	0.00008	0.00016	0.00023	0.00029	0.00034	0.00039
-15.000	0.00006	0.00013	0.00021	0.00028	0.00034	0.00039	0.00044
-10.000	0.00011	0.00017	0.00024	0.00030	0.00036	0.00041	0.00046
-5.000	0.00014	0.00022	0.00029	0.00035	0.00041	0.00045	0.00049
0.0	0.00019	0.00025	0.00031	0.00037	0.00042	0.00047	0.00052
5.000	0.00021	0.00029	0.00037	0.00043	0.00049	0.00053	0.00057
10.000	0.00024	0.00033	0.00042	0.00049	0.00054	0.00058	0.00060
15.000	0.00029	0.00037	0.00044	0.00050	0.00056	0.00061	0.00065

ENGINEER NASA
DATE

FIGURE 4.2.1.1-72
EFFECT OF AILERON



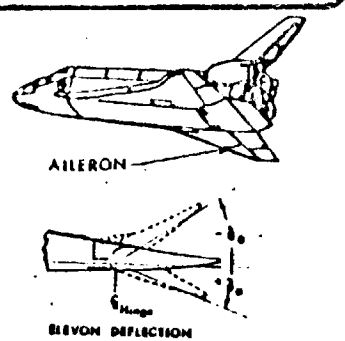
CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY: X_{cg} = FS 1076.70
OR: Y_{cg} = BL 0.00
MOMENT REFERENCE: Z_{cg} = WL 373.00

REFERENCE DIMENSIONS

AREA: S_w = 2690.000 ft²
SPAN: b_w = 78.056 ft
MAC: $\bar{c}_w$ = 39.869 ft
BODY LENGTH: L_b = 1290.300 in



δ_e ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{Y_{\delta_a}}$ ~ per Degree												
-30.000							-0.00004	0.00001	0.00006	0.00011	0.00017	0.00023	0.00029
-25.000							-0.00002	0.00004	0.00011	0.00017	0.00023	0.00029	0.00034
-20.000							0.00001	0.00008	0.00016	0.00023	0.00029	0.00034	0.00039
-15.000							0.00006	0.00013	0.00021	0.00028	0.00034	0.00039	0.00044
-10.000							0.00011	0.00017	0.00024	0.00030	0.00036	0.00041	0.00046
-5.000							0.00014	0.00022	0.00029	0.00035	0.00041	0.00045	0.00049
0.0							0.00019	0.00025	0.00031	0.00037	0.00042	0.00047	0.00052
5.000							0.00021	0.00029	0.00037	0.00043	0.00049	0.00053	0.00057
10.000							0.00024	0.00033	0.00042	0.00049	0.00054	0.00058	0.00060
15.000							0.00029	0.00037	0.00044	0.00050	0.00056	0.00061	0.00065

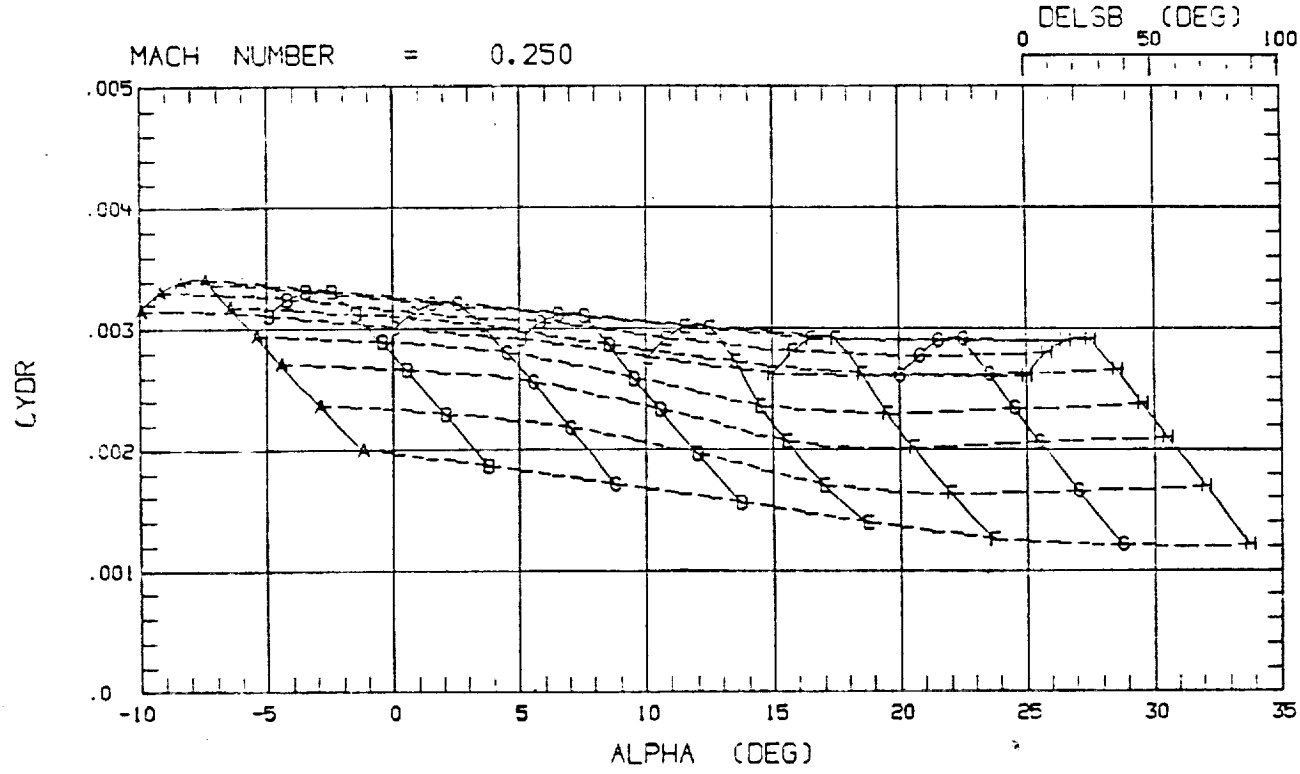
ENGINEER: NASA
DATE:
REVISED:

Figure 4.2.1.1-73
EFFECT OF AILERON

4.2.1.1-79

SD72-SH-0060 IM

Rockwell International
Space Division



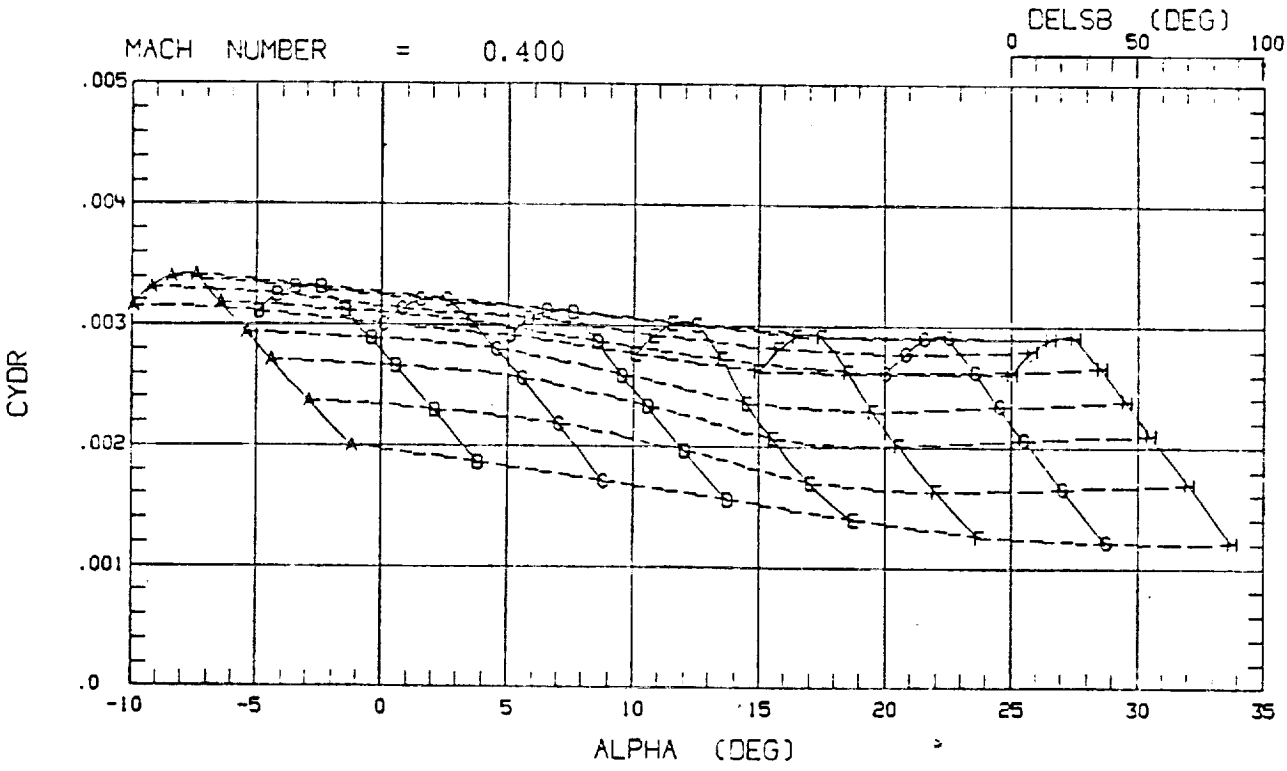
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00315	0.00310	0.00300	0.00290	0.00275	0.00262	0.00260	0.00260
7.500	0.00330	0.00324	0.00312	0.00305	0.00291	0.00290	0.00277	0.00279
15.000	0.00339	0.00330	0.00320	0.00311	0.00301	0.00291	0.00289	0.00289
25.000	0.00340	0.00330	0.00320	0.00310	0.00300	0.00291	0.00290	0.00290
35.000	0.00317	0.00311	0.00302	0.00285	0.00271	0.00262	0.00262	0.00265
45.000	0.00293	0.00288	0.00279	0.00268	0.00235	0.00229	0.00233	0.00237
55.000	0.00270	0.00265	0.00255	0.00232	0.00205	0.00200	0.00205	0.00210
70.000	0.00236	0.00229	0.00217	0.00195	0.00169	0.00162	0.00165	0.00169
87.200	0.00199	0.00185	0.00170	0.00155	0.00138	0.00125	0.00120	0.00120

ENGINEER_____
DATE_____

FIGURE 4.2.1.1-74
EFFECT OF RUDDER



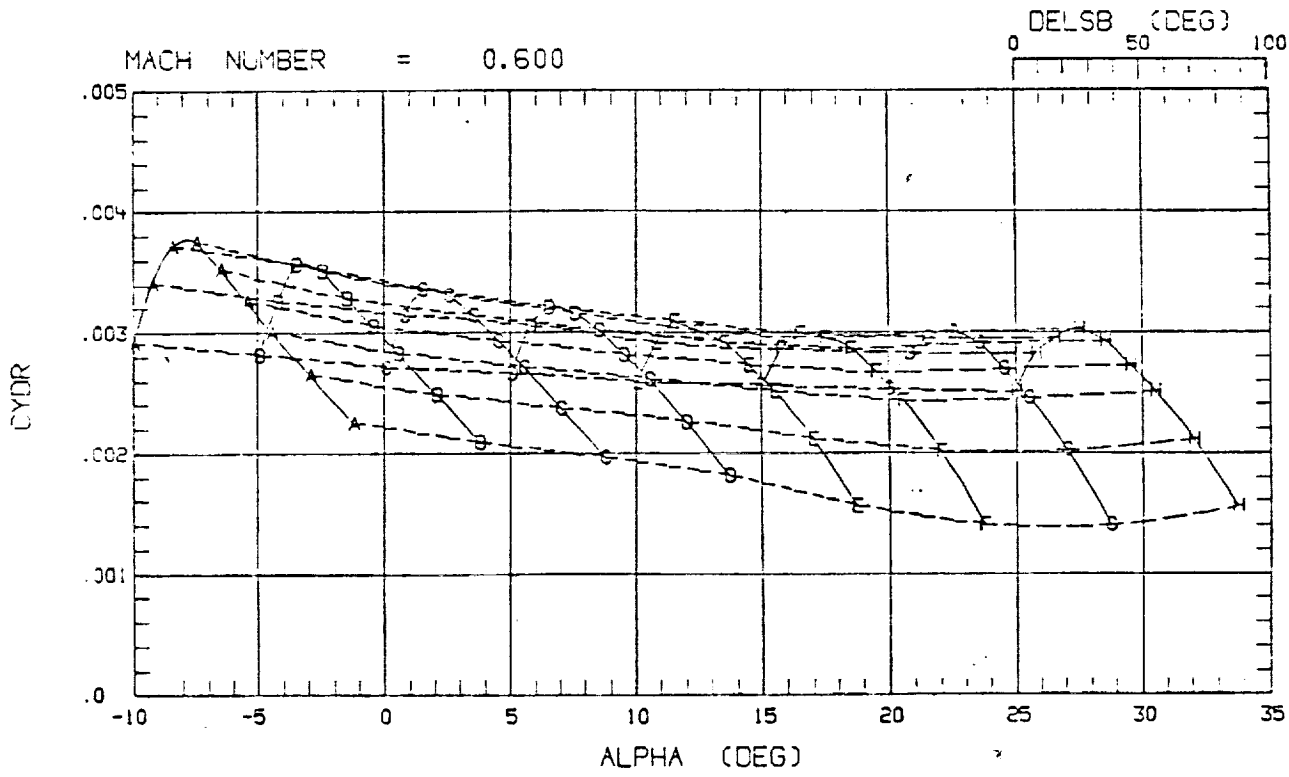
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00315	0.00310	0.00300	0.00290	0.00275	0.00262	0.00260	0.00260
7.500	0.00330	0.00324	0.00312	0.00305	0.00291	0.00280	0.00277	0.00279
15.000	0.00339	0.00330	0.00320	0.00311	0.00301	0.00291	0.00299	0.00299
25.000	0.00340	0.00330	0.00320	0.00310	0.00300	0.00291	0.00290	0.00290
35.000	0.00317	0.00311	0.00302	0.00295	0.00271	0.00262	0.00262	0.00265
45.000	0.00293	0.00288	0.00279	0.00258	0.00235	0.00229	0.00233	0.00237
55.000	0.00270	0.00265	0.00255	0.00232	0.00205	0.00200	0.00205	0.00210
70.000	0.00236	0.00229	0.00217	0.00195	0.00169	0.00162	0.00165	0.00169
87.200	0.00199	0.00185	0.00170	0.00155	0.00138	0.00125	0.00120	0.00120

ENGINEER_____
DATE_____

FIGURE 4.2.1.1-75
EFFECT OF RUDDER

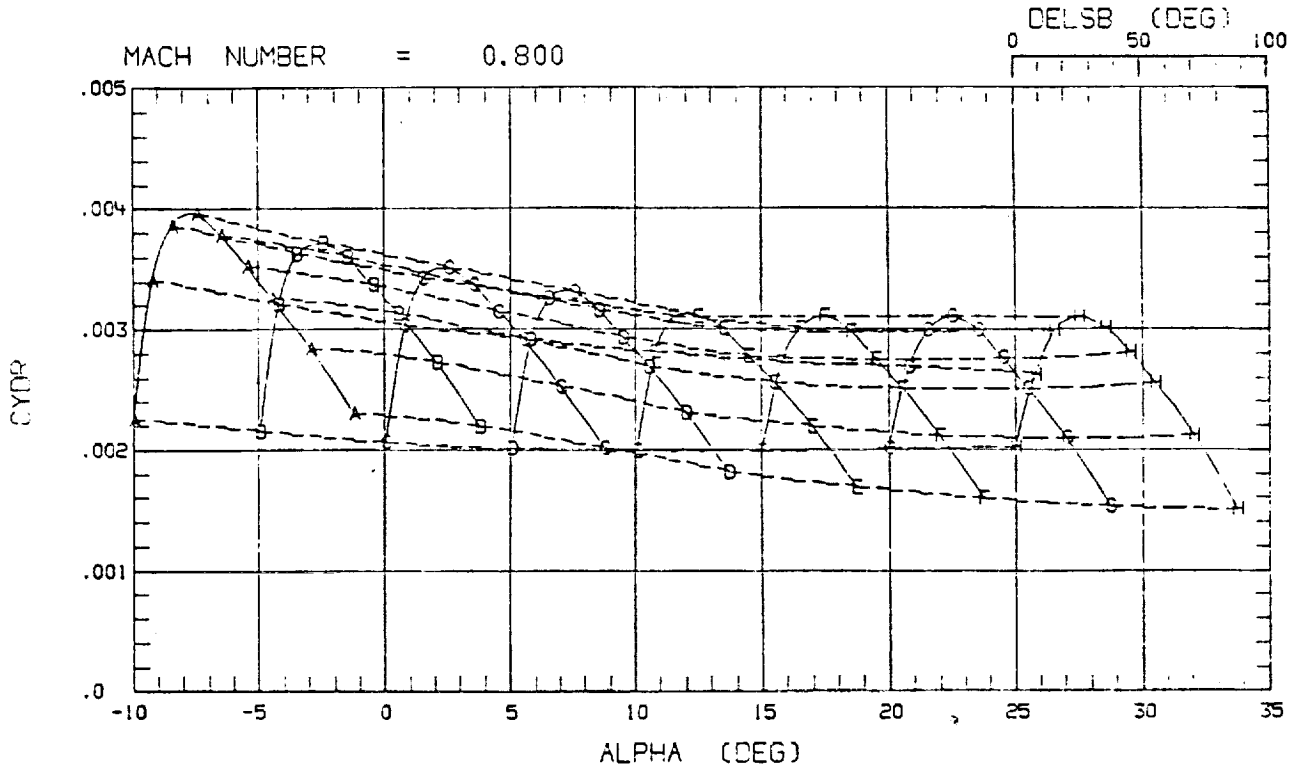


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00290	0.00280	0.00270	0.00265	0.00258	0.00255	0.00252	0.00250
7.500	0.00340	0.00325	0.00314	0.00305	0.00290	0.00285	0.00282	0.00282
15.000	0.00370	0.00355	0.00335	0.00320	0.00308	0.00298	0.00295	0.00295
25.000	0.00375	0.00350	0.00330	0.00315	0.00300	0.00295	0.00300	0.00302
35.000	0.00351	0.00329	0.00313	0.00301	0.00291	0.00286	0.00290	0.00292
45.000	0.00325	0.00305	0.00292	0.00281	0.00272	0.00266	0.00269	0.00272
55.000	0.00300	0.00282	0.00270	0.00260	0.00250	0.00243	0.00245	0.00250
70.000	0.00264	0.00248	0.00236	0.00225	0.00211	0.00201	0.00202	0.00211
87.200	0.00225	0.00208	0.00195	0.00180	0.00155	0.00140	0.00140	0.00155

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-76
EFFECT OF RUDDER



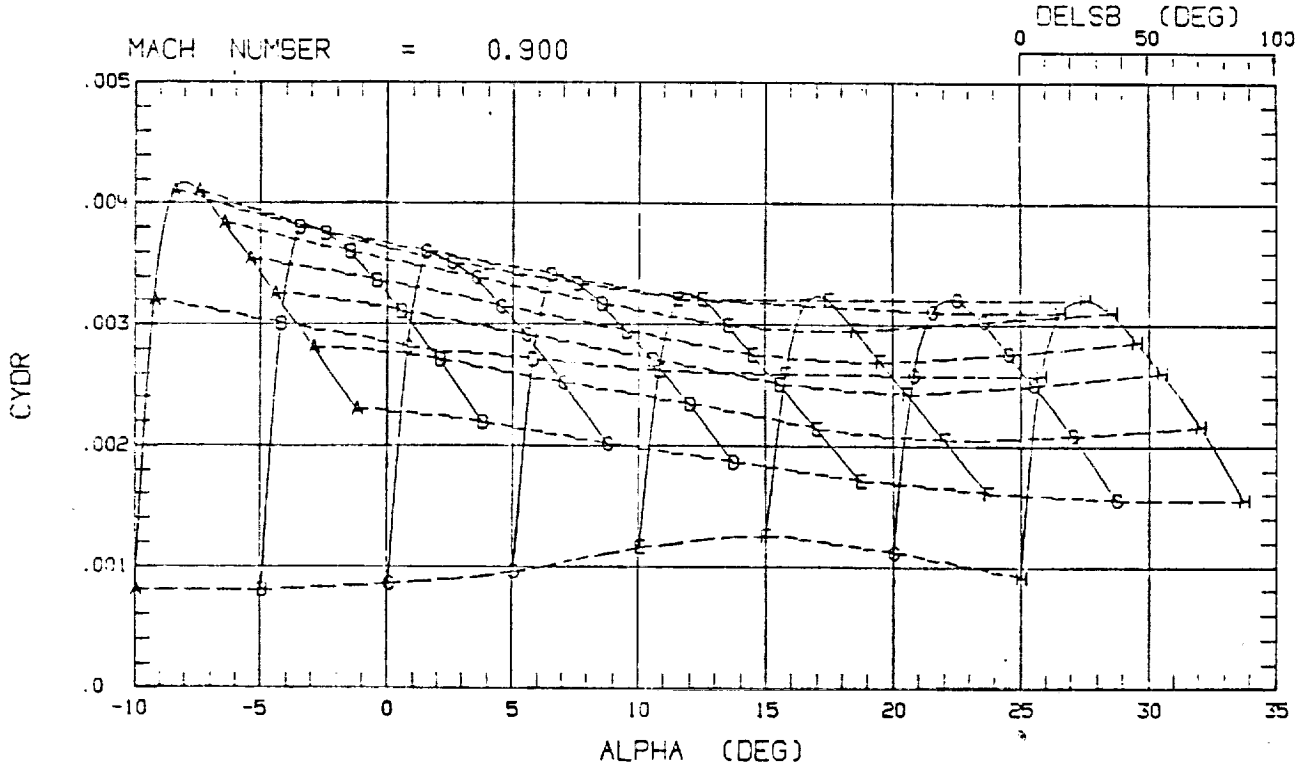
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00225	0.00214	0.00205	0.00200	0.00198	0.00198	0.00200	0.00202
7.500	0.00340	0.00320	0.00302	0.00290	0.00290	0.00272	0.00268	0.00262
15.000	0.00385	0.00362	0.00342	0.00325	0.00310	0.00300	0.00298	0.00298
25.000	0.00395	0.00370	0.00350	0.00330	0.00310	0.00310	0.00310	0.00310
35.000	0.00377	0.00359	0.00336	0.00315	0.00299	0.00297	0.00298	0.00301
45.000	0.00351	0.00336	0.00314	0.00292	0.00277	0.00274	0.00275	0.00290
55.000	0.00325	0.00312	0.00290	0.00268	0.00255	0.00250	0.00250	0.00255
70.000	0.00283	0.00272	0.00251	0.00230	0.00218	0.00211	0.00203	0.00212
97.200	0.00230	0.00218	0.00200	0.00180	0.00167	0.00158	0.00152	0.00150

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1- 77
EFFECT OF RUDDER

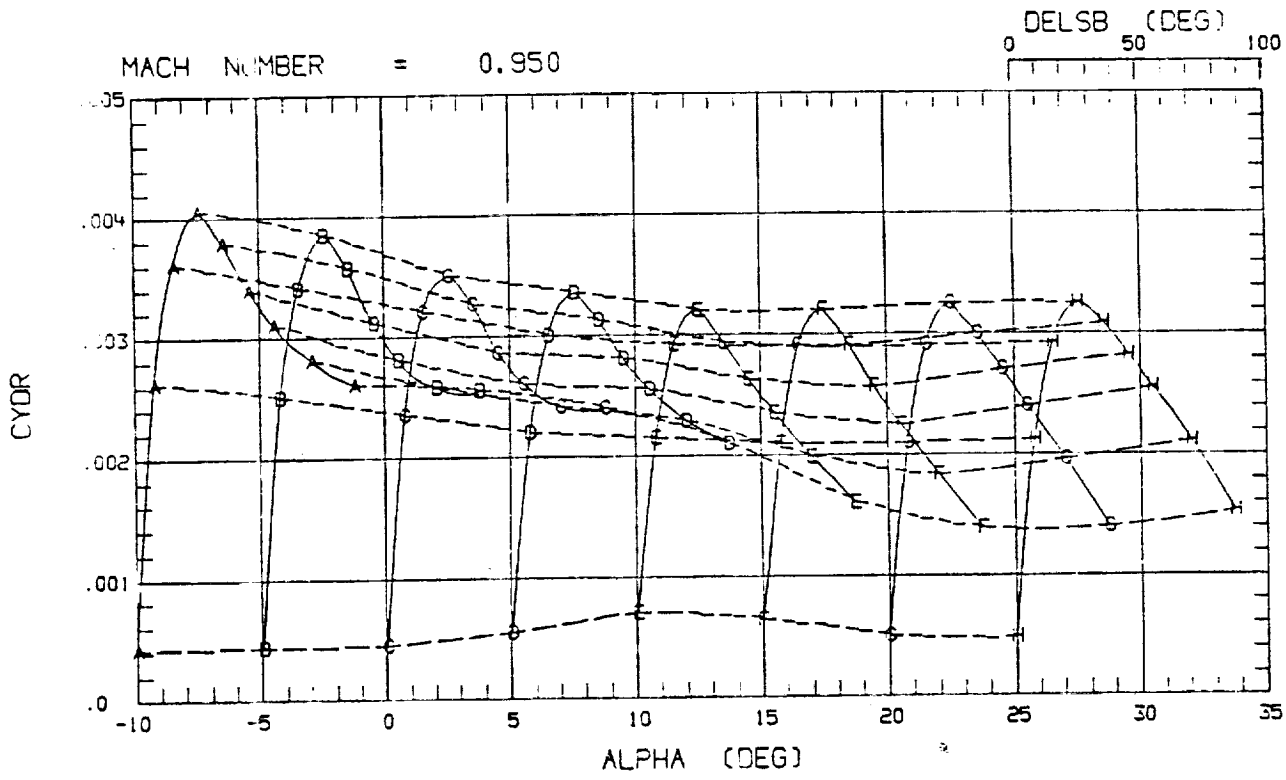


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00080	0.00080	0.00085	0.00095	0.00115	0.00125	0.00110	0.00090
7.500	0.00320	0.00300	0.00280	0.00270	0.00261	0.00259	0.00259	0.00259
15.000	0.00410	0.00360	0.00359	0.00340	0.00320	0.00315	0.00310	0.00310
25.000	0.00410	0.00375	0.00350	0.00332	0.00320	0.00320	0.00320	0.00320
35.000	0.00383	0.00359	0.00337	0.00316	0.00298	0.00294	0.00302	0.00310
45.000	0.00354	0.00335	0.00314	0.00293	0.00274	0.00269	0.00276	0.00286
55.000	0.00325	0.00310	0.00290	0.00270	0.00250	0.00243	0.00250	0.00260
70.000	0.00281	0.00270	0.00251	0.00233	0.00213	0.00204	0.00208	0.00216
87.200	0.00230	0.00219	0.00200	0.00185	0.00170	0.00160	0.00155	0.00155

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-78
EFFECT OF RUDDER



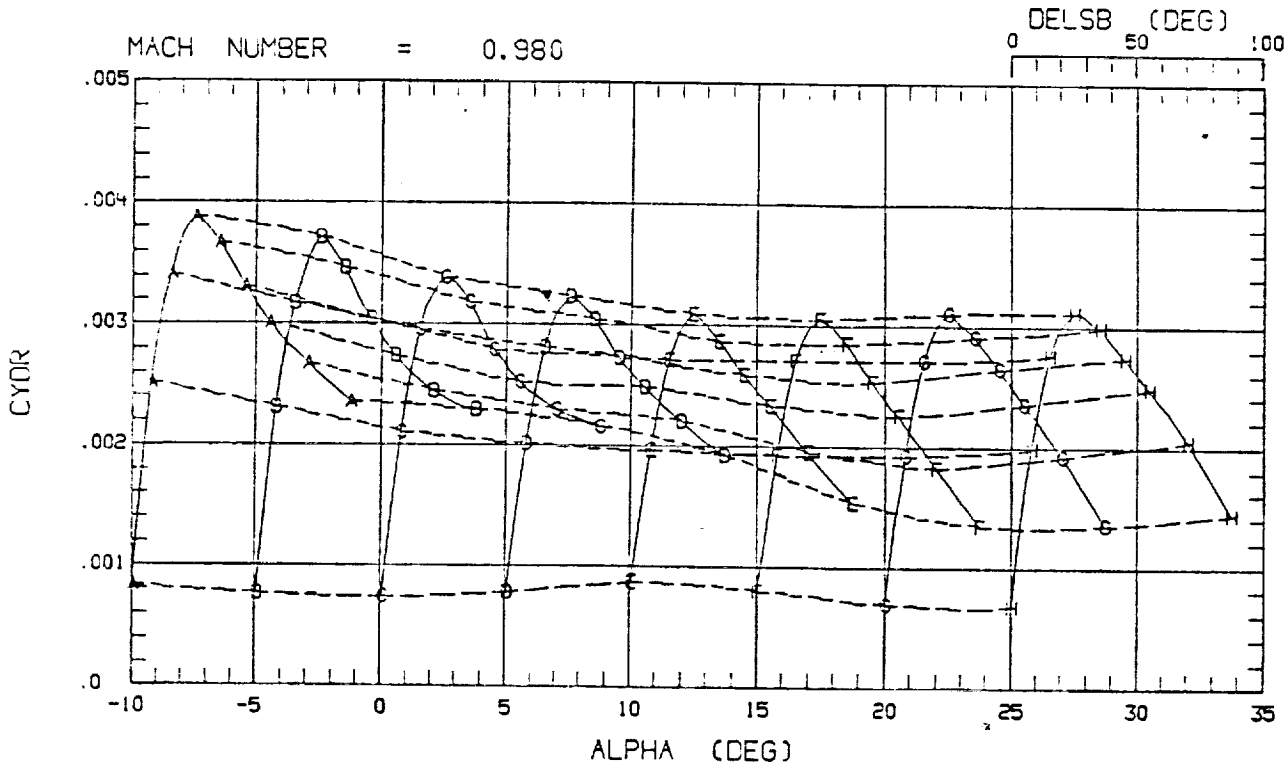
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00042	0.00043	0.00045	0.00055	0.00070	0.00053	0.00050	0.00048
7.500	0.00262	0.00250	0.00235	0.00220	0.00215	0.00210	0.00210	0.00212
15.000	0.00360	0.00340	0.00320	0.00300	0.00292	0.00290	0.00290	0.00292
25.000	0.00405	0.00385	0.00350	0.00335	0.00320	0.00320	0.00325	0.00325
35.000	0.00378	0.00357	0.00326	0.00312	0.00293	0.00290	0.00299	0.00309
45.000	0.00339	0.00311	0.00286	0.00280	0.00263	0.00256	0.00270	0.00282
55.000	0.00310	0.00280	0.00260	0.00255	0.00235	0.00225	0.00240	0.00255
70.000	0.00280	0.00257	0.00241	0.00229	0.00198	0.00183	0.00195	0.00211
85.200	0.00260	0.00255	0.00240	0.00210	0.00160	0.00138	0.00140	0.00152

ENGINEER [illegible]
DATE [illegible]-78

FIGURE 4.2.1.1-79
EFFECT OF RUDDER



CONFIGURATION

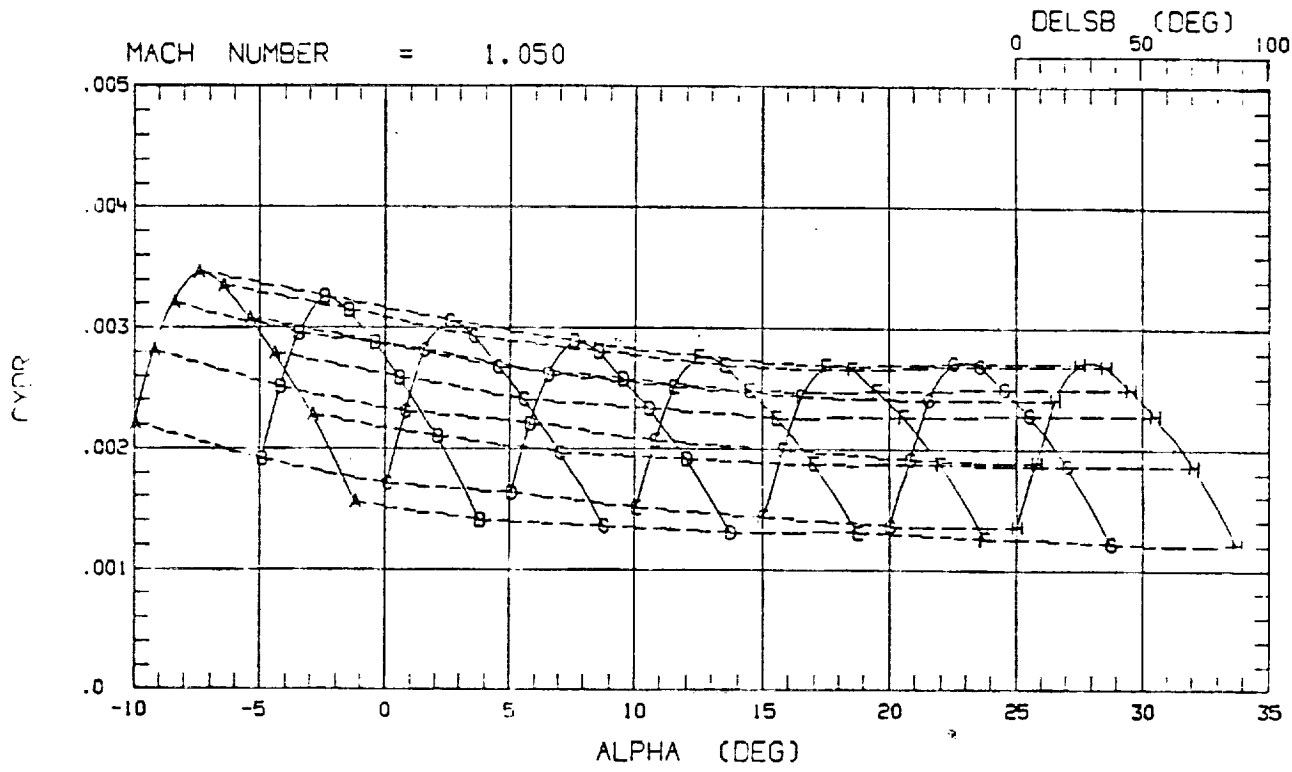
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00082	0.00076	0.00073	0.00078	0.00086	0.00079	0.00083	0.00067
7.500	0.00250	0.00230	0.00210	0.00200	0.00195	0.00192	0.00192	0.00198
15.000	0.00340	0.00316	0.00295	0.00280	0.00270	0.00270	0.00270	0.00275
25.000	0.00387	0.00370	0.00338	0.00322	0.00308	0.00305	0.00310	0.00311
35.000	0.00366	0.00345	0.00317	0.00303	0.00286	0.00284	0.00290	0.00298
45.000	0.00330	0.00303	0.00278	0.00272	0.00257	0.00252	0.00264	0.00273
55.000	0.00300	0.00273	0.00251	0.00247	0.00232	0.00224	0.00235	0.00248
70.000	0.00266	0.00244	0.00229	0.00219	0.00194	0.00182	0.00192	0.00204
87.200	0.00235	0.00228	0.00215	0.00191	0.00152	0.00133	0.00134	0.00144

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-80
EFFECT OF RUDDER



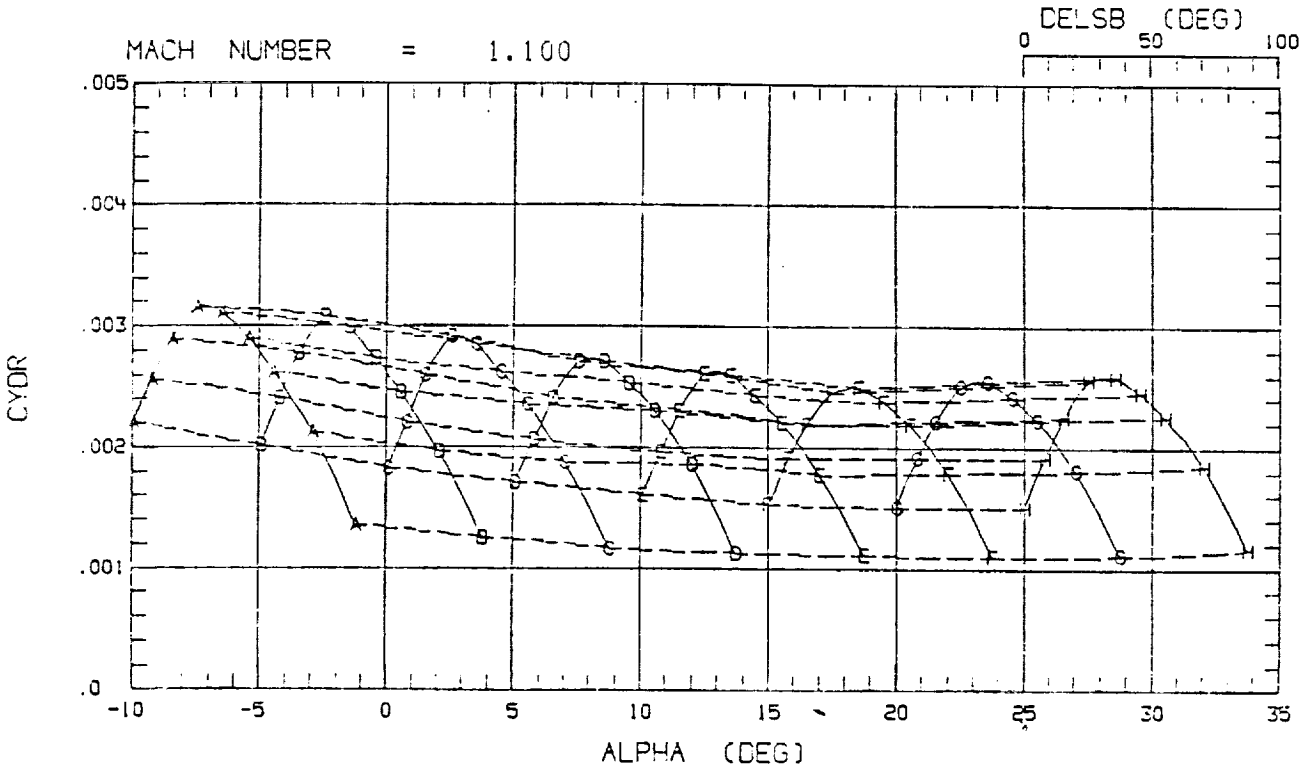
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00220	0.00190	0.00170	0.00162	0.00150	0.00142	0.00135	0.00135
7.500	0.00260	0.00250	0.00230	0.00220	0.00205	0.00198	0.00190	0.00188
15.000	0.00320	0.00295	0.00290	0.00260	0.00250	0.00242	0.00240	0.00240
25.000	0.00345	0.00325	0.00305	0.00298	0.00275	0.00268	0.00270	0.00270
35.000	0.00334	0.00313	0.00292	0.00279	0.00268	0.00265	0.00268	0.00268
45.000	0.00307	0.00287	0.00267	0.00256	0.00247	0.00247	0.00249	0.00249
55.000	0.00278	0.00258	0.00240	0.00232	0.00225	0.00226	0.00227	0.00227
70.000	0.00227	0.00209	0.00196	0.00190	0.00186	0.00186	0.00185	0.00185
87.200	0.00155	0.00140	0.00135	0.00130	0.00130	0.00125	0.00120	0.00120

ENGINEER [illegible]
DATE 10-2-72

FIGURE 4.2.1.1-81
EFFECT OF RUDDER



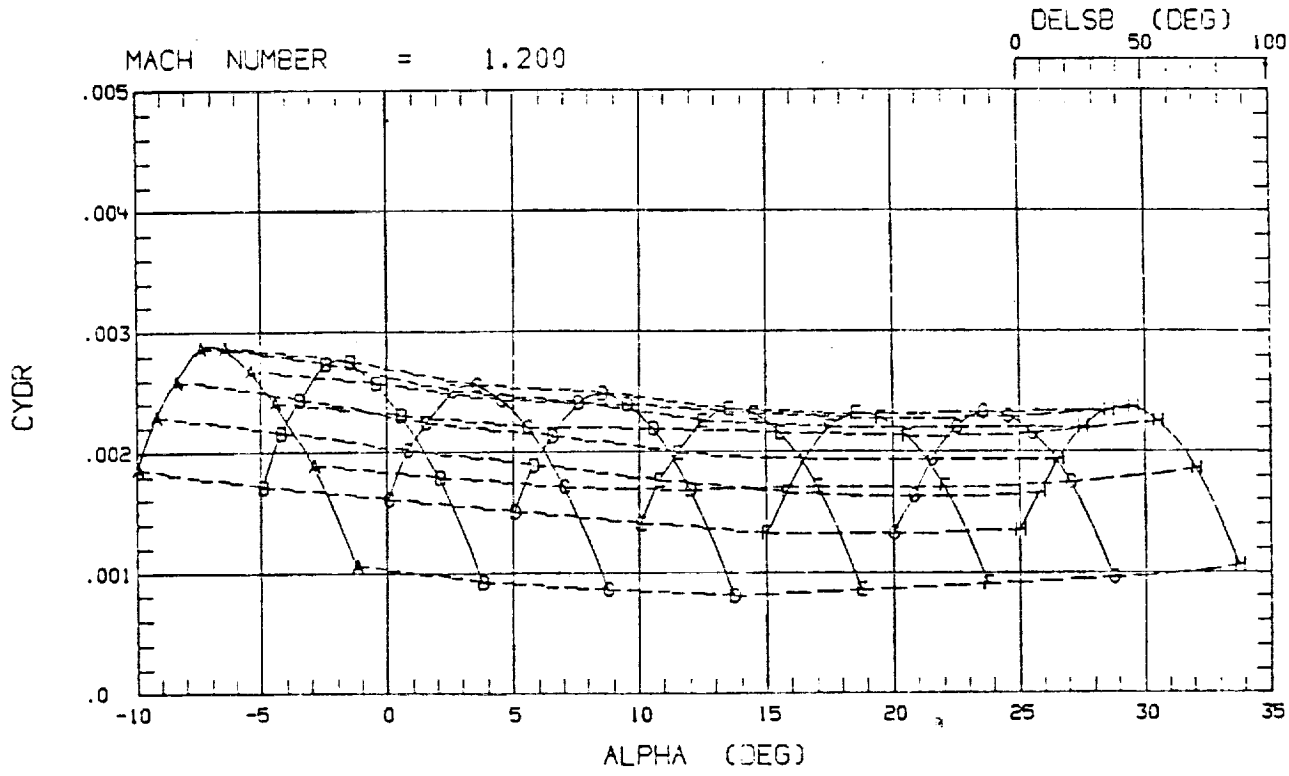
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0	IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0	IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00220	0.00200	0.00182	0.00170	0.00160	0.00152	0.00150	0.00150
7.500	0.00255	0.00240	0.00220	0.00205	0.00195	0.00190	0.00190	0.00190
15.000	0.00298	0.00277	0.00259	0.00240	0.00230	0.00218	0.00221	0.00224
25.000	0.00315	0.00307	0.00290	0.00270	0.00260	0.00245	0.00250	0.00255
35.000	0.00310	0.00298	0.00294	0.00270	0.00259	0.00249	0.00254	0.00258
45.000	0.00299	0.00273	0.00261	0.00253	0.00242	0.00237	0.00241	0.00245
55.000	0.00262	0.00245	0.00235	0.00230	0.00220	0.00218	0.00222	0.00225
70.000	0.00212	0.00196	0.00187	0.00185	0.00177	0.00178	0.00180	0.00184
87.200	0.00135	0.00125	0.00115	0.00112	0.00110	0.00109	0.00110	0.00115

ENGINEER
DATE

FIGURE 4.2.1.1-82
EFFECT OF RUDDER



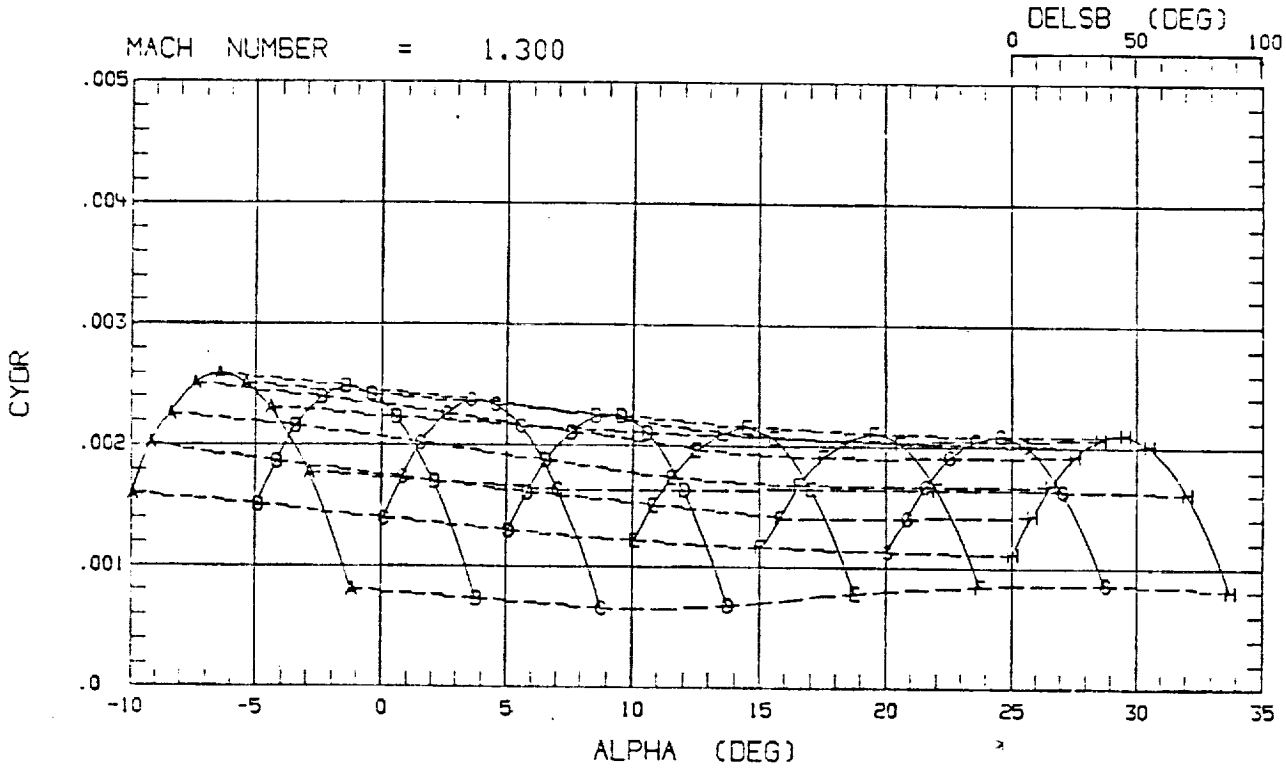
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00185	0.00170	0.00160	0.00150	0.00140	0.00132	0.00132	0.00135
7.500	0.00229	0.00215	0.00200	0.00188	0.00175	0.00165	0.00162	0.00165
15.000	0.00258	0.00243	0.00223	0.00212	0.00198	0.00193	0.00193	0.00193
25.000	0.00286	0.00273	0.00250	0.00240	0.00225	0.00220	0.00220	0.00220
35.000	0.00286	0.00274	0.00255	0.00248	0.00235	0.00231	0.00232	0.00234
45.000	0.00266	0.00256	0.00242	0.00238	0.00231	0.00227	0.00229	0.00236
55.000	0.00240	0.00230	0.00220	0.00218	0.00215	0.00212	0.00215	0.00225
70.000	0.00188	0.00178	0.00170	0.00168	0.00170	0.00170	0.00174	0.00185
87.200	0.00105	0.00092	0.00085	0.00080	0.00085	0.00090	0.00085	0.00105

ENGINEER
DATE

FIGURE 4.2.1.1-83
EFFECT OF RUDDER



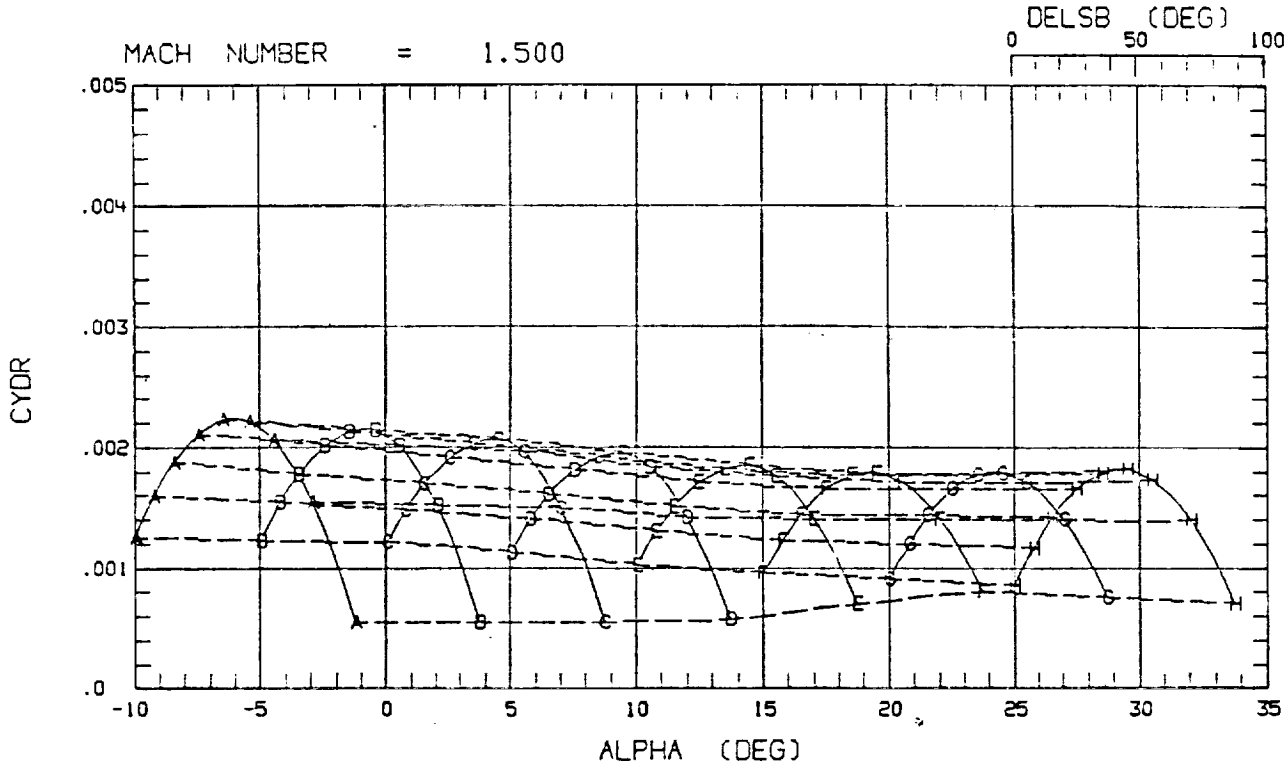
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00158	0.00150	0.00138	0.00128	0.00120	0.00115	0.00112	0.00110
7.500	0.00200	0.00185	0.00172	0.00160	0.00150	0.00140	0.00140	0.00142
15.000	0.00225	0.00214	0.00201	0.00186	0.00172	0.00167	0.00166	0.00167
25.000	0.00250	0.00238	0.00225	0.00210	0.00195	0.00190	0.00190	0.00192
35.000	0.00258	0.00247	0.00236	0.00223	0.00209	0.00204	0.00204	0.00206
45.000	0.00250	0.00241	0.00232	0.00223	0.00214	0.00210	0.00208	0.00209
55.000	0.00230	0.00222	0.00215	0.00210	0.00205	0.00202	0.00200	0.00200
70.000	0.00177	0.00169	0.00163	0.00162	0.00164	0.00164	0.00163	0.00161
87.200	0.00080	0.00072	0.00065	0.00067	0.00078	0.00084	0.00085	0.00080

ENGINEER _____
DATE _____

FIGURE 4.2.1.1- 84
EFFECT OF RUDDER



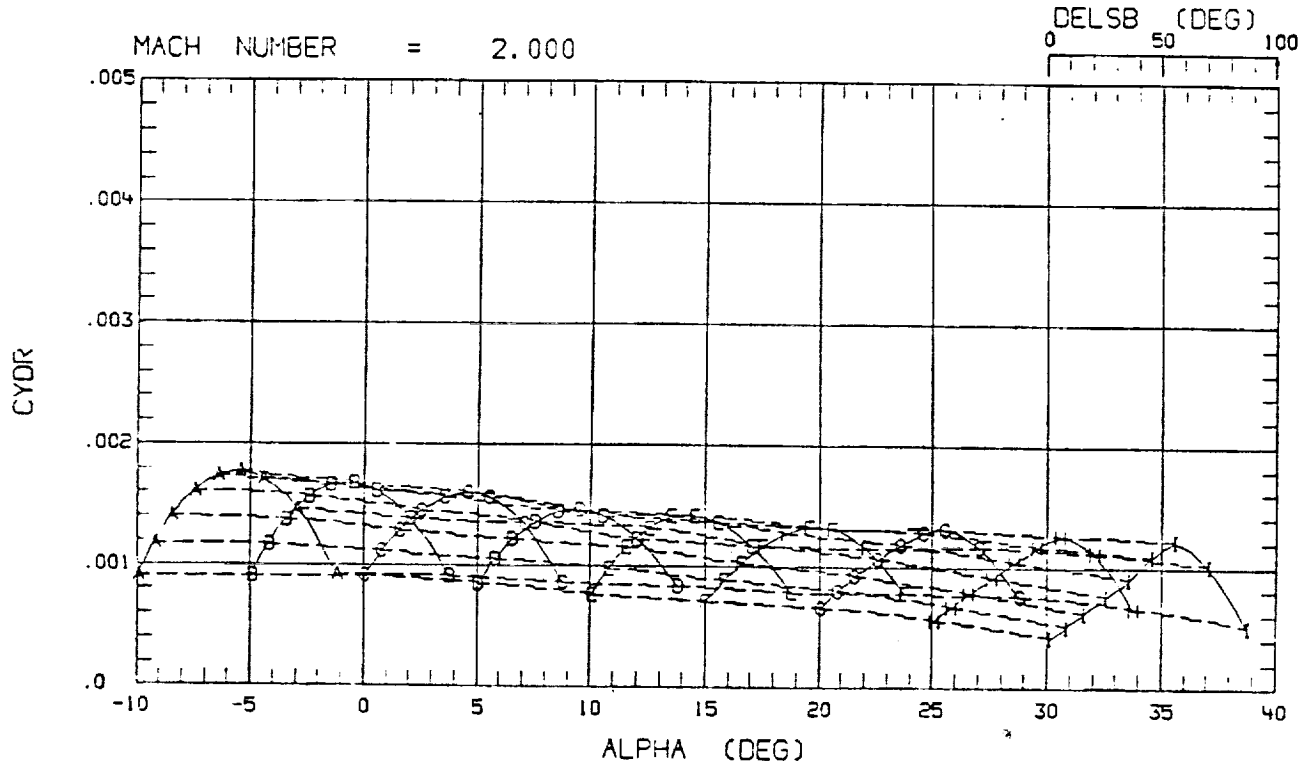
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00125	0.00122	0.00120	0.00112	0.00102	0.00095	0.00090	0.00085
7.500	0.00159	0.00153	0.00147	0.00139	0.00129	0.00122	0.00119	0.00116
15.000	0.00186	0.00177	0.00169	0.00160	0.00150	0.00144	0.00143	0.00141
25.000	0.00210	0.00200	0.00190	0.00180	0.00170	0.00165	0.00165	0.00165
35.000	0.00222	0.00212	0.00202	0.00191	0.00181	0.00176	0.00177	0.00178
45.000	0.00221	0.00213	0.00206	0.00194	0.00184	0.00178	0.00178	0.00181
55.000	0.00205	0.00200	0.00195	0.00183	0.00175	0.00170	0.00170	0.00172
70.000	0.00154	0.00151	0.00149	0.00141	0.00140	0.00140	0.00139	0.00139
97.200	0.00055	0.00055	0.00055	0.00057	0.00070	0.00060	0.00075	0.00070

ENGINEER _____
DATE _____

FIGURE 4.2.1.1-85
EFFECT OF RUDDER



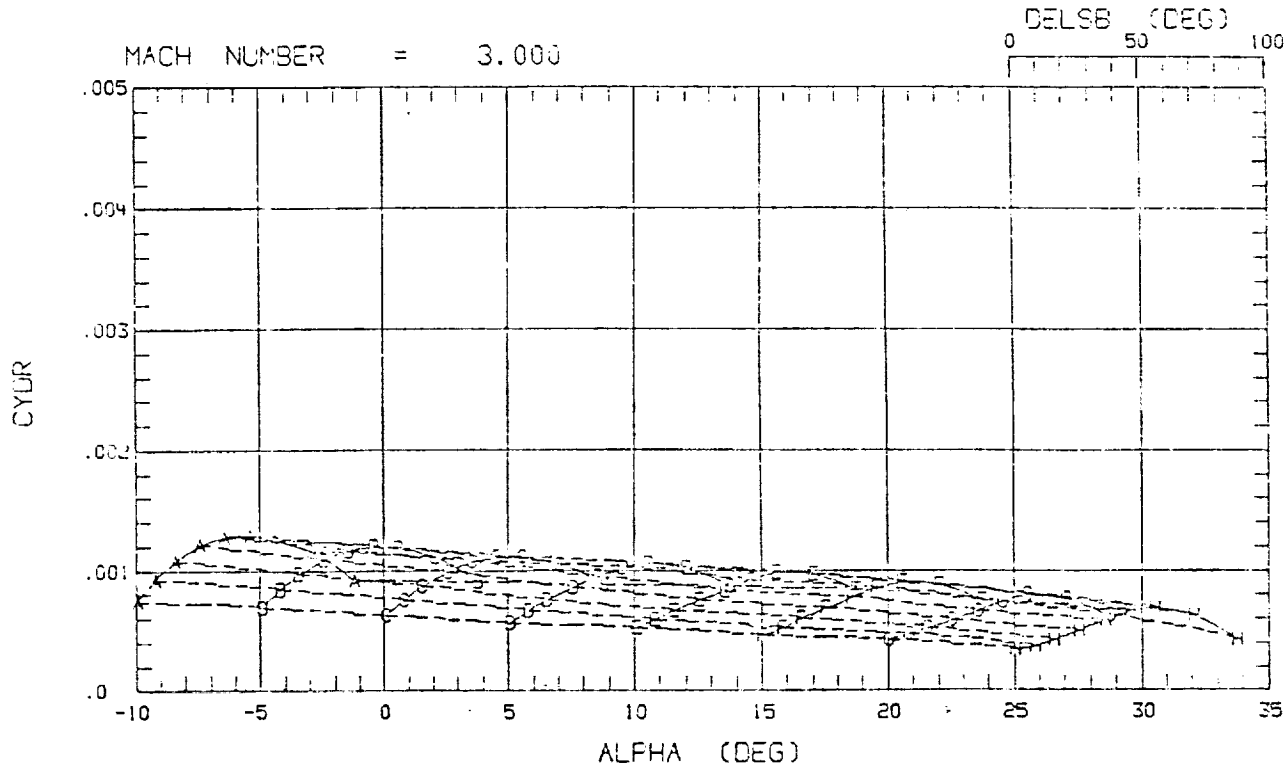
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE								
0.0	0.00090	0.00090	0.00090	0.00084	0.00075	0.00070	0.00065	0.00055	0.00040
7.500	0.00117	0.00115	0.00110	0.00104	0.00097	0.00087	0.00079	0.00066	0.00050
15.000	0.00139	0.00136	0.00127	0.00120	0.00114	0.00101	0.00091	0.00077	0.00061
25.000	0.00160	0.00155	0.00144	0.00135	0.00130	0.00116	0.00105	0.00090	0.00075
35.000	0.00172	0.00165	0.00155	0.00143	0.00139	0.00125	0.00117	0.00103	0.00089
45.000	0.00176	0.00166	0.00159	0.00145	0.00140	0.00131	0.00127	0.00116	0.00108
55.000	0.00170	0.00160	0.00155	0.00140	0.00135	0.00130	0.00130	0.00125	0.00120
70.000	0.00145	0.00137	0.00133	0.00121	0.00116	0.00114	0.00115	0.00110	0.00100
87.200	0.00092	0.00090	0.00085	0.00082	0.00077	0.00077	0.00075	0.00065	0.00050

ENGINEER [illegible]
DATE 10-3-78

FIGURE 4.2.1.1-86
EFFECT OF RUDDER



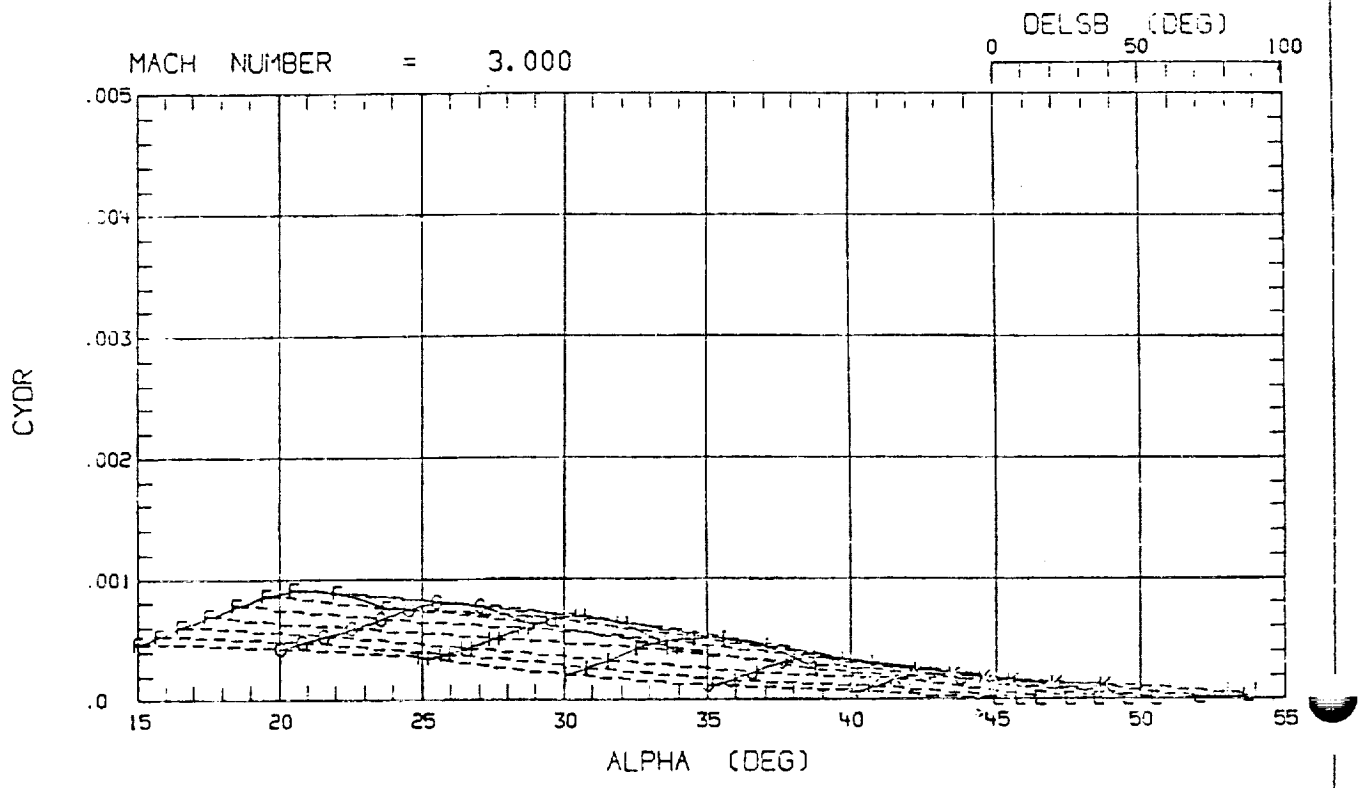
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1075.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00074	0.00069	0.00062	0.00055	0.00052	0.00046	0.00042	0.00034
7.500	0.00092	0.00084	0.00075	0.00066	0.00059	0.00052	0.00047	0.00037
15.000	0.00105	0.00096	0.00083	0.00075	0.00066	0.00060	0.00052	0.00043
25.000	0.00120	0.00106	0.00093	0.00085	0.00075	0.00068	0.00058	0.00050
35.000	0.00127	0.00116	0.00105	0.00094	0.00083	0.00077	0.00066	0.00058
45.000	0.00129	0.00119	0.00110	0.00101	0.00092	0.00085	0.00074	0.00066
55.000	0.00125	0.00118	0.00110	0.00105	0.00098	0.00090	0.00080	0.00066
70.000	0.00115	0.00110	0.00104	0.00101	0.00096	0.00087	0.00076	0.00062
87.200	0.00092	0.00090	0.00086	0.00086	0.00084	0.00075	0.00062	0.00048

ENGINEER
DATE -7-78

FIGURE 4.2.1.1-87
EFFECT OF RUDDER



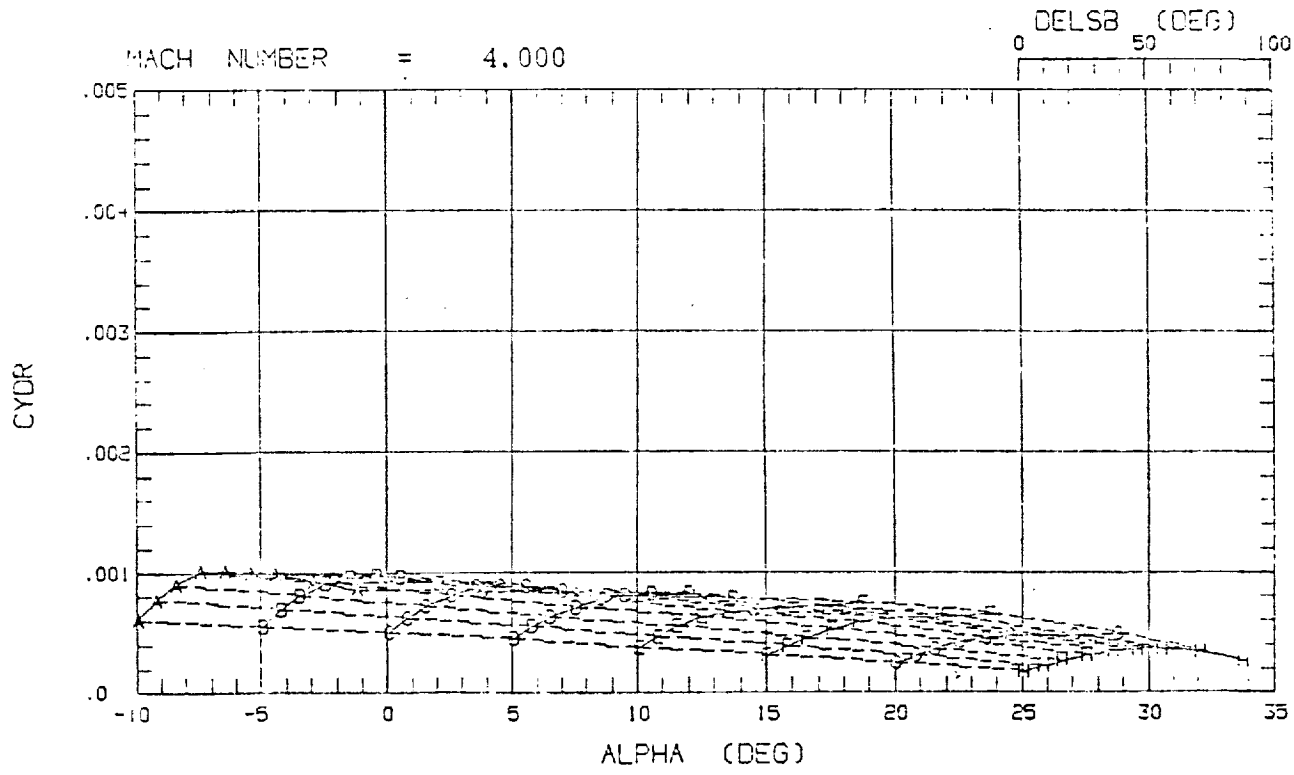
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE						
0.0	0.00046	0.00042	0.00034	0.00020	0.00011	0.00006	0.0
7.500	0.00052	0.00047	0.00037	0.00026	0.00015	0.00010	0.0
15.000	0.00060	0.00052	0.00042	0.00032	0.00022	0.00016	0.0
25.000	0.00068	0.00058	0.00050	0.00042	0.00030	0.00020	0.0
35.000	0.00077	0.00066	0.00058	0.00048	0.00034	0.00020	0.0
45.000	0.00085	0.00074	0.00066	0.00050	0.00033	0.00018	0.0
55.000	0.00090	0.00080	0.00068	0.00050	0.00030	0.00015	0.0
70.000	0.00087	0.00076	0.00062	0.00043	0.00024	0.00013	0.00001
87.300	0.00075	0.00062	0.00042	0.00024	0.00016	0.00012	0.00002

ENGINEER
DATE

FIGURE 4.2.1.1-88
EFFECT OF RUDDER



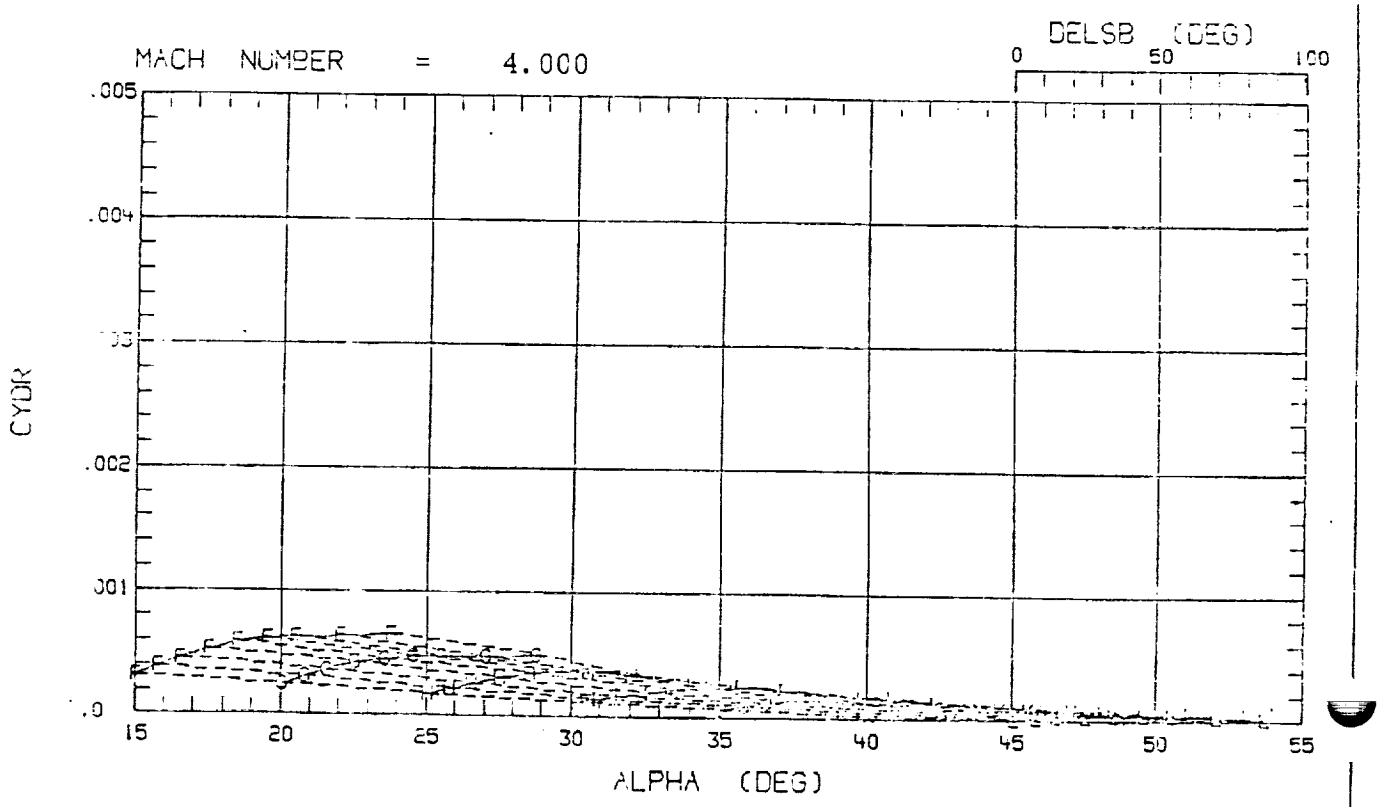
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00050	0.00055	0.00049	0.00044	0.00037	0.00031	0.00024	0.00017
7.500	0.00076	0.00069	0.00061	0.00054	0.00046	0.00038	0.00030	0.00021
15.000	0.00089	0.00080	0.00071	0.00062	0.00054	0.00045	0.00036	0.00025
25.000	0.00100	0.00090	0.00080	0.00070	0.00062	0.00052	0.00042	0.00030
35.000	0.00100	0.00095	0.00087	0.00077	0.00066	0.00058	0.00045	0.00034
45.000	0.00099	0.00096	0.00089	0.00080	0.00068	0.00061	0.00047	0.00038
55.000	0.00098	0.00095	0.00088	0.00081	0.00070	0.00062	0.00047	0.00036
70.000	0.00092	0.00090	0.00084	0.00081	0.00071	0.00063	0.00047	0.00033
87.200	0.00085	0.00084	0.00080	0.00078	0.00074	0.00065	0.00048	0.00035

ENGINEER [illegible]
DATE 10-1-78

FIGURE 4.2.1.1-89
EFFECT OF RUDDER

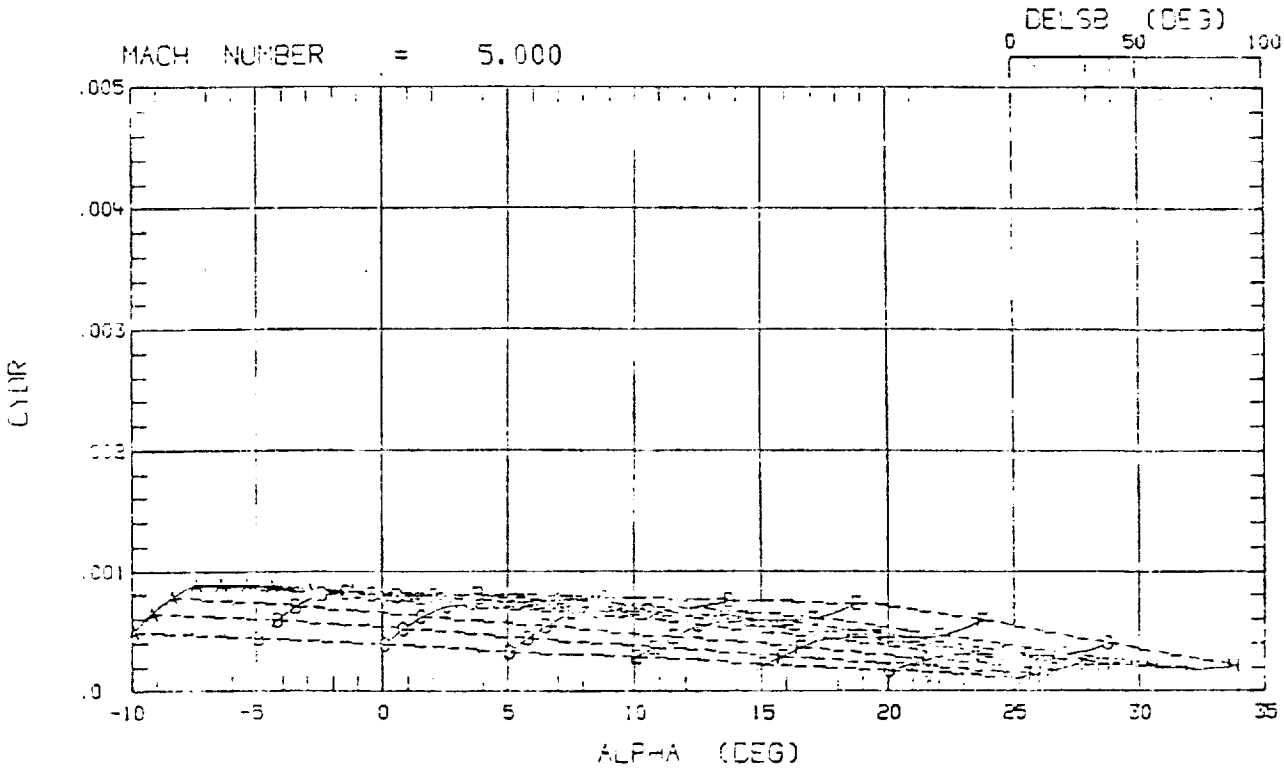


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE						
0.0	0.00031	0.00024	0.00017	0.00011	0.00006	0.00002	0.0
7.500	0.00038	0.00030	0.00021	0.00014	0.00009	0.00004	0.00001
15.000	0.00046	0.00036	0.00025	0.00016	0.00012	0.00006	0.00002
25.000	0.00052	0.00042	0.00030	0.00019	0.00014	0.00008	0.00003
35.000	0.00058	0.00045	0.00034	0.00022	0.00015	0.00008	0.00004
45.000	0.00061	0.00047	0.00036	0.00023	0.00016	0.00008	0.00004
55.000	0.00062	0.00047	0.00036	0.00024	0.00016	0.00008	0.00004
70.000	0.00063	0.00047	0.00033	0.00022	0.00013	0.00007	0.00003
87.200	0.00065	0.00048	0.00026	0.00014	0.00006	0.00003	0.00001

ENGINEER
DATE

FIGURE 4.2.1.1-90
EFFECT OF RUDDER



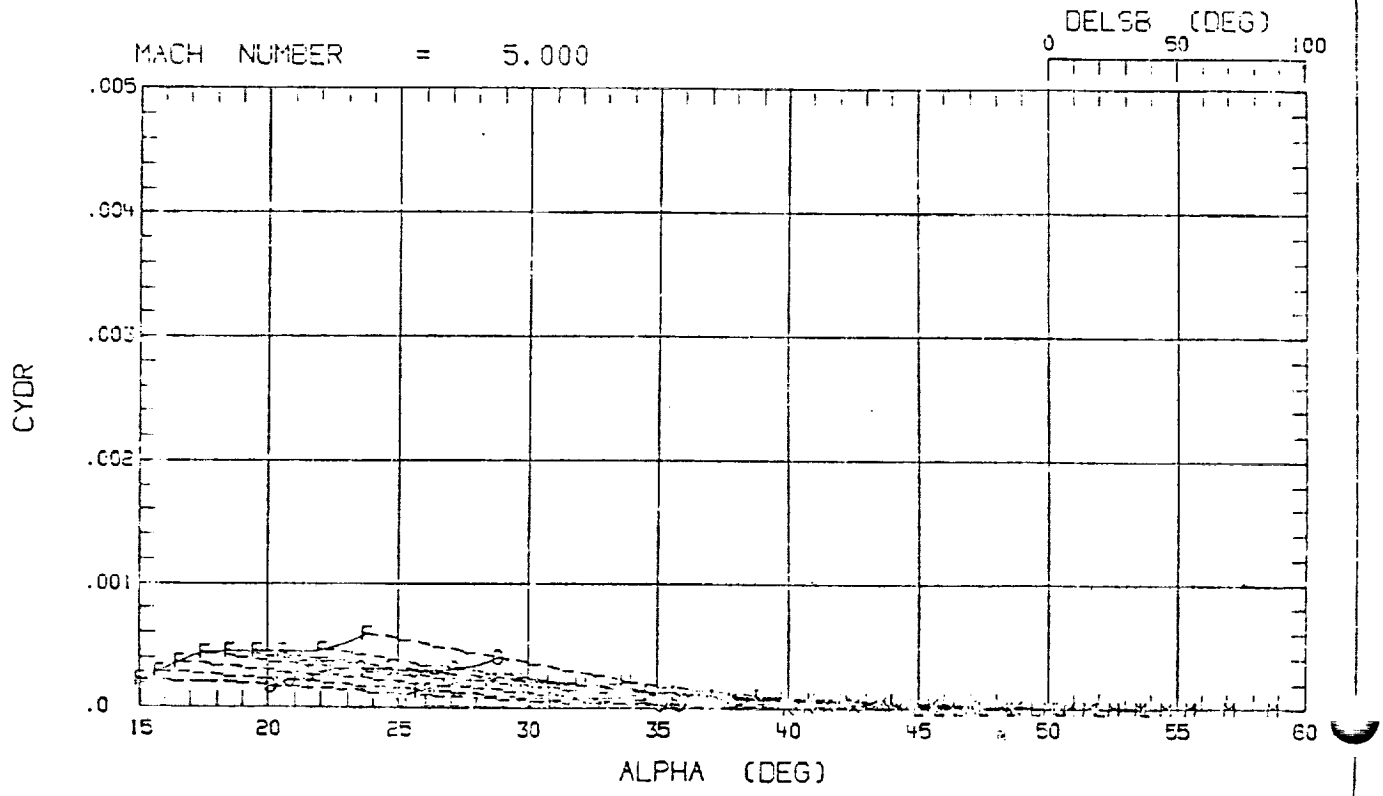
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1075.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
CG	YO = BL 0.0	IN.	WING SPAN	BW = 78.056	FT
MOMENT REFERENCE	ZO = WL 375.0	IN	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00048	0.00043	0.00038	0.00032	0.00028	0.00022	0.00017	0.00010
7.500	0.00084	0.00058	0.00051	0.00043	0.00036	0.00028	0.00021	0.00013
15.000	0.00077	0.00070	0.00061	0.00053	0.00044	0.00036	0.00025	0.00017
25.000	0.00083	0.00080	0.00071	0.00065	0.00054	0.00043	0.00030	0.00021
35.000	0.00088	0.00081	0.00072	0.00066	0.00057	0.00044	0.00031	0.00018
45.000	0.00088	0.00080	0.00073	0.00066	0.00058	0.00044	0.00030	0.00021
55.000	0.00085	0.00079	0.00074	0.00066	0.00058	0.00044	0.00029	0.00020
70.000	0.00082	0.00079	0.00075	0.00068	0.00060	0.00046	0.00030	0.00018
87.300	0.00082	0.00080	0.00078	0.00075	0.00072	0.00058	0.00039	0.00021

ENGINEER _____
DATE _____

FIGURE 4.2.1.1-91
EFFECT OF RUDDER



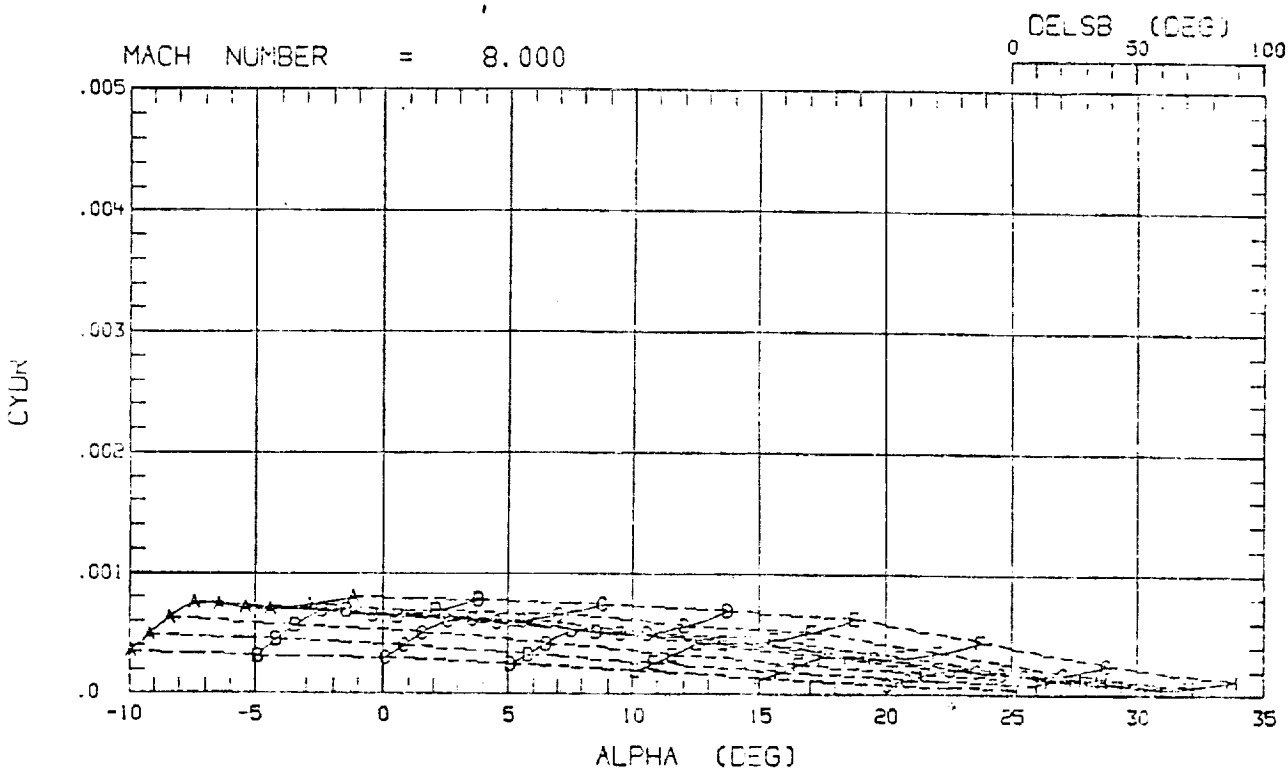
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00022	0.00017	0.00010	0.00005	0.00002	0.0	0.0	0.0
7.500	0.00029	0.00021	0.00013	0.00006	0.00003	0.00001	0.0	0.0
15.000	0.00036	0.00026	0.00017	0.00008	0.00005	0.00002	0.0	0.0
25.000	0.00043	0.00030	0.00021	0.00012	0.00007	0.00003	0.0	0.0
35.000	0.00044	0.00031	0.00022	0.00013	0.00007	0.00004	0.0	0.0
45.000	0.00044	0.00030	0.00021	0.00012	0.00007	0.00002	0.0	0.0
55.000	0.00044	0.00029	0.00020	0.00011	0.00006	0.00002	0.0	0.0
70.000	0.00046	0.00030	0.00018	0.00009	0.00005	0.00001	0.0	0.0
87.200	0.00058	0.00039	0.00023	0.00009	0.00005	0.0	0.0	0.0

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-92
EFFECT OF RUDDER



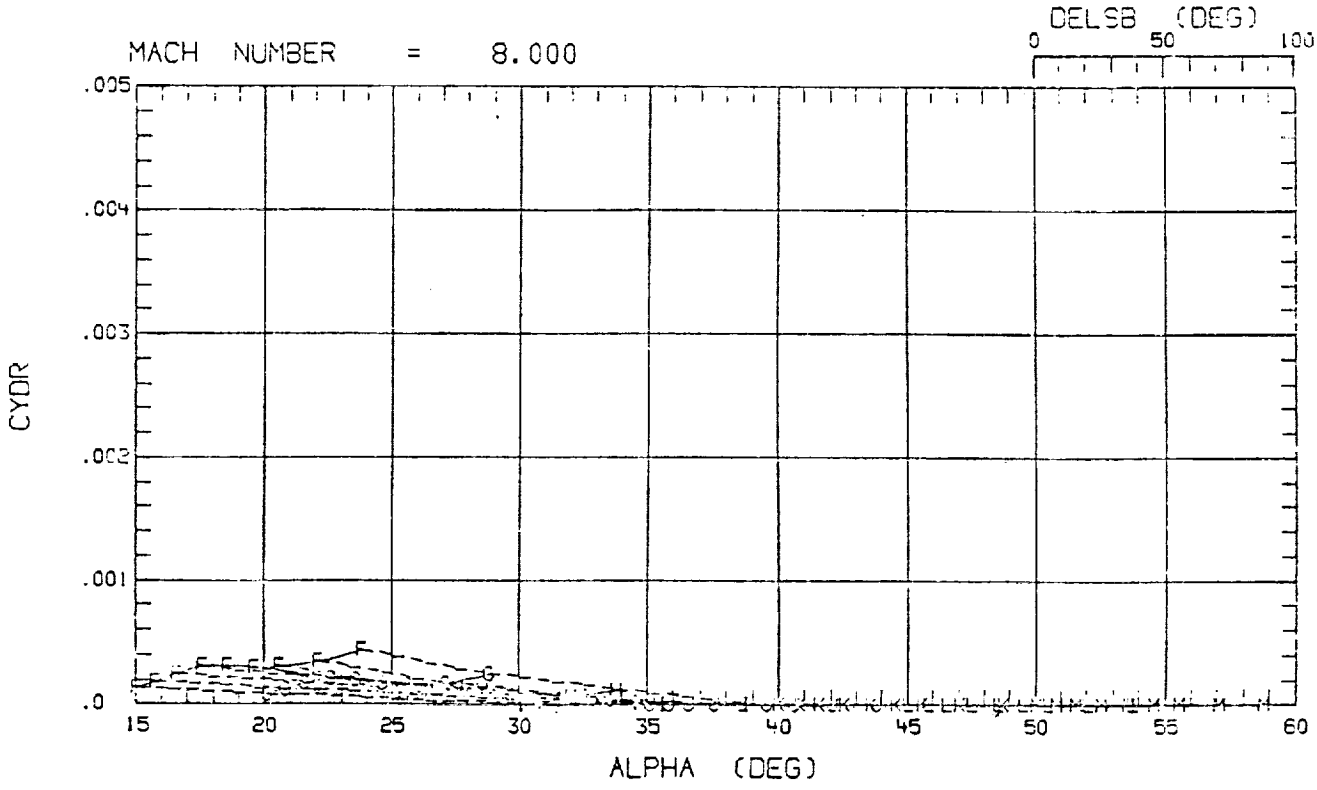
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XC = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00034	0.00031	0.00029	0.00024	0.00019	0.00013	0.00008	0.00004
7.500	0.00048	0.00044	0.00039	0.00032	0.00025	0.00018	0.00012	0.00008
15.000	0.00062	0.00056	0.00050	0.00041	0.00032	0.00024	0.00017	0.00011
25.000	0.00075	0.00068	0.00060	0.00052	0.00042	0.00030	0.00020	0.00013
35.000	0.00074	0.00069	0.00061	0.00051	0.00042	0.00031	0.00019	0.00011
45.000	0.00071	0.00065	0.00059	0.00049	0.00042	0.00029	0.00018	0.00007
55.000	0.00070	0.00064	0.00060	0.00053	0.00044	0.00030	0.00015	0.00005
70.000	0.00073	0.00068	0.00065	0.00056	0.00051	0.00034	0.00017	0.00006
87.200	0.00080	0.00077	0.00074	0.00068	0.00062	0.00043	0.00024	0.00012

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-93
EFFECT OF RUDDER



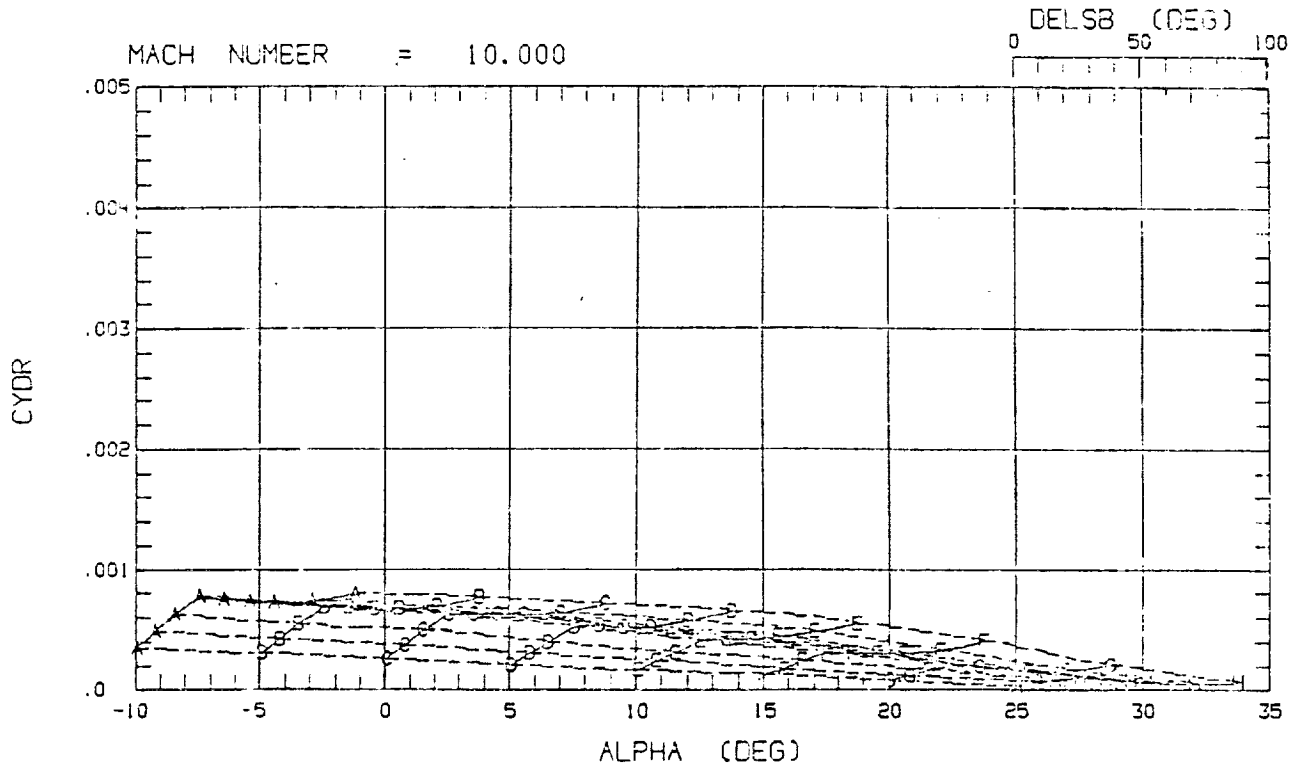
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
CR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00013	0.00008	0.00004	0.0	0.0	0.0	0.0	0.0
7.500	0.00018	0.00012	0.00009	0.00002	0.0	0.0	0.0	0.0
15.000	0.00024	0.00017	0.00011	0.00004	0.0	0.0	0.0	0.0
25.000	0.00030	0.00020	0.00013	0.00006	0.0	0.0	0.0	0.0
35.000	0.00031	0.00019	0.00011	0.00004	0.0	0.0	0.0	0.0
45.000	0.00029	0.00016	0.00007	0.00001	0.0	0.0	0.0	0.0
55.000	0.00030	0.00015	0.00005	0.0	0.0	0.0	0.0	0.0
70.000	0.00034	0.00017	0.00006	-0.00001	0.0	0.0	0.0	0.0
87.200	0.00043	0.00024	0.00012	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE 16-JUL-78

FIGURE 4.2.1.1-94
EFFECT OF RUDDER



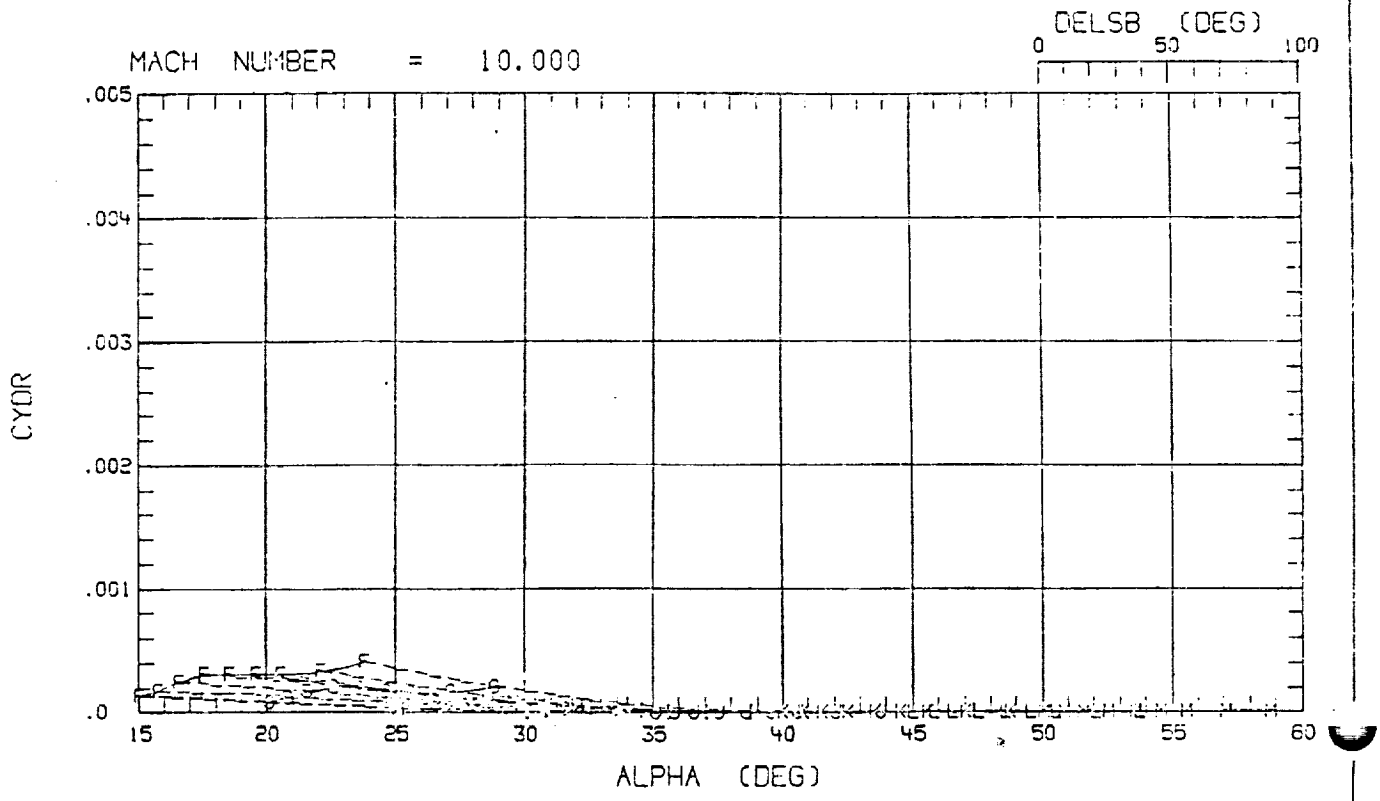
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00034	0.00030	0.00026	0.00020	0.00016	0.00013	0.00008	0.00003
7.500	0.00048	0.00042	0.00037	0.00030	0.00024	0.00017	0.00012	0.00006
15.000	0.00062	0.00054	0.00049	0.00039	0.00031	0.00024	0.00015	0.00008
25.000	0.00077	0.00068	0.00062	0.00052	0.00041	0.00030	0.00020	0.00010
35.000	0.00075	0.00068	0.00062	0.00053	0.00042	0.00031	0.00019	0.00009
45.000	0.00073	0.00067	0.00062	0.00052	0.00042	0.00030	0.00018	0.00007
55.000	0.00072	0.00067	0.00062	0.00052	0.00044	0.00030	0.00015	0.00006
70.000	0.00073	0.00069	0.00064	0.00057	0.00048	0.00033	0.00016	0.00005
87.200	0.00080	0.00076	0.00071	0.00065	0.00055	0.00040	0.00020	0.00006

ENGINEER [illegible]
DATE [illegible]78

FIGURE 4.2.1.1-95
EFFECT OF RUDDER

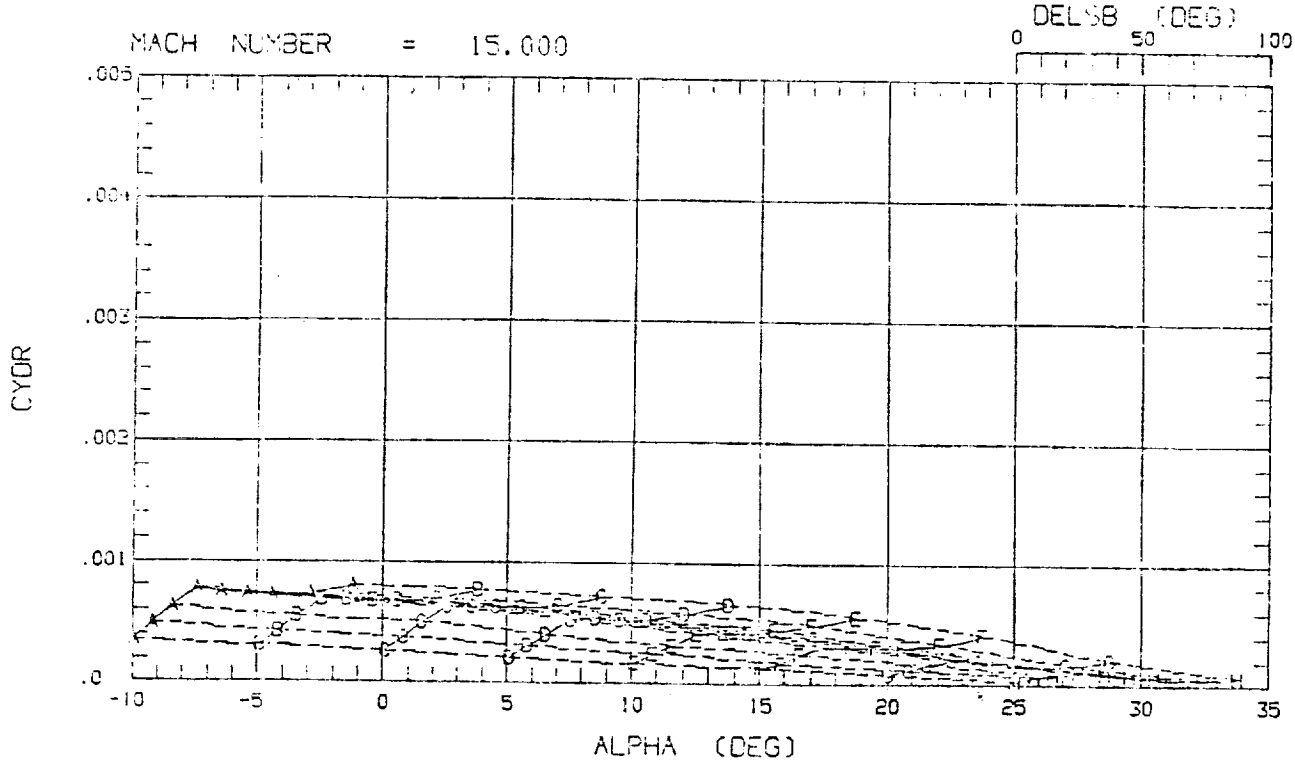


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2630.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00013	0.00008	0.00003	0.0	0.0	0.0	0.0	0.0
7.500	0.00017	0.00012	0.00005	0.00001	0.0	0.0	0.0	0.0
15.000	0.00024	0.00016	0.00008	0.00002	0.0	0.0	0.0	0.0
25.000	0.00030	0.00020	0.00010	0.00004	0.0	0.0	0.0	0.0
35.000	0.00031	0.00019	0.00009	0.00002	0.0	0.0	0.0	0.0
45.000	0.00030	0.00016	0.00007	0.00001	0.0	0.0	0.0	0.0
55.000	0.00030	0.00015	0.00006	0.0	0.0	0.0	0.0	0.0
70.000	0.00033	0.00016	0.00005	0.0	0.0	0.0	0.0	0.0
87.200	0.00040	0.00020	0.00006	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE 12-3-78

FIGURE 4.2.1.1-96
EFFECT OF RUDDER



CONFIGURATION

BASE LINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

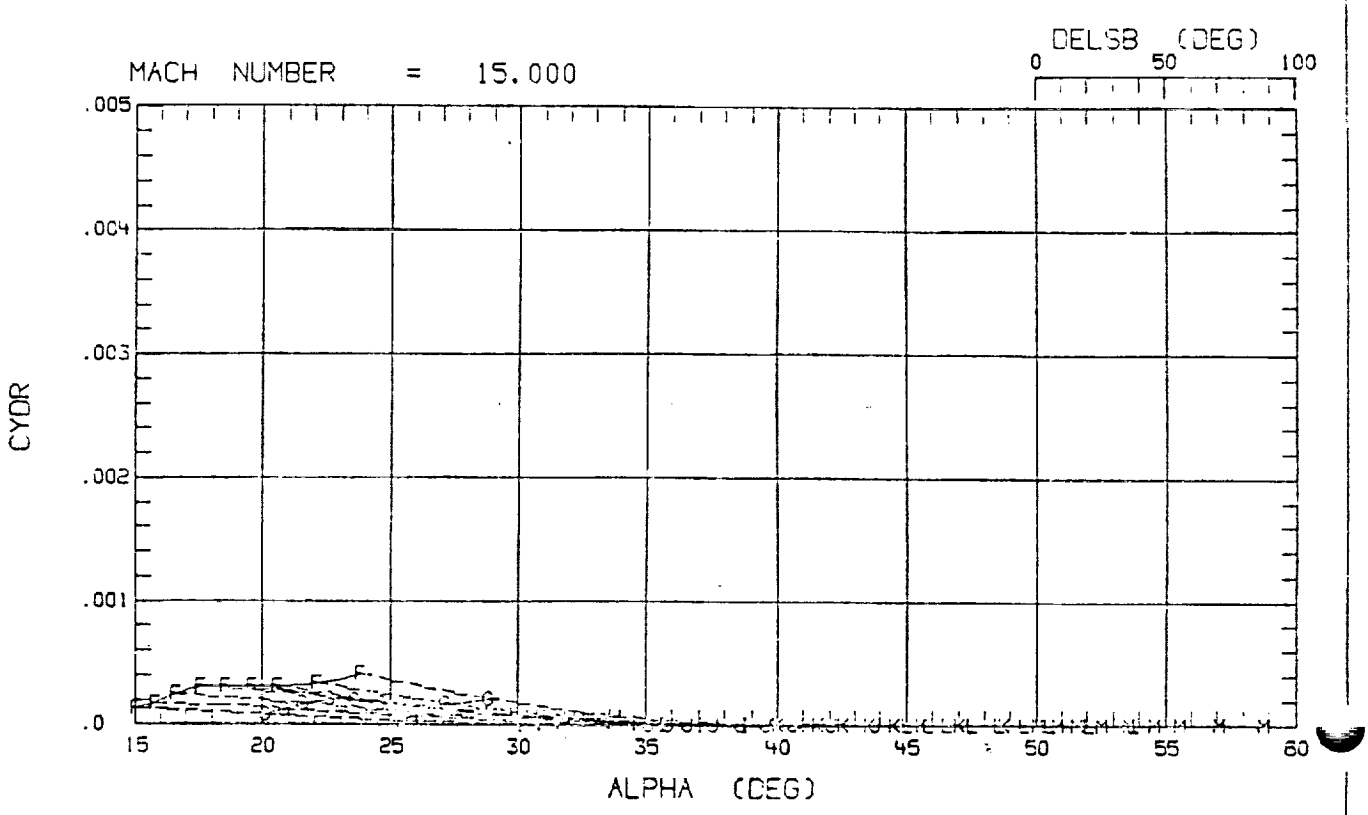
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1390.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00034	0.00030	0.00026	0.00020	0.00016	0.00013	0.00008	0.00003
7.500	0.00048	0.00042	0.00037	0.00030	0.00024	0.00017	0.00012	0.00006
15.000	0.00062	0.00054	0.00049	0.00039	0.00031	0.00024	0.00016	0.00009
25.000	0.00077	0.00068	0.00062	0.00052	0.00041	0.00030	0.00020	0.00010
35.000	0.00075	0.00068	0.00062	0.00053	0.00042	0.00031	0.00019	0.00009
45.000	0.00073	0.00067	0.00062	0.00052	0.00042	0.00030	0.00016	0.00007
55.000	0.00072	0.00067	0.00062	0.00052	0.00044	0.00030	0.00015	0.00006
70.000	0.00073	0.00069	0.00064	0.00057	0.00048	0.00033	0.00016	0.00005
87.200	0.00080	0.00076	0.00071	0.00065	0.00055	0.00040	0.00020	0.00006

ENGINEER WMT
DATE 6-21-78

FIGURE 4.2.1.1- 97
EFFECT OF RUDDER



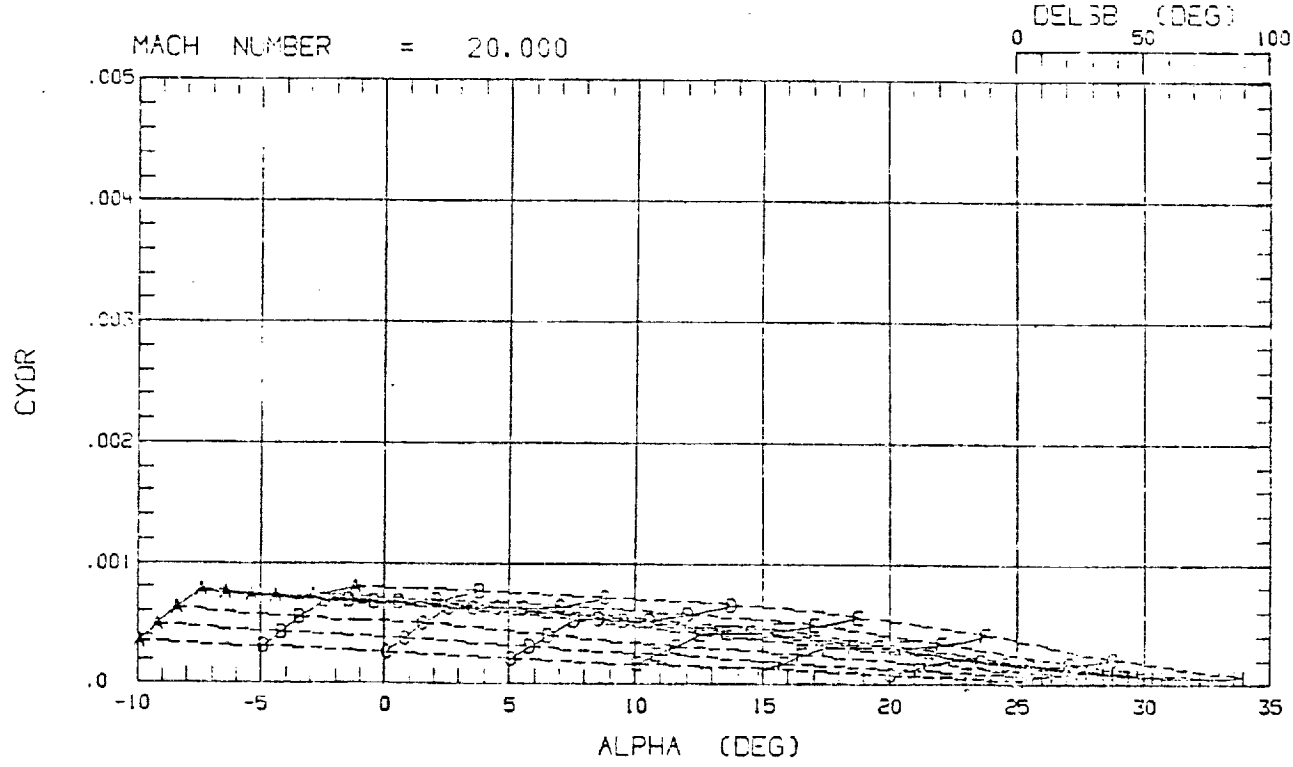
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00013	0.00008	0.00003	0.0	0.0	0.0	0.0	0.0
7.500	0.00017	0.00012	0.00006	0.00001	0.0	0.0	0.0	0.0
15.000	0.00024	0.00016	0.00008	0.00002	0.0	0.0	0.0	0.0
25.000	0.00030	0.00020	0.00010	0.00004	0.0	0.0	0.0	0.0
35.000	0.00031	0.00019	0.00009	0.00002	0.0	0.0	0.0	0.0
45.000	0.00030	0.00016	0.00007	0.00001	0.0	0.0	0.0	0.0
55.000	0.00030	0.00015	0.00006	0.0	0.0	0.0	0.0	0.0
70.000	0.00033	0.00016	0.00005	0.0	0.0	0.0	0.0	0.0
87.200	0.00040	0.00020	0.00006	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE 10-3-78

FIGURE 4.2.1.1-98
EFFECT OF RUDDER



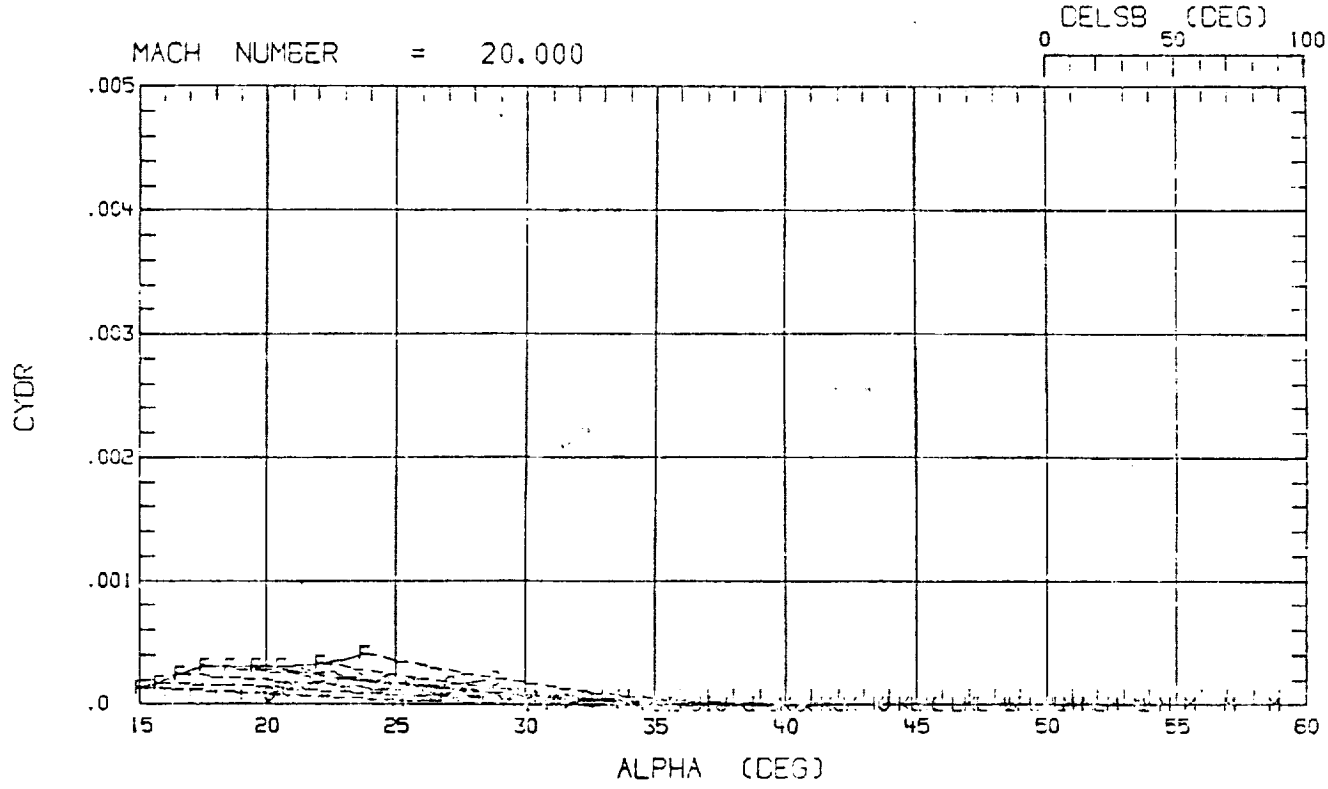
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XC = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00034	0.00030	0.00026	0.00020	0.00016	0.00013	0.00008	0.00003
7.500	0.00048	0.00042	0.00037	0.00030	0.00024	0.00017	0.00012	0.00006
15.000	0.00062	0.00054	0.00049	0.00039	0.00031	0.00024	0.00016	0.00008
25.000	0.00077	0.00068	0.00062	0.00052	0.00041	0.00030	0.00020	0.00010
35.000	0.00075	0.00068	0.00062	0.00053	0.00042	0.00031	0.00019	0.00009
45.000	0.00073	0.00067	0.00062	0.00052	0.00042	0.00030	0.00016	0.00007
55.000	0.00072	0.00067	0.00062	0.00052	0.00044	0.00030	0.00015	0.00006
70.000	0.00073	0.00069	0.00064	0.00057	0.00048	0.00033	0.00018	0.00005
87.200	0.00080	0.00076	0.00071	0.00065	0.00055	0.00040	0.00020	0.00006

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-99
EFFECT OF RUDDER



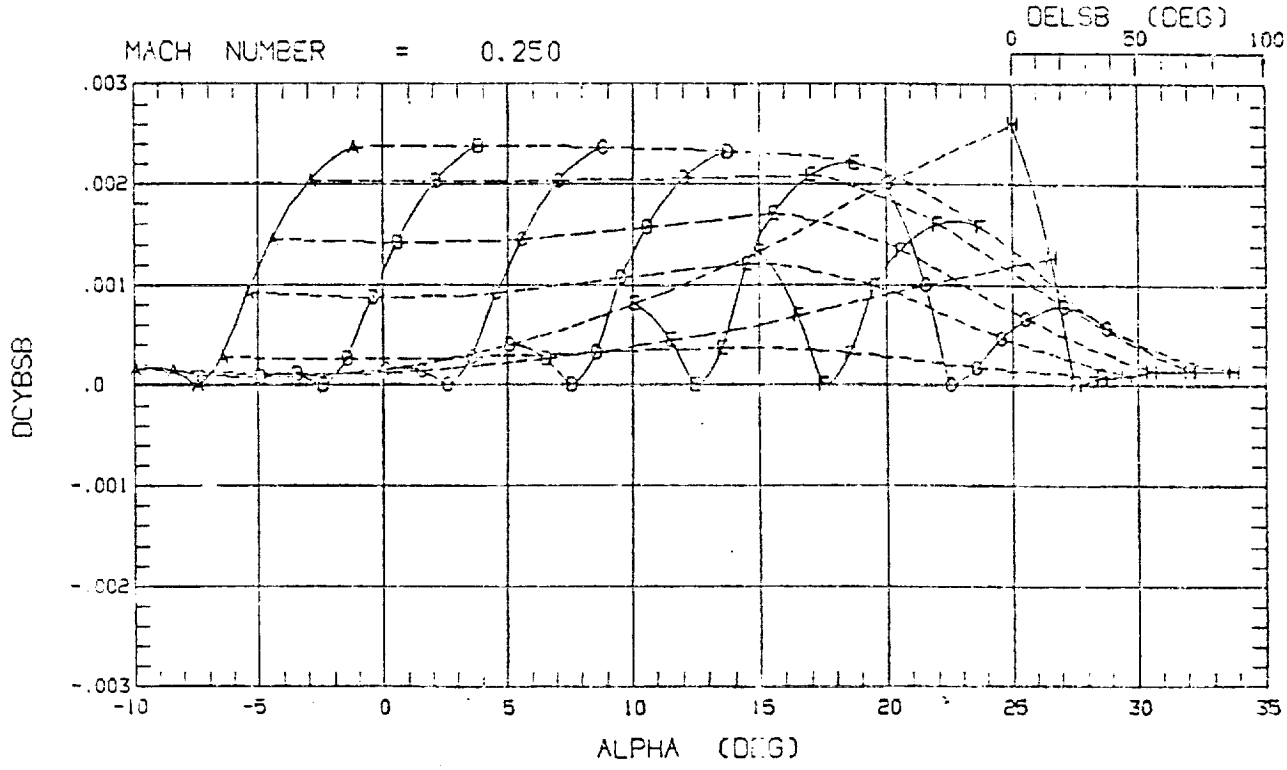
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SIDE FORCE DERIVATIVE							
0.0	0.00013	0.00009	0.00003	0.0	0.0	0.0	0.0	0.0
7.500	0.00017	0.00012	0.00006	0.00001	0.0	0.0	0.0	0.0
15.000	0.00024	0.00016	0.00009	0.00002	0.0	0.0	0.0	0.0
25.000	0.00030	0.00020	0.00010	0.00004	0.0	0.0	0.0	0.0
35.000	0.00031	0.00019	0.00009	0.00002	0.0	0.0	0.0	0.0
45.000	0.00030	0.00016	0.00007	0.00001	0.0	0.0	0.0	0.0
55.000	0.00030	0.00015	0.00006	0.0	0.0	0.0	0.0	0.0
70.000	0.00033	0.00016	0.00005	0.0	0.0	0.0	0.0	0.0
87.200	0.00040	0.00020	0.00006	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.1-100
EFFECT OF RUDDER



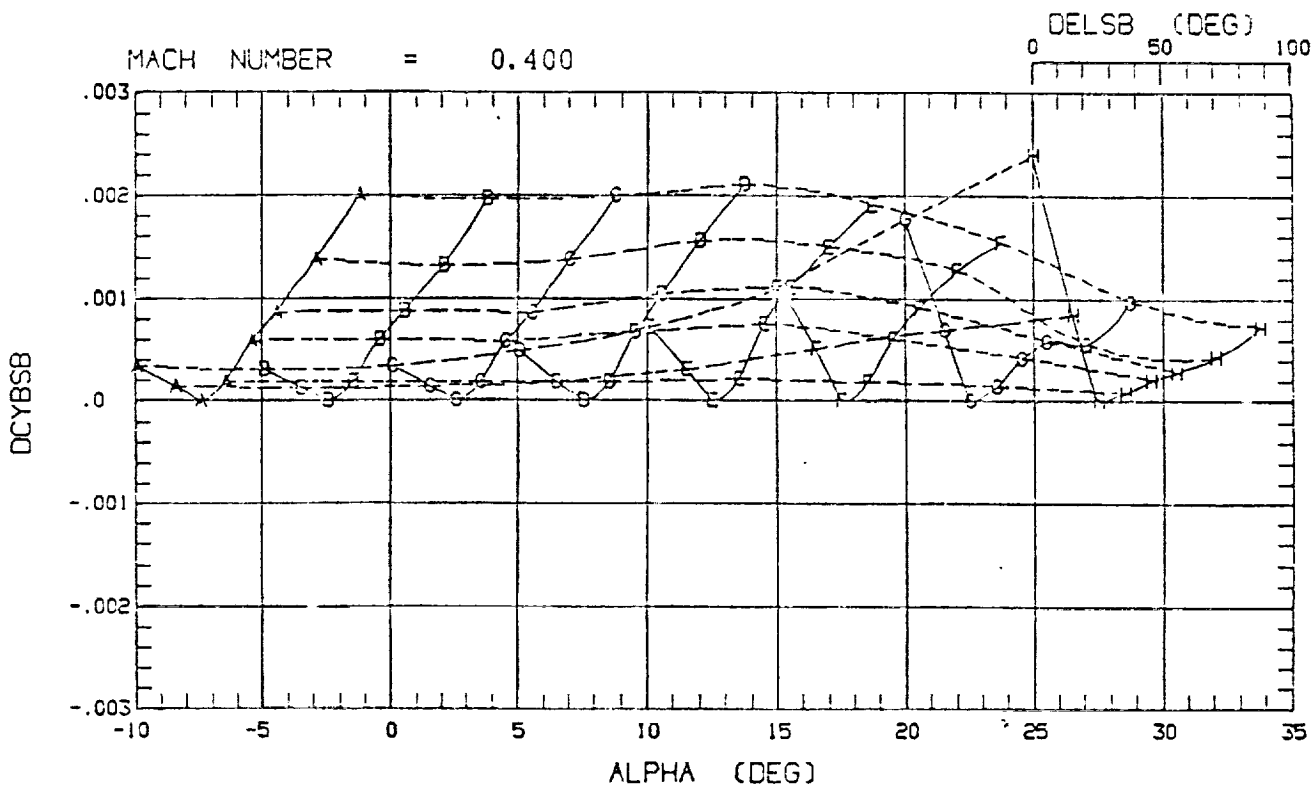
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1075.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00015	0.00007	0.00015	0.00040	0.00080	0.00133	0.00200	0.00260
15.000	0.00014	0.00010	0.00014	0.00026	0.00044	0.00068	0.00099	0.00126
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00027	0.00026	0.00027	0.00032	0.00037	0.00031	0.00017	0.00007
45.000	0.00091	0.00087	0.00091	0.00106	0.00121	0.00097	0.00046	0.00009
55.000	0.00145	0.00142	0.00145	0.00157	0.00170	0.00134	0.00065	0.00013
70.000	0.00203	0.00202	0.00203	0.00205	0.00208	0.00160	0.00078	0.00013
87.200	0.00235	0.00238	0.00236	0.00232	0.00221	0.00157	0.00056	0.00013

ENGINEER
DATE 9/13/78

FIGURE 4.2.1.1-101
EFFECT OF SPEEDBRAKE

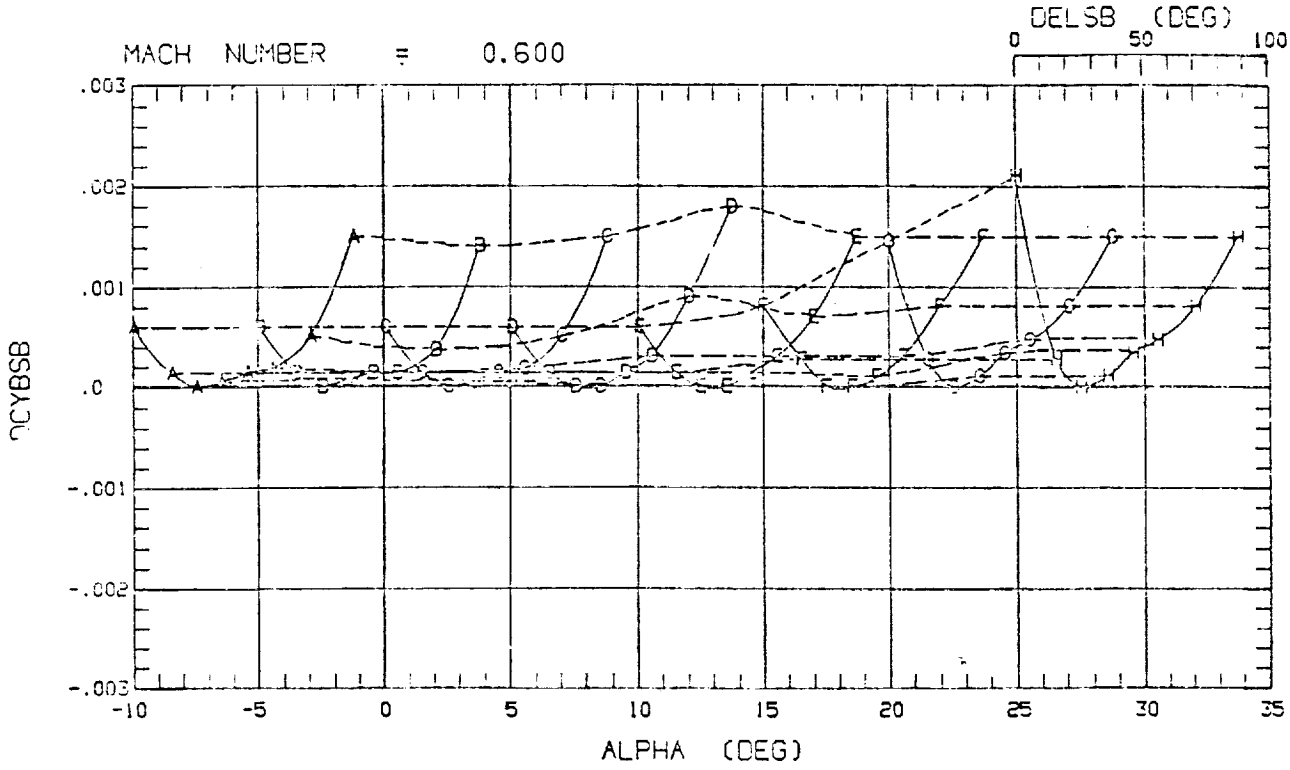


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00034	0.00030	0.00034	0.00048	0.00071	0.00110	0.00176	0.00239
15.000	0.00014	0.00012	0.00014	0.00019	0.00031	0.00051	0.00089	0.00084
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00018	0.00018	0.00018	0.00018	0.00021	0.00018	0.00014	0.00008
45.000	0.00058	0.00060	0.00058	0.00067	0.00075	0.00060	0.00041	0.00020
55.000	0.00086	0.00087	0.00086	0.00103	0.00110	0.00090	0.00059	0.00028
70.000	0.00137	0.00131	0.00137	0.00156	0.00149	0.00126	0.00055	0.00042
87.200	0.00199	0.00195	0.00199	0.00210	0.00191	0.00154	0.00086	0.00072

ENGINEER
DATE 9-13-83

FIGURE 4.2.1.1-102
EFFECT OF SPEEDBRAKE



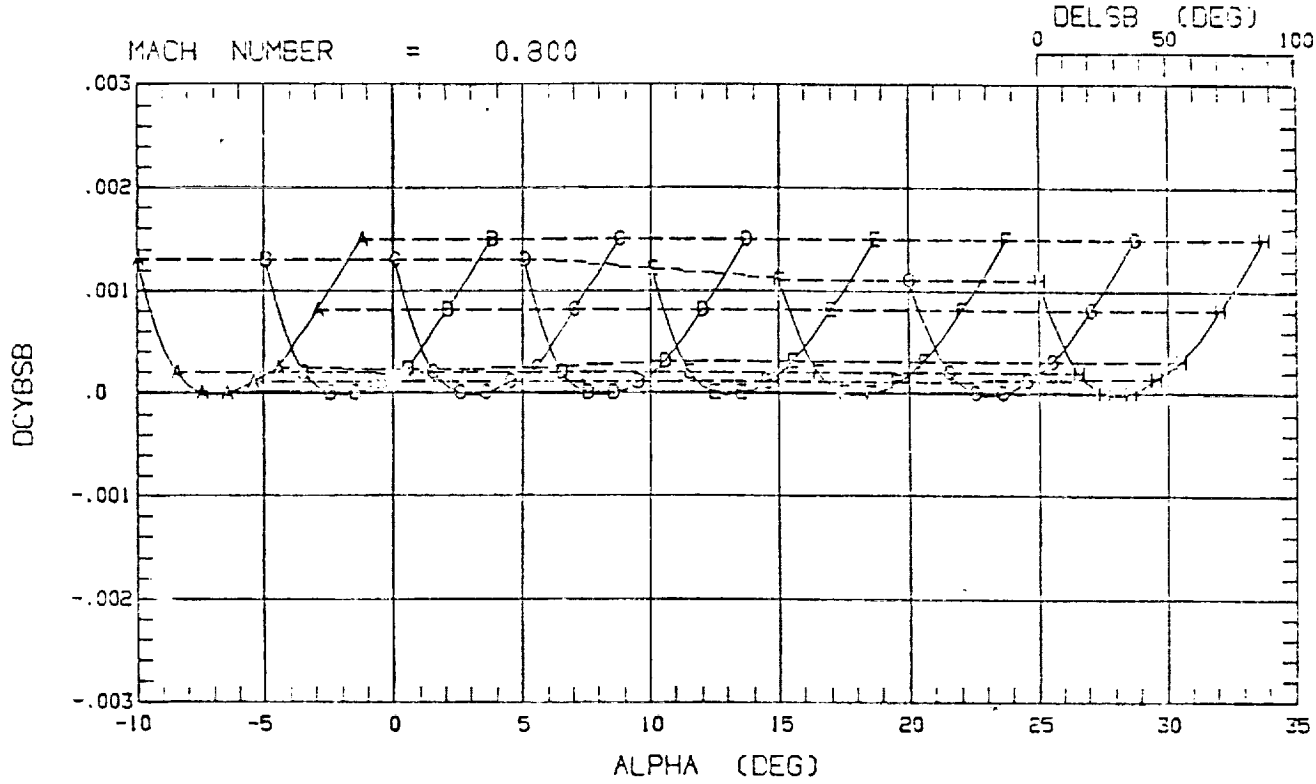
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00060	0.00060	0.00060	0.00060	0.00060	0.00080	0.00145	0.00210
15.000	0.00014	0.00014	0.00014	0.00014	0.00014	0.00028	0.00028	0.00028
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00005	0.00007	0.00005	0.0	0.0	0.0	0.00010	0.00010
45.000	0.00014	0.00014	0.0001	0.00014	0.00014	0.00010	0.00034	0.00034
55.000	0.00013	0.00014	0.00018	0.00030	0.00030	0.00030	0.00047	0.00047
70.000	0.00050	0.00037	0.00050	0.00090	0.00070	0.00080	0.00080	0.00080
87.200	0.00150	0.00140	0.00150	0.00180	0.00150	0.00150	0.00150	0.00150

ENGINEER LLL
DATE 9-13-85

FIGURE 4.2.1.1- 103
EFFECT OF SPEEDBRAKE



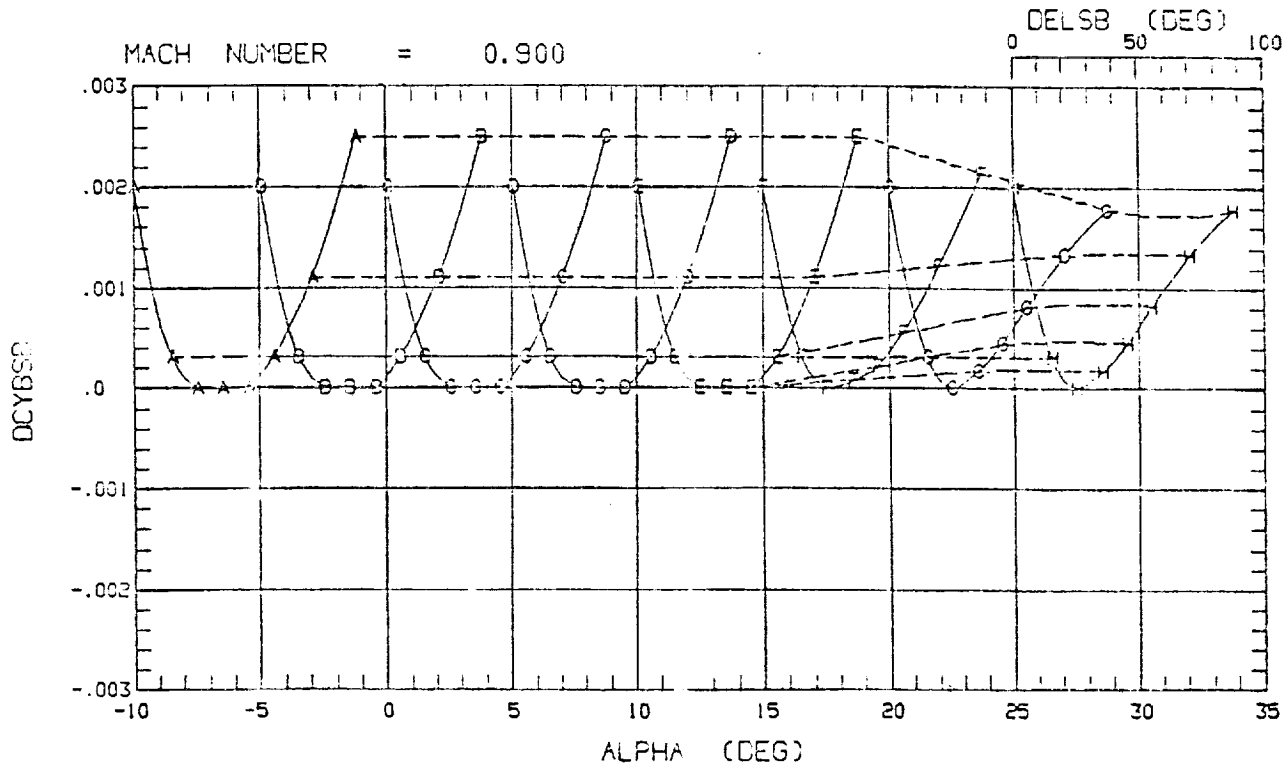
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00130	0.00130	0.00130	0.00130	0.00120	0.00110	0.00110	0.00110
15.000	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00012	0.00014
55.000	0.00025	0.00023	0.00025	0.00030	0.00030	0.00030	0.00030	0.00030
70.000	0.00080	0.00080	0.00080	0.00080	0.00080	0.00080	0.00080	0.00080
87.200	0.00150	0.00150	0.00150	0.00150	0.00150	0.00150	0.00150	0.00150

ENGINEER LLL
DATE 7-13-78

FIGURE 4.2.1.1-104
EFFECT OF SPEEDBRAKE



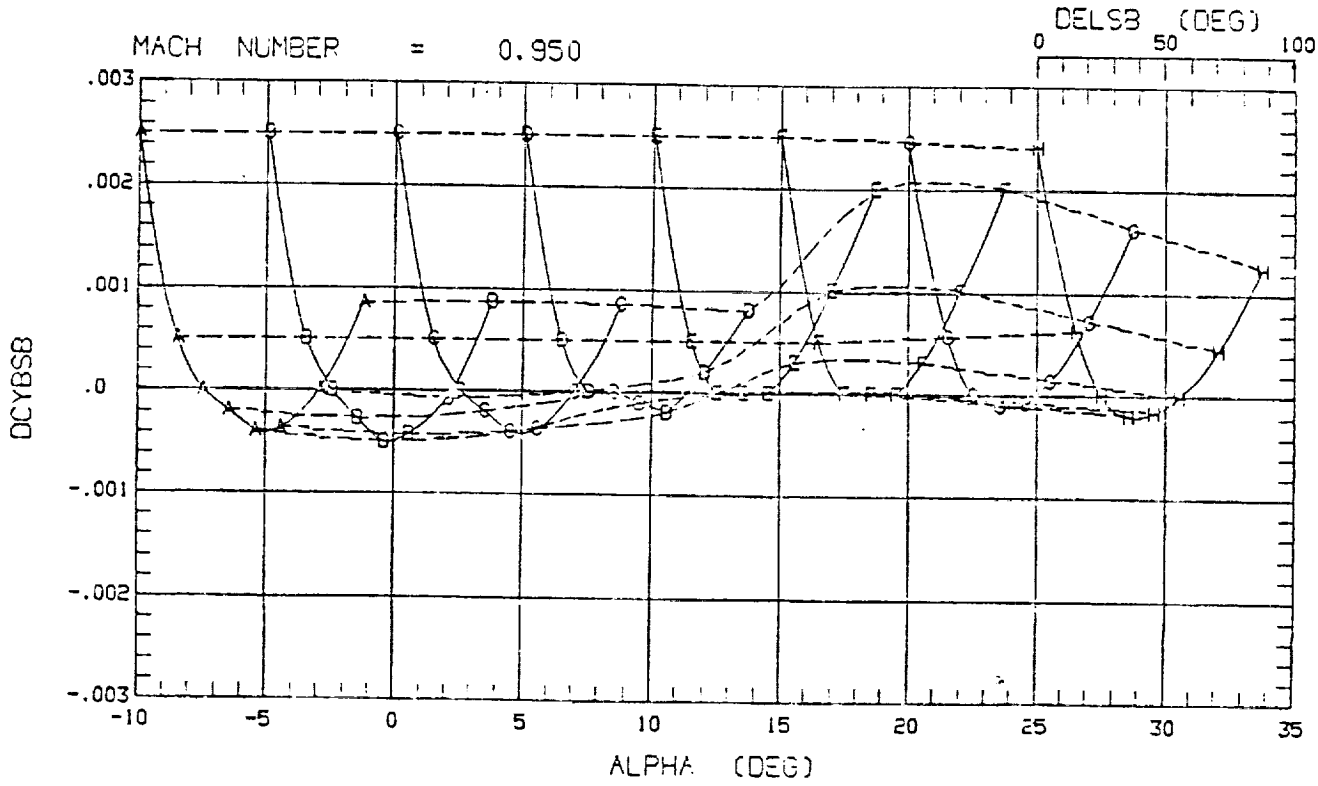
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00200	0.00200	0.00200	0.00200	0.00200	0.00200	0.00200	0.00200
15.000	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.00008	0.00017	0.00017
45.000	0.0	0.0	0.0	0.0	0.0	0.00022	0.00044	0.00044
55.000	0.00030	0.00030	0.00030	0.00030	0.00030	0.00055	0.00081	0.00081
70.000	0.00110	0.00110	0.00110	0.00110	0.00110	0.00122	0.00133	0.00133
87.200	0.00250	0.00250	0.00250	0.00250	0.00250	0.00213	0.00176	0.00176

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.1-105
EFFECT OF SPEEDBRAKE



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

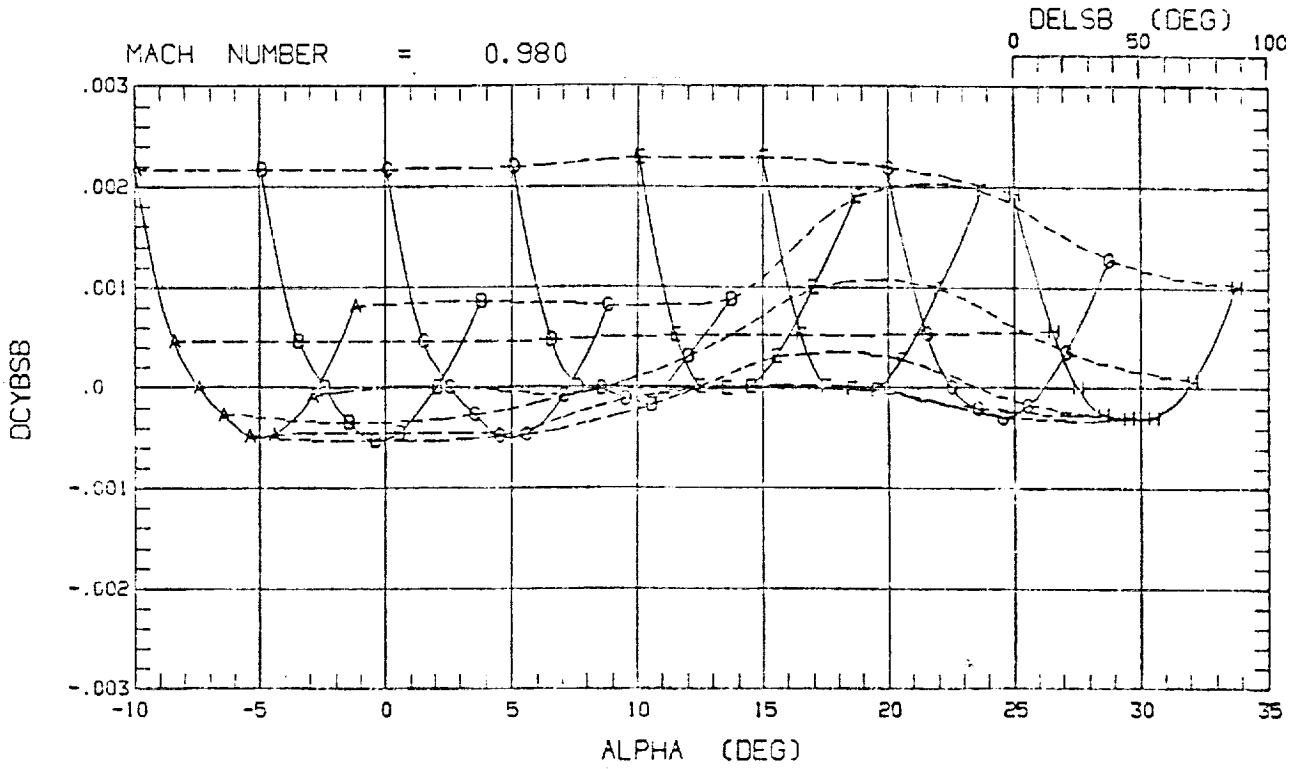
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00245	0.00240
15.000	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00056	0.00062
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00020	-0.00027	-0.00020	0.0	0.0	0.0	-0.00010	-0.00020
45.000	-0.00040	-0.00050	-0.00040	-0.00010	0.0	0.0	-0.00008	-0.00015
55.000	-0.00037	-0.00043	-0.00037	-0.00020	0.00030	0.00030	0.00014	-0.00002
70.000	0.0	-0.00007	0.0	0.00020	0.00100	0.00100	0.00072	0.00044
87.200	0.00085	0.00087	0.00085	0.00080	0.00200	0.00200	0.00162	0.00124

ENGINEER [illegible]
DATE 9-28-78

FIGURE 4.2.1.1-106
EFFECT OF SPEEDBRAKE



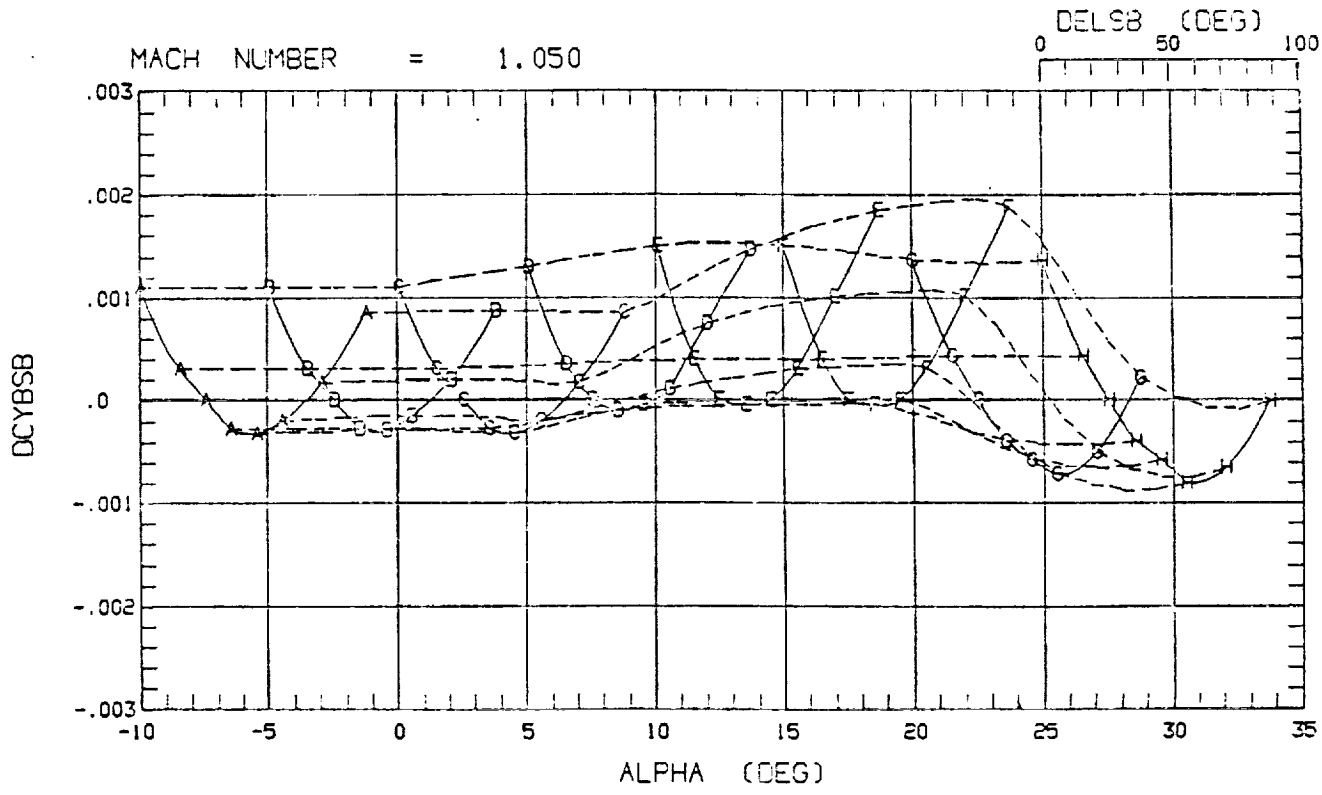
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00217	0.00217	0.00217	0.00219	0.00228	0.00228	0.00218	0.00192
15.000	0.00045	0.00045	0.00045	0.00047	0.00052	0.00052	0.00053	0.00056
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00029	-0.00035	-0.00028	-0.00002	-0.00001	-0.00002	-0.00022	-0.00028
45.000	-0.00049	-0.00054	-0.00049	-0.00012	0.0	-0.00003	-0.00030	-0.00031
55.000	-0.00047	-0.00045	-0.00047	-0.00018	0.00030	0.00027	-0.00019	-0.00030
70.000	-0.00009	0.0	-0.00009	0.00030	0.00099	0.00097	0.00035	0.00006
87.200	0.00081	0.00095	0.00081	0.00087	0.00190	0.00195	0.00126	0.00101

ENGINEER [illegible]
DATE 9-13-78

FIGURE 4.2.1.1-107
EFFECT OF SPEEDBRAKE



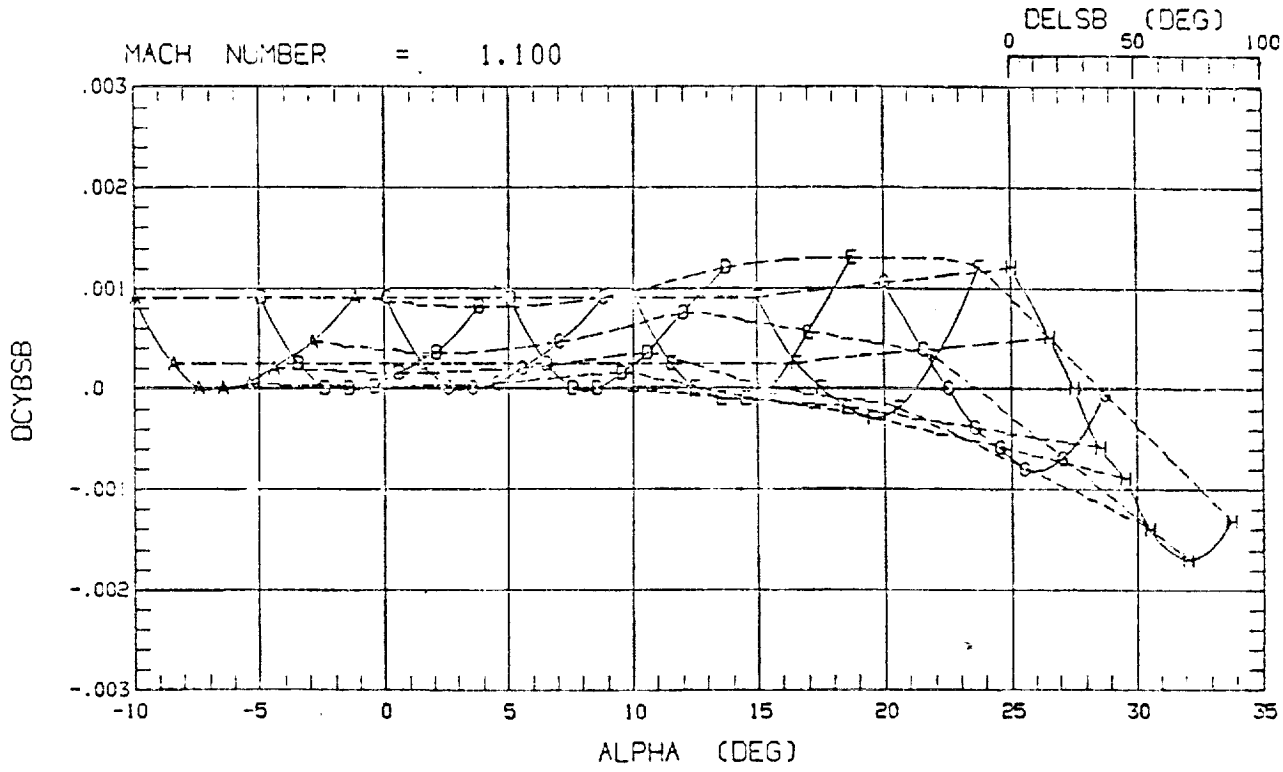
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00110	0.00110	0.00110	0.00130	0.00150	0.00150	0.00135	0.00135
15.000	0.00030	0.00030	0.00030	0.00035	0.00040	0.00040	0.00043	0.00043
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00028	-0.00027	-0.00028	-0.00010	-0.00005	-0.00005	-0.00039	-0.00039
45.000	-0.00032	-0.00029	-0.00032	-0.00005	0.0	0.0	-0.00058	-0.00053
55.000	-0.00020	-0.00015	-0.00020	0.00010	0.00030	0.00030	-0.00072	-0.00080
70.000	0.00016	0.00020	0.00016	0.00075	0.00100	0.00100	-0.00050	-0.00065
87.200	0.00085	0.00087	0.00085	0.00146	0.00184	0.00188	0.00022	-0.00001

ENGINEER LLL
DATE 7-13-78

FIGURE 4.2.1.1-108
EFFECT OF SPEEDBRAKE



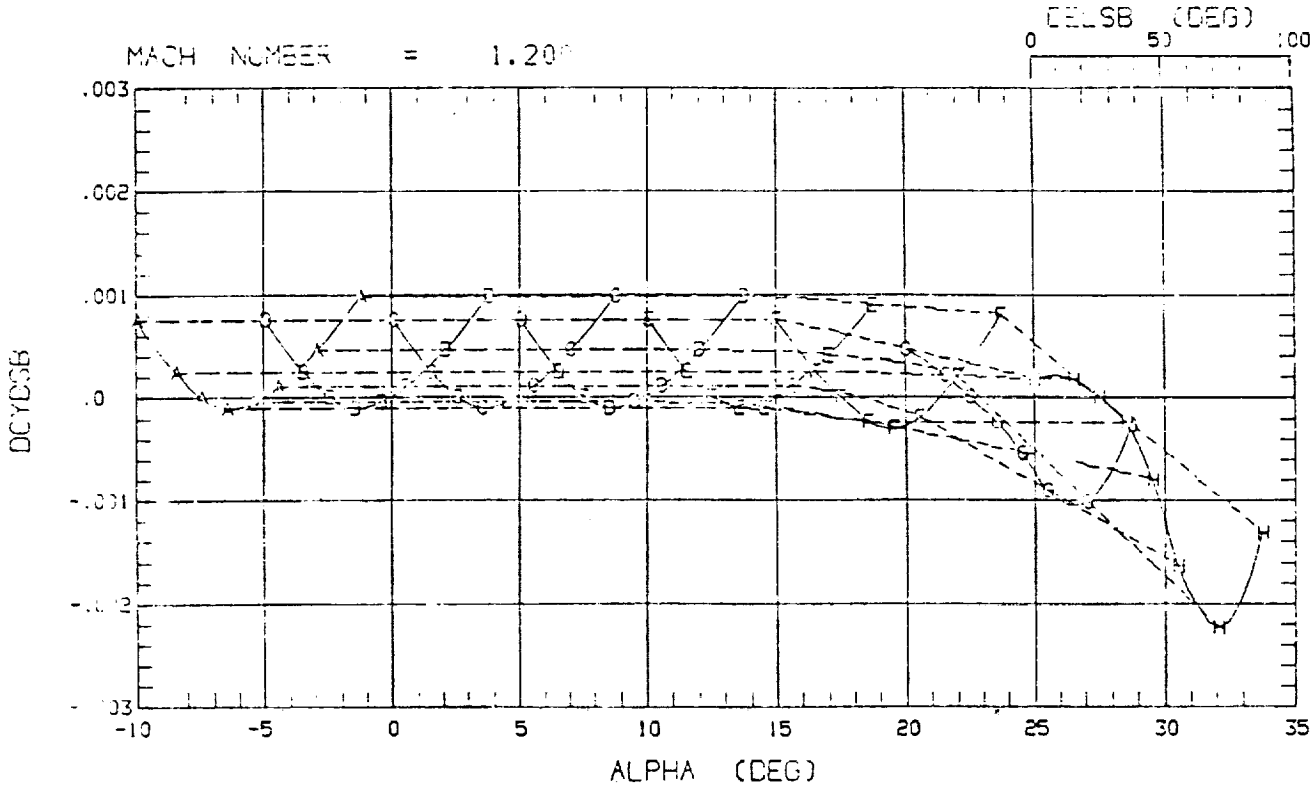
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00090	0.00090	0.00090	0.00090	0.00090	0.00090	0.00105	0.00120
15.000	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00038	0.00051
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	-0.00010	-0.00020	-0.00040	-0.00060
45.000	0.00005	0.00002	0.00005	0.00015	-0.00010	-0.00030	-0.00060	-0.00090
55.000	0.00020	0.00015	0.00020	0.00035	0.0	-0.00020	-0.00080	-0.00140
70.000	0.00045	0.00035	0.00045	0.00075	0.00055	0.00030	-0.00070	-0.00170
87.200	0.00090	0.00090	0.00090	0.00120	0.00130	0.00120	-0.00005	-0.00132

ENGINEER ///
DATE 9-13-85

FIGURE 4.2.1.1-109
EFFECT OF SPEEDBRAKE



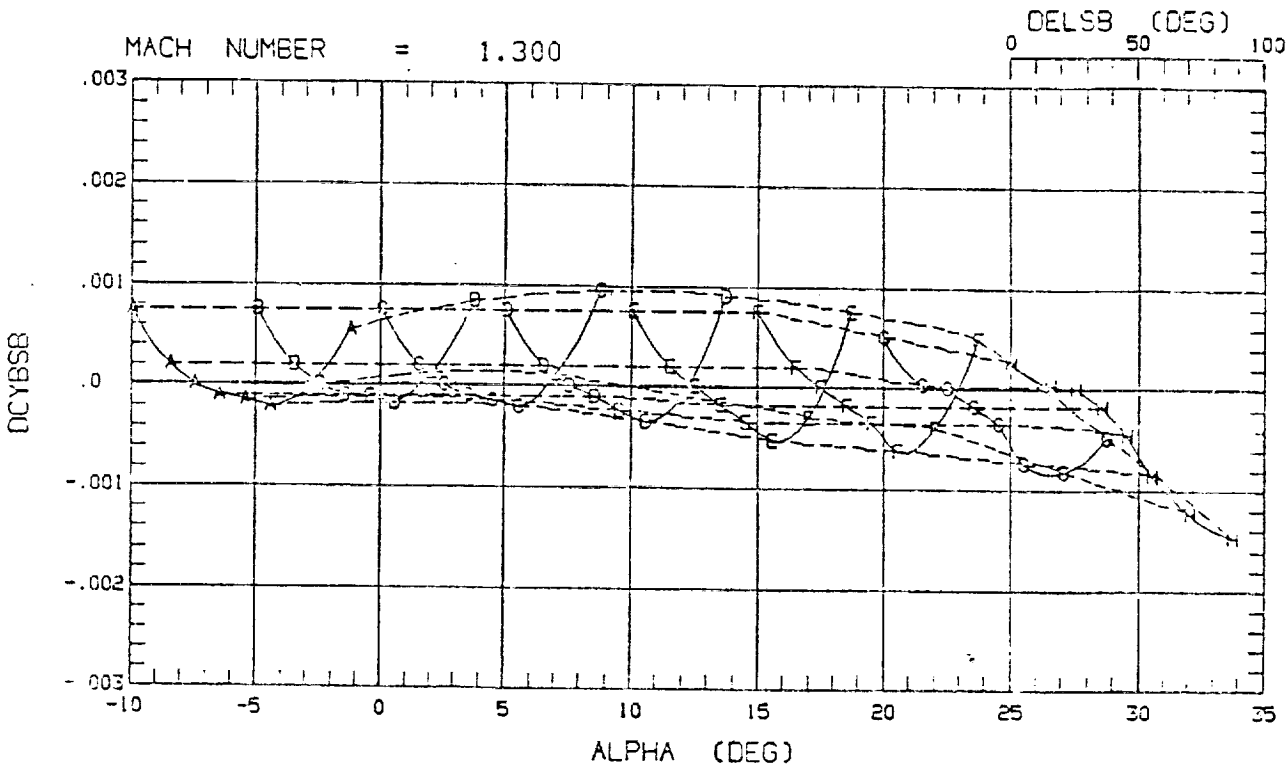
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00075	0.00075	0.00075	0.00075	0.00075	0.00075	0.00046	0.00017
15.000	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00021	0.00017
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00024	-0.00024	-0.00024
45.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00010	-0.00030	-0.00055	-0.00080
55.000	0.00010	0.00010	0.00010	0.00010	0.00010	-0.00020	-0.00092	-0.00164
70.000	0.00045	0.00045	0.00045	0.00045	0.00040	0.00020	-0.00102	-0.00224
87.200	0.00098	0.00098	0.00098	0.00096	0.00086	0.00079	-0.00027	-0.00133

ENGINEER
DATE 2-13-78

FIGURE 4.2.1.1-110
EFFECT OF SPEEDBRAKE



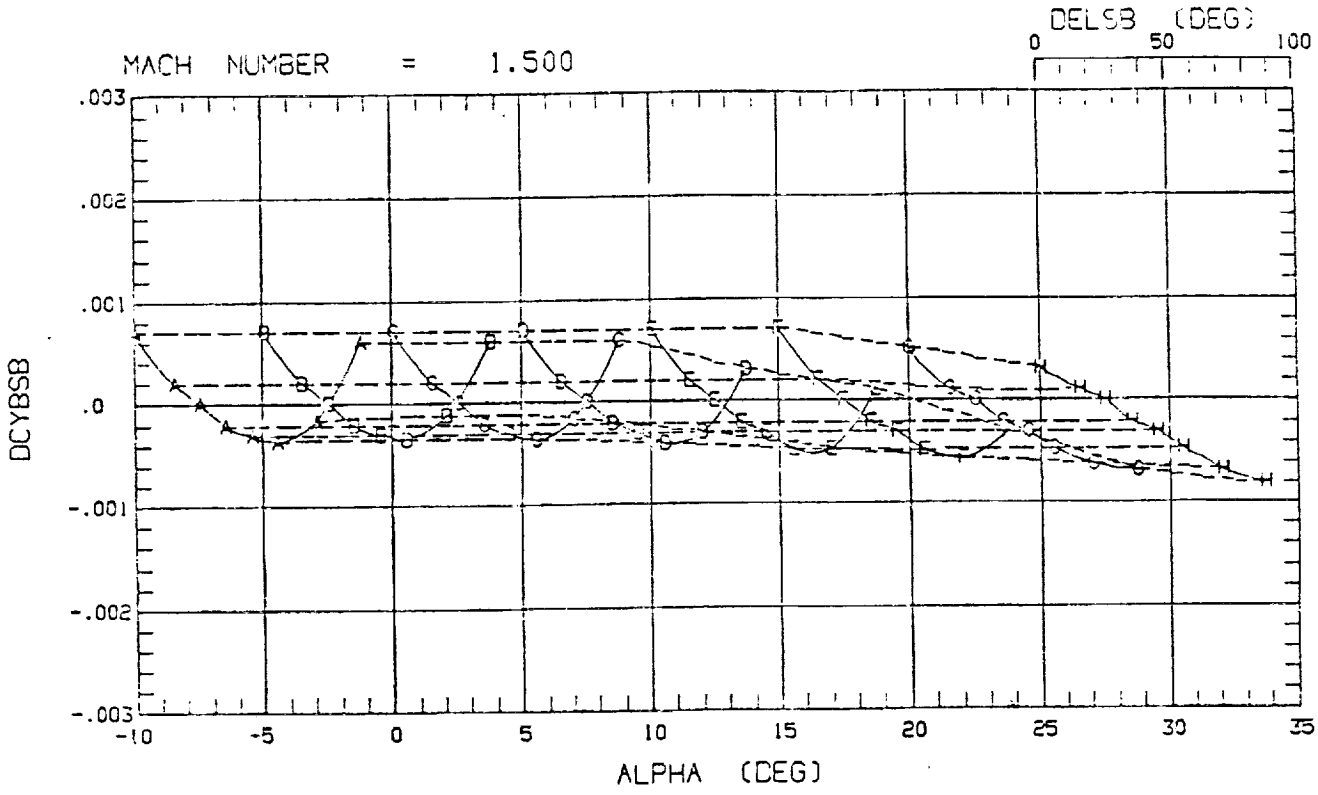
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00074	0.00074	0.00074	0.00074	0.00074	0.00074	0.00050	0.00026
15.000	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00003	0.00003
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00018	-0.00018	-0.00018	-0.00018
45.000	-0.00015	-0.00012	-0.00015	-0.00025	-0.00035	-0.00035	-0.00035	-0.00045
55.000	-0.00022	-0.00018	-0.00022	-0.00035	-0.00053	-0.00063	-0.00074	-0.00085
70.000	-0.00004	0.00012	0.00010	-0.00010	-0.00030	-0.00040	-0.00082	-0.00124
87.200	0.00055	0.00083	0.00095	0.00090	0.00074	0.00049	-0.00049	-0.00147

ENGINEER
DATE 7-18-85

FIGURE 4.2.1.1-111
EFFECT OF SPEEDBRAKE



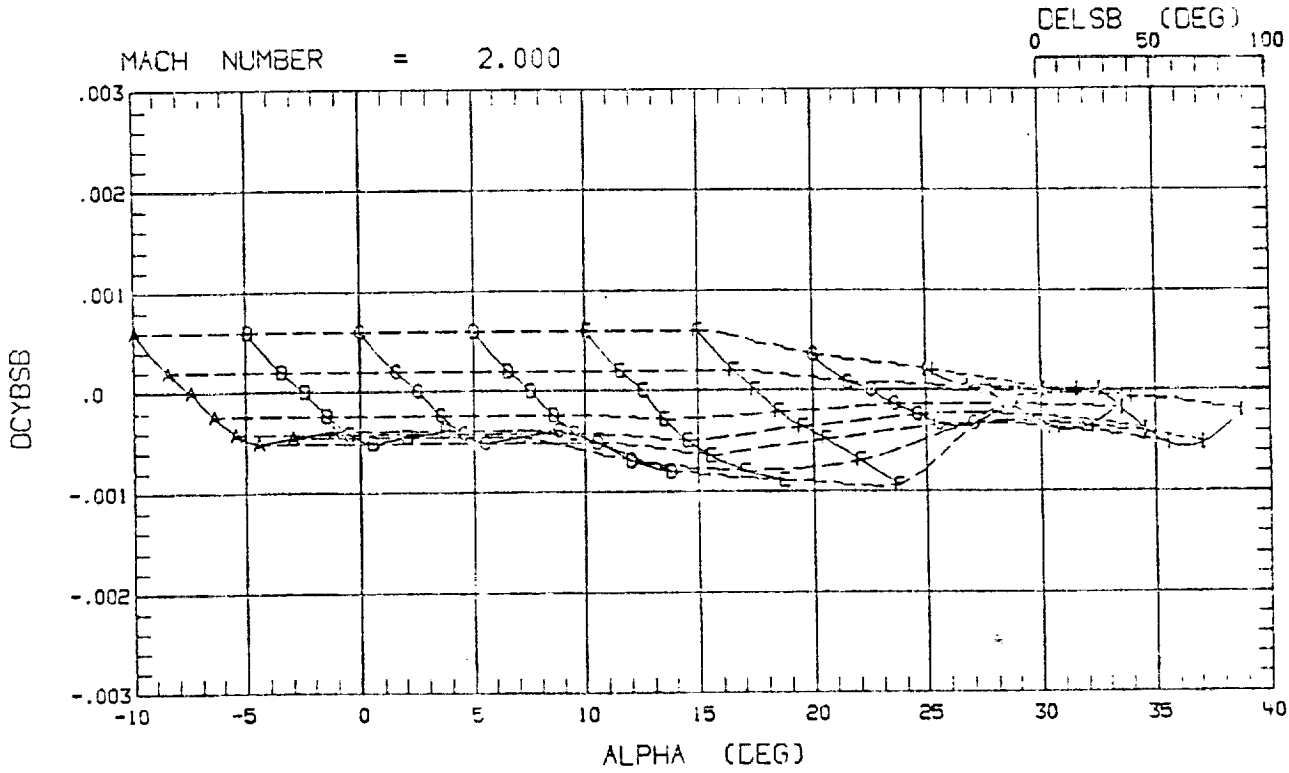
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070	0.00050	0.00030
15.000	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00010	0.00010
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00021	-0.00021	-0.00021	-0.00021	-0.00021	-0.00021	-0.00021	-0.00021
45.000	-0.00031	-0.00031	-0.00031	-0.00031	-0.00031	-0.00031	-0.00031	-0.00031
55.000	-0.00036	-0.00035	-0.00036	-0.00041	-0.00047	-0.00048	-0.00047	-0.00047
70.000	-0.00016	-0.00012	-0.00016	-0.00031	-0.00047	-0.00056	-0.00062	-0.00069
87.200	0.00060	0.00060	0.00060	0.00030	0.00010	-0.00030	-0.00088	-0.00081

ENGINEER
DATE 2-13-92

FIGURE 4.2.1.1- 112
EFFECT OF SPEEDBRAKE



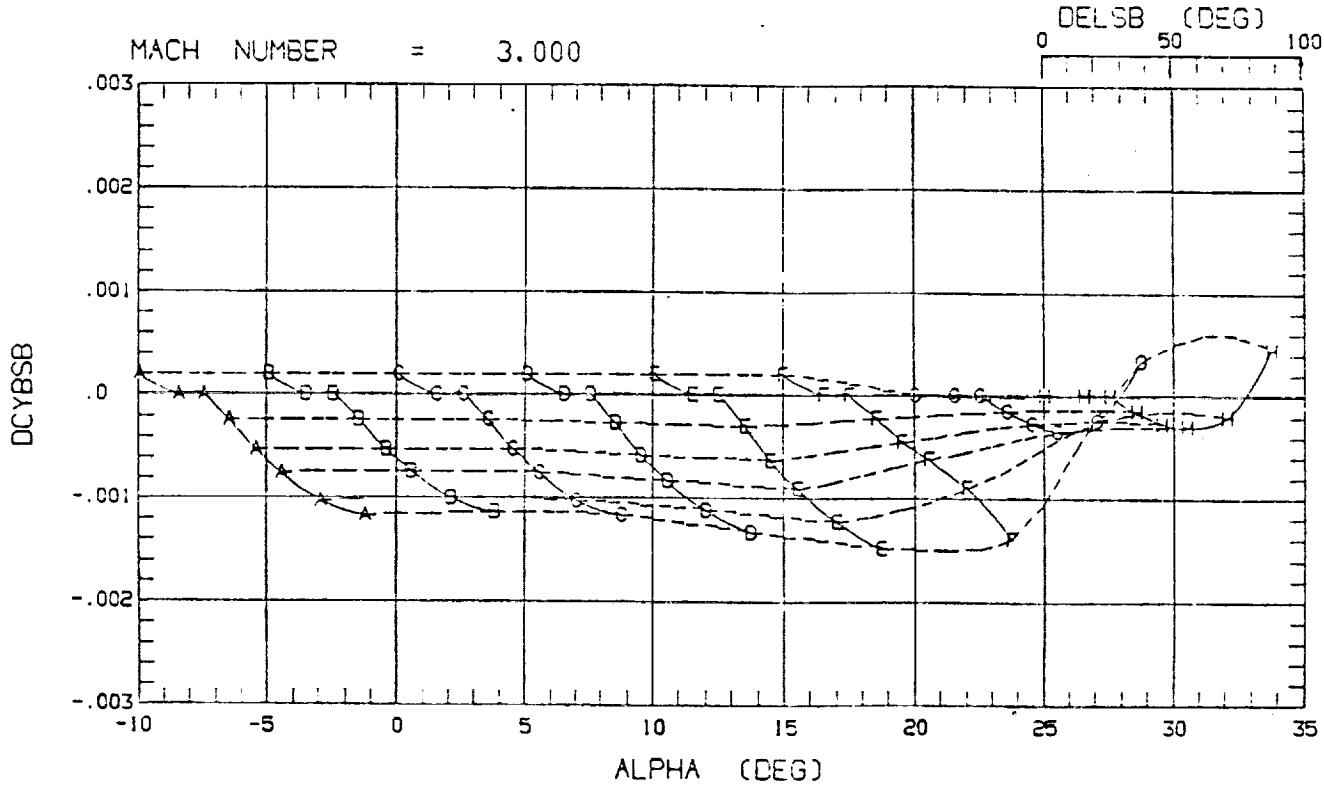
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT								
0.0	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00035	0.00020	0.0
15.000	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00008	0.00004	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00024	-0.00024	-0.00024	-0.00024	-0.00029	-0.00022	-0.00014	-0.00014	-0.00019
45.000	-0.00042	-0.00042	-0.00042	-0.00042	-0.00050	-0.00037	-0.00024	-0.00026	-0.00039
55.000	-0.00052	-0.00052	-0.00052	-0.00052	-0.00065	-0.00049	-0.00034	-0.00038	-0.00054
70.000	-0.00046	-0.00046	-0.00046	-0.00070	-0.00080	-0.00070	-0.00033	-0.00036	-0.00053
87.200	-0.00040	-0.00040	-0.00040	-0.00080	-0.00090	-0.00095	-0.00006	-0.00007	-0.00022

ENGINEER LLL
DATE 2-13-78

FIGURE 4.2.1.1- 113
EFFECT OF SPEEDBRAKE



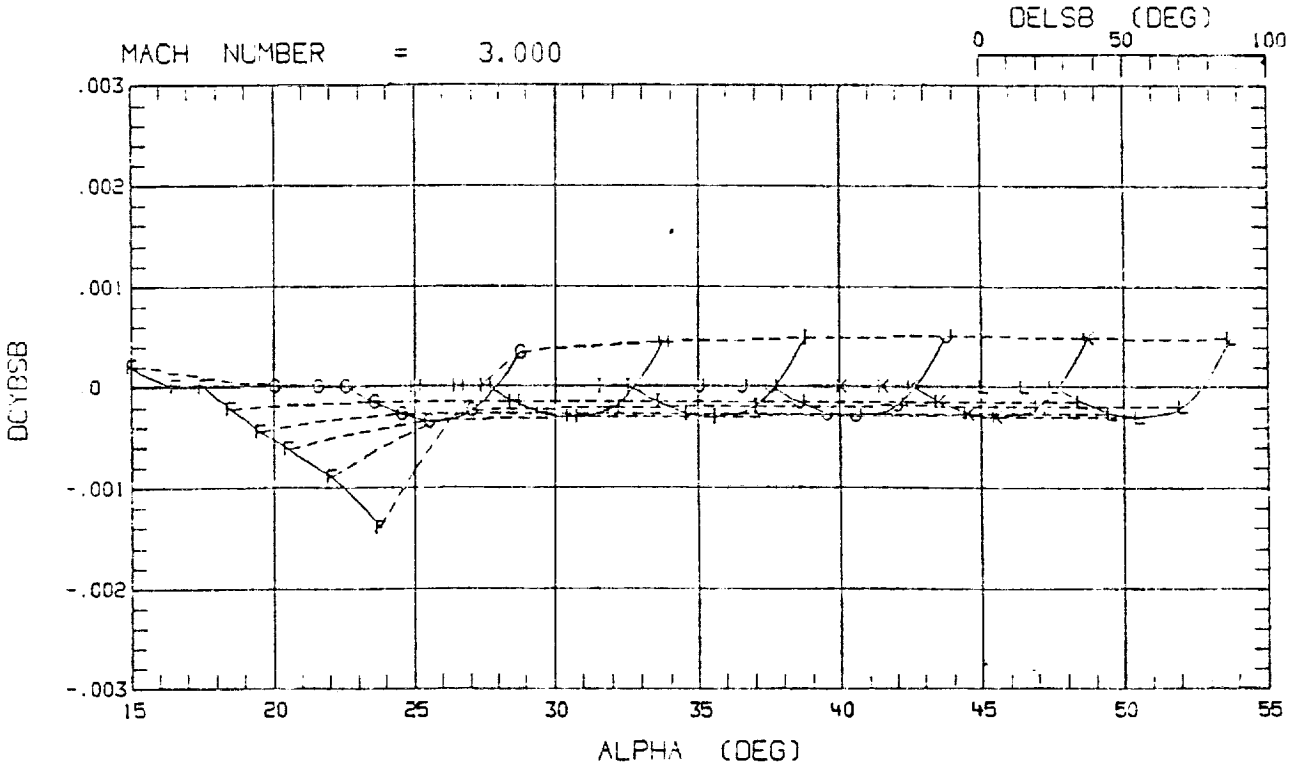
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00025	-0.00024	-0.00025	-0.00028	-0.00031	-0.00023	-0.00015	-0.00015
45.000	-0.00054	-0.00053	-0.00054	-0.00059	-0.00064	-0.00045	-0.00027	-0.00027
55.000	-0.00076	-0.00074	-0.00076	-0.00084	-0.00092	-0.00063	-0.00035	-0.00031
70.000	-0.00103	-0.00100	-0.00103	-0.00113	-0.00124	-0.00090	-0.00025	-0.00021
87.200	-0.00118	-0.00114	-0.00118	-0.00134	-0.00150	-0.00140	0.00033	0.00044

ENGINEER LLL
DATE 5-13-78

FIGURE 4.2.1.1-114
EFFECT OF SPEEDBRAKE



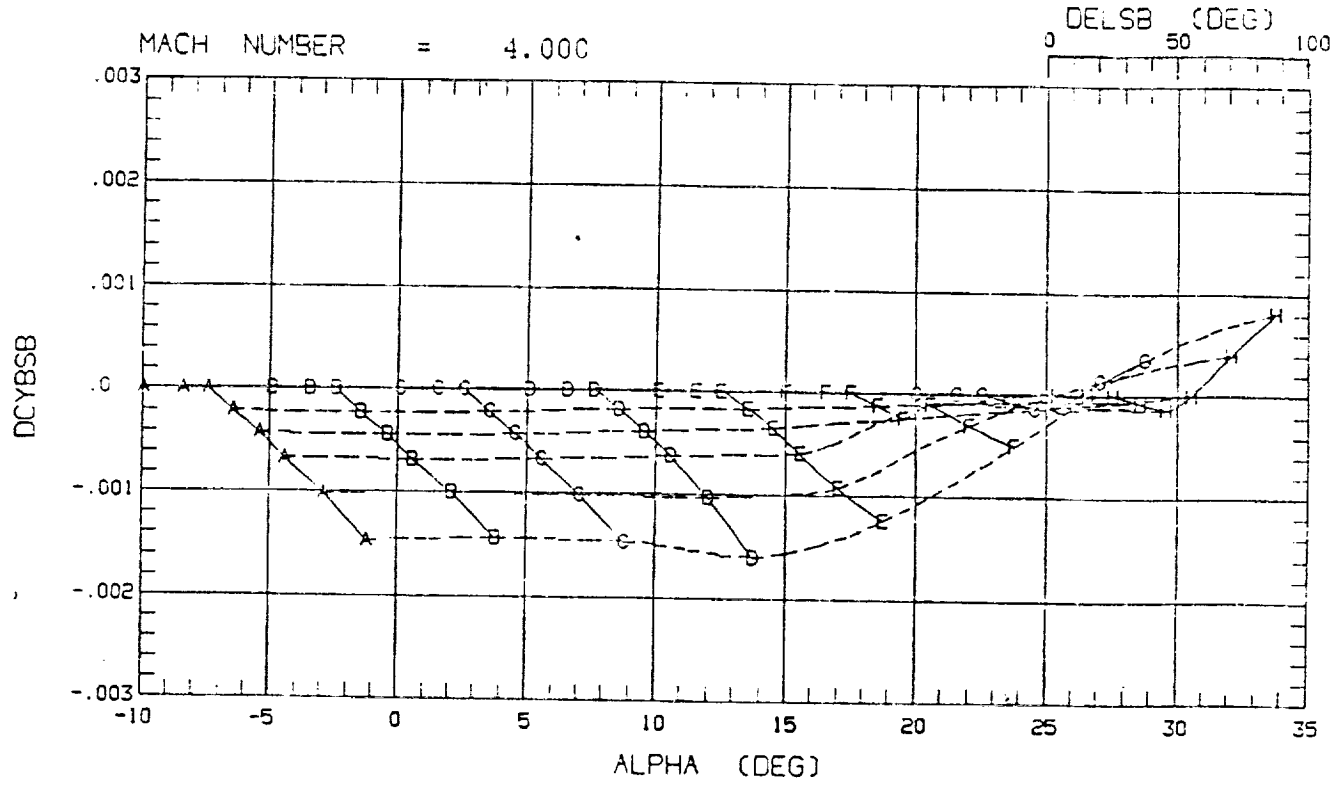
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT						
0.0	0.00020	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00023	-0.00015	-0.00015	-0.00015	-0.00015	-0.00015	-0.00015
45.000	-0.00045	-0.00027	-0.00027	-0.00027	-0.00027	-0.00027	-0.00027
55.000	-0.00063	-0.00035	-0.00031	-0.00030	-0.00029	-0.00030	-0.00030
70.000	-0.00090	-0.00025	-0.00021	-0.00020	-0.00019	-0.00020	-0.00020
87.200	-0.00140	0.00033	0.00044	0.00048	0.00050	0.00048	0.00048

ENGINEER LLL
DATE 7-13-78

FIGURE 4.2.1.1-115
EFFECT OF SPEEDBRAKE



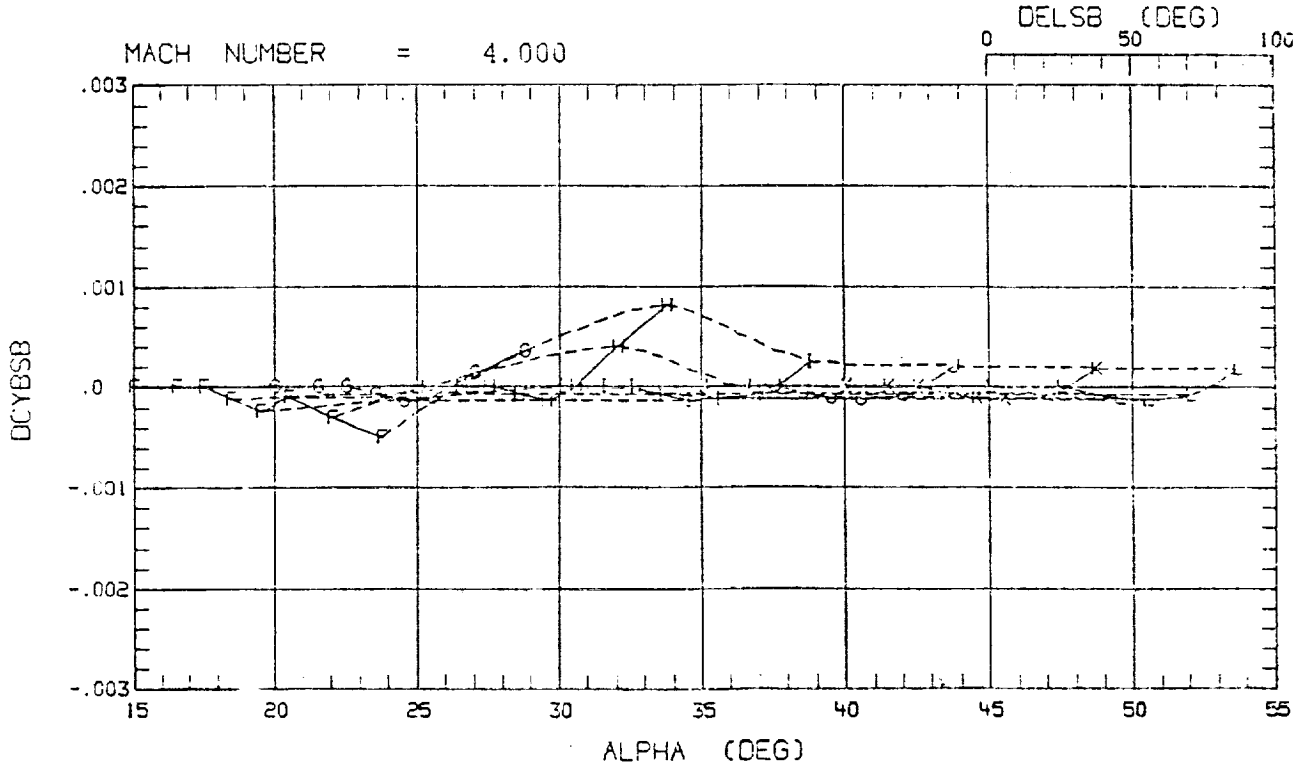
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00022	-0.00023	-0.00022	-0.00018	-0.00016	-0.00012	-0.00007	-0.00007
45.000	-0.00043	-0.00044	-0.00043	-0.00039	-0.00035	-0.00024	-0.00014	-0.00014
55.000	-0.00067	-0.00068	-0.00067	-0.00063	-0.00060	-0.00010	-0.00010	0.0
70.000	-0.00102	-0.00101	-0.00102	-0.00104	-0.00093	-0.00033	0.00013	0.00040
87.200	-0.00148	-0.00145	-0.00148	-0.00162	-0.00125	-0.00050	0.00035	0.00080

ENGINEER
DATE 9-10-78

FIGURE 4.2.1.1-116
EFFECT OF SPEEDBRAKE

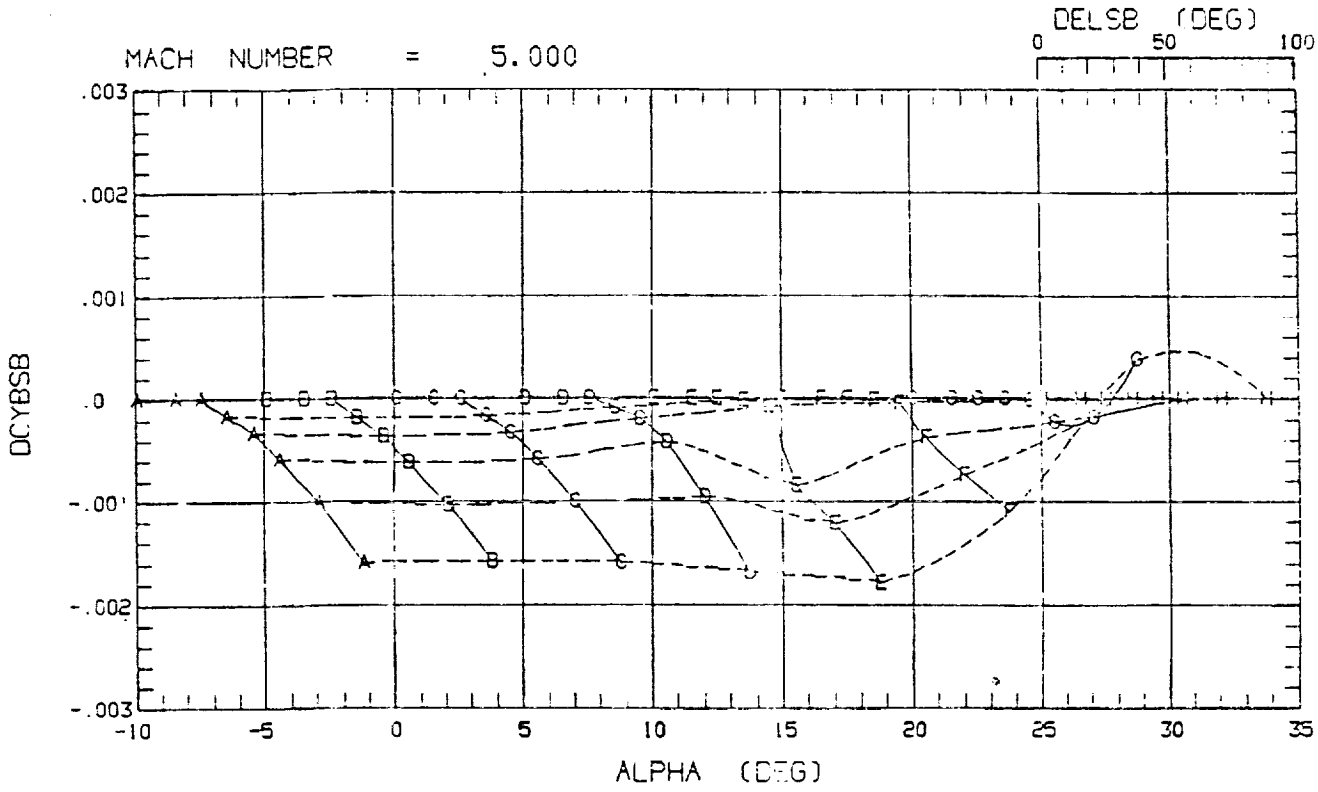


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00012	-0.00007	-0.00007	-0.00008	-0.00006	-0.00006	-0.00006
45.000	-0.00024	-0.00014	-0.00014	-0.00013	-0.00011	-0.00011	-0.00011
55.000	-0.00010	-0.00010	0.0	-0.00012	-0.00012	-0.00012	-0.00012
70.000	-0.00030	0.00013	0.00040	-0.00007	-0.00008	-0.00008	-0.00008
87.200	-0.00050	0.00035	0.00080	0.00024	0.00020	0.00019	0.00019

ENGINEER
DATE 9-13-82

FIGURE 4.2.1.1-117
EFFECT OF SPEEDBRAKE



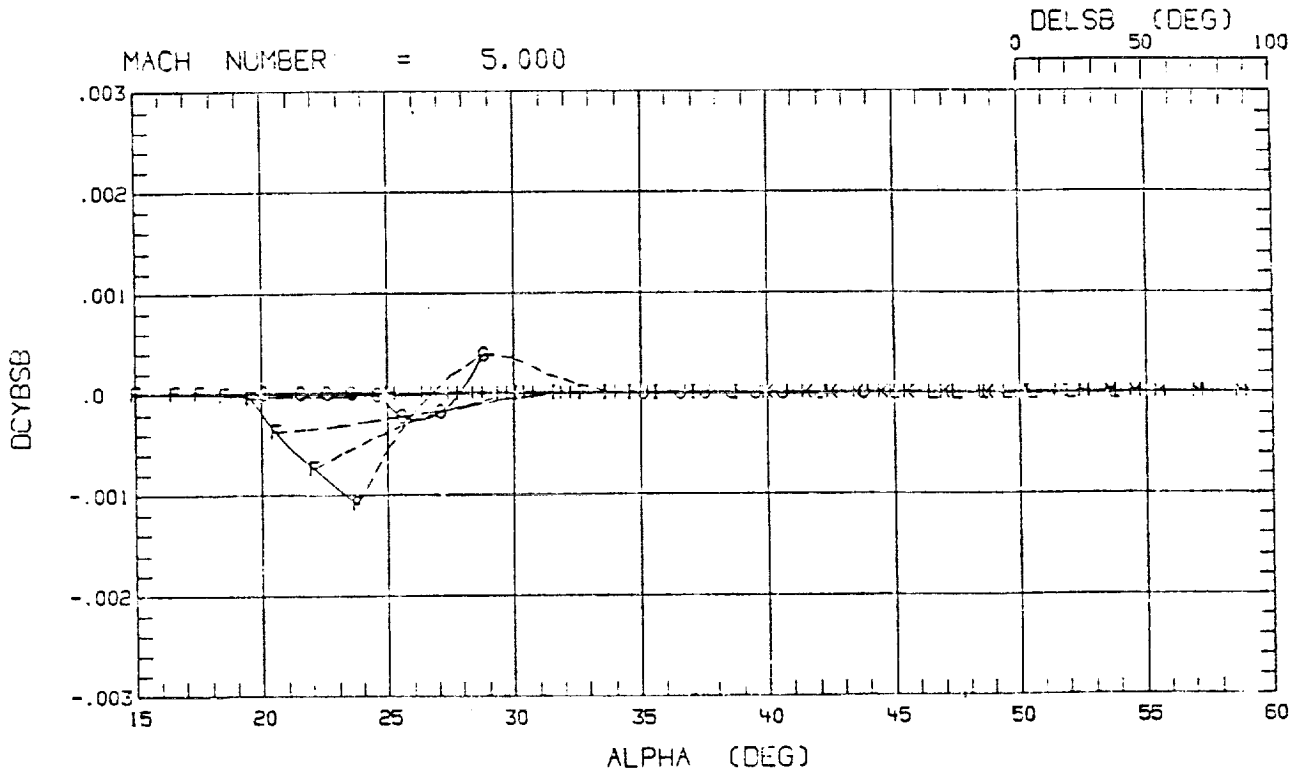
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.058 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00017	-0.00019	-0.00017	-0.00009	-0.00002	-0.00001	0.0	0.0
45.000	-0.00033	-0.00036	-0.00033	-0.00020	-0.00007	-0.00004	-0.00002	0.0
55.000	-0.00059	-0.00063	-0.00059	-0.00043	-0.00035	-0.00038	-0.00023	0.0
70.000	-0.00101	-0.00103	-0.00101	-0.00096	-0.00122	-0.00075	-0.00019	0.0
87.200	-0.00160	-0.00158	-0.00160	-0.00169	-0.00173	-0.00110	0.00038	0.0

ENGINEER LLL
DATE 9-13-85

FIGURE 4.2.1.1-118
EFFECT OF SPEEDBRAKE



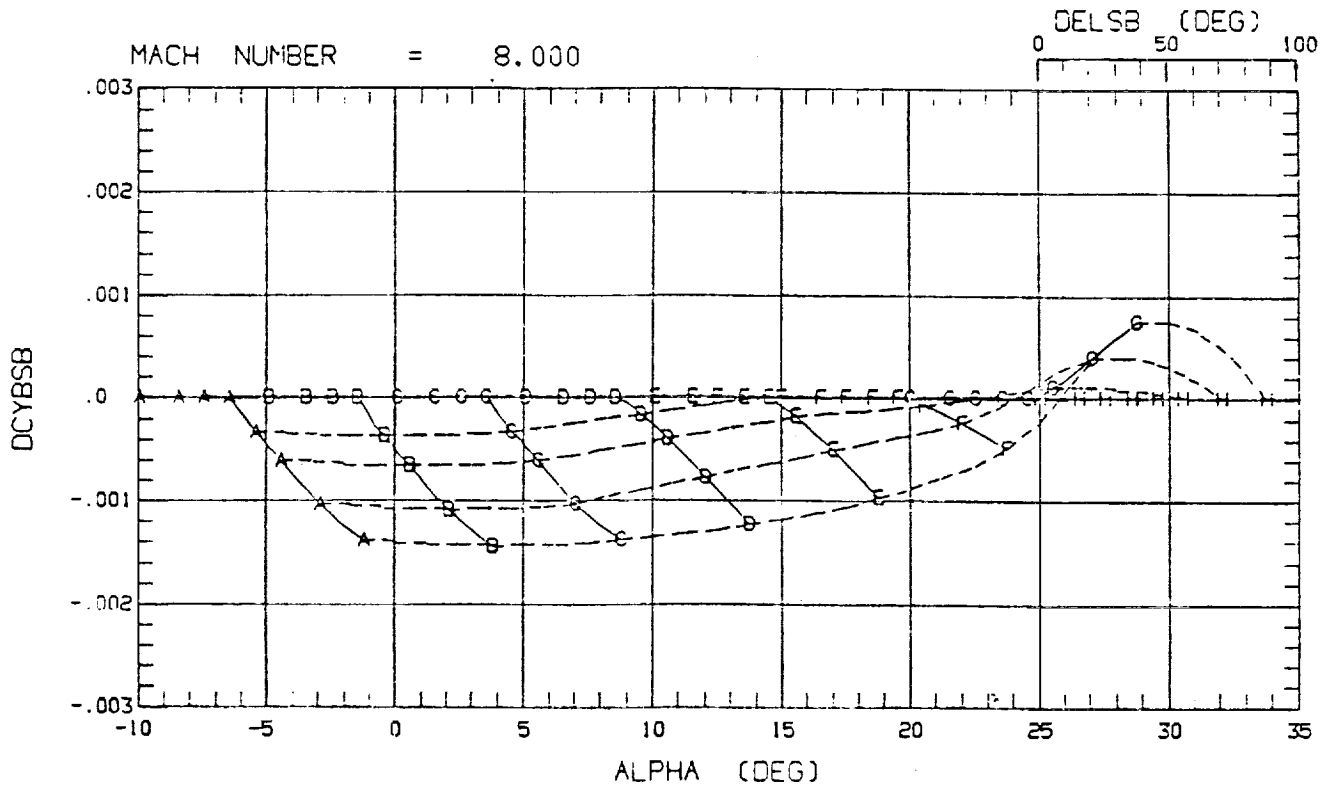
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BOC LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00001	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00004	-0.00002	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00038	-0.00023	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00075	-0.00019	0.0	0.0	0.0	0.0	0.0	0.0
87.200	-0.00110	0.00038	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER LLL
DATE 8-13-85

FIGURE 4.2.1.1-119
EFFECT OF SPEEDBRAKE



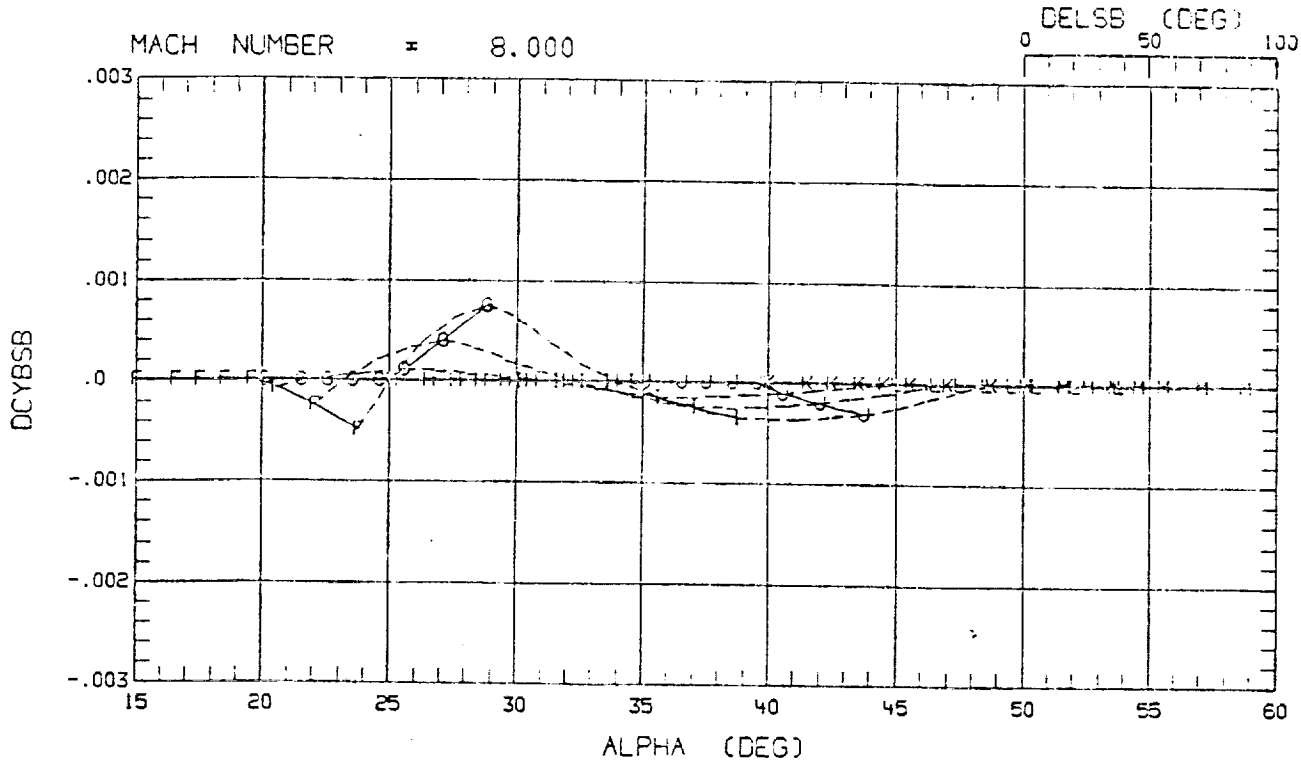
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00033	-0.00037	-0.00033	-0.00016	0.0	0.0	0.0	0.0
55.000	-0.00061	-0.00066	-0.00061	-0.00040	-0.00019	-0.00007	0.00010	0.0
70.000	-0.00103	-0.00109	-0.00103	-0.00077	-0.00051	-0.00025	0.00040	0.0
97.200	-0.00139	-0.00144	-0.00139	-0.00124	-0.00093	-0.00049	0.00075	0.0

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.1-120
EFFECT OF SPEEDBRAKE

SD72-SH-0[illegible]C IM



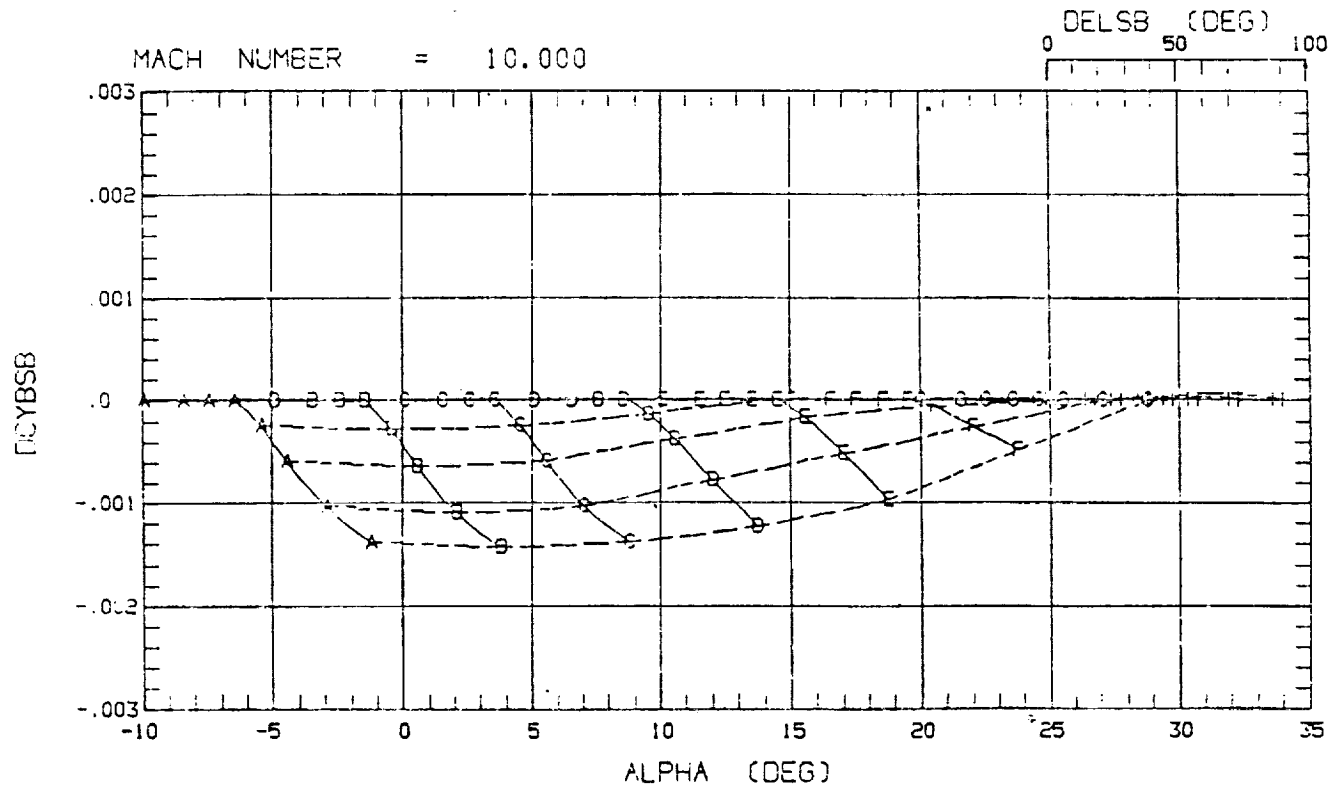
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00007	0.00010	0.0	-0.00015	-0.00010	0.0	0.0	0.0
70.000	-0.00025	0.00040	0.0	-0.00025	-0.00020	0.0	0.0	0.0
87.200	-0.00049	0.00075	0.0	-0.00035	-0.00030	0.0	0.0	0.0

ENGINEER [illegible]
DATE 7-13-78

FIGURE 4.2.1.1-121
EFFECT OF SPEEDBRAKE



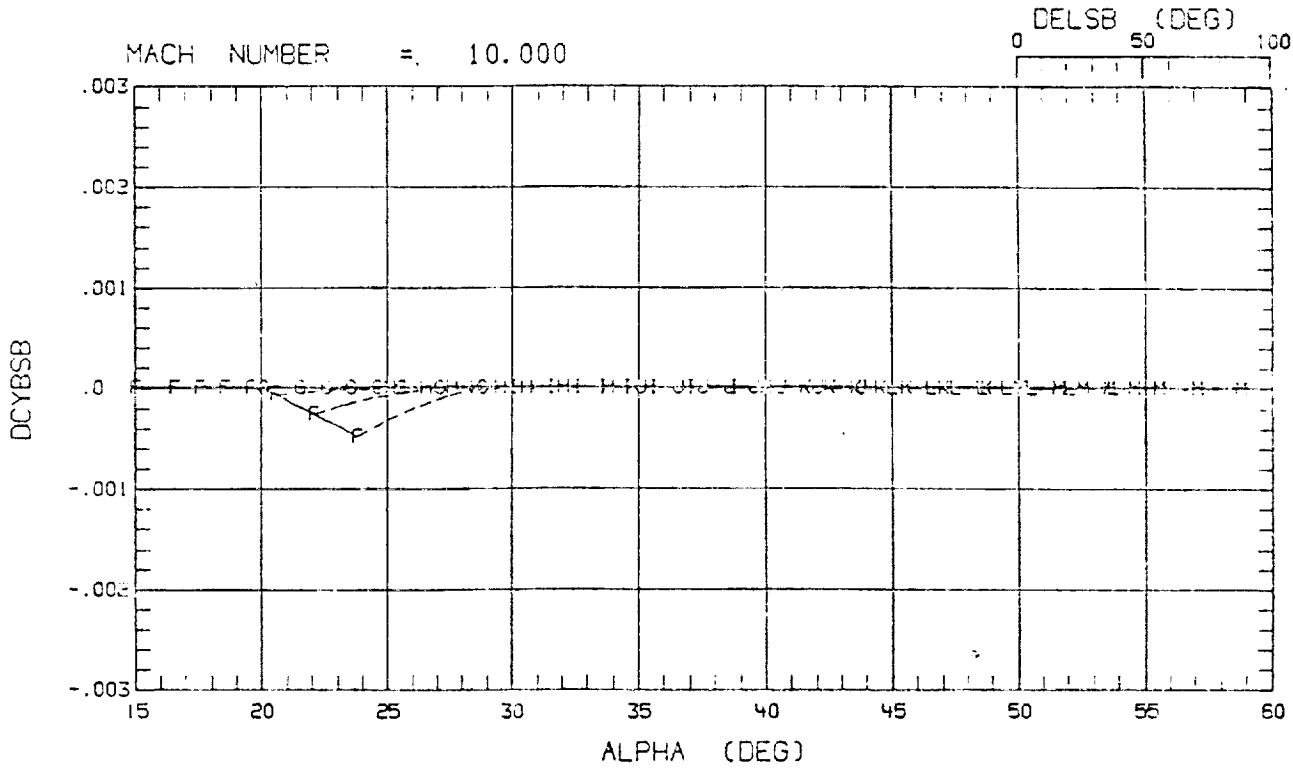
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00025	-0.00028	-0.00025	-0.00013	0.0	0.0	0.0	0.0
55.000	-0.00059	-0.00064	-0.00059	-0.00038	-0.00017	-0.00006	0.0	0.0
70.000	-0.00104	-0.00110	-0.00104	-0.00078	-0.00052	-0.00026	0.0	0.0
87.200	-0.00138	-0.00143	-0.00138	-0.00123	-0.00097	-0.00048	0.0	0.0

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.1-122
EFFECT OF SPEEDBRAKE



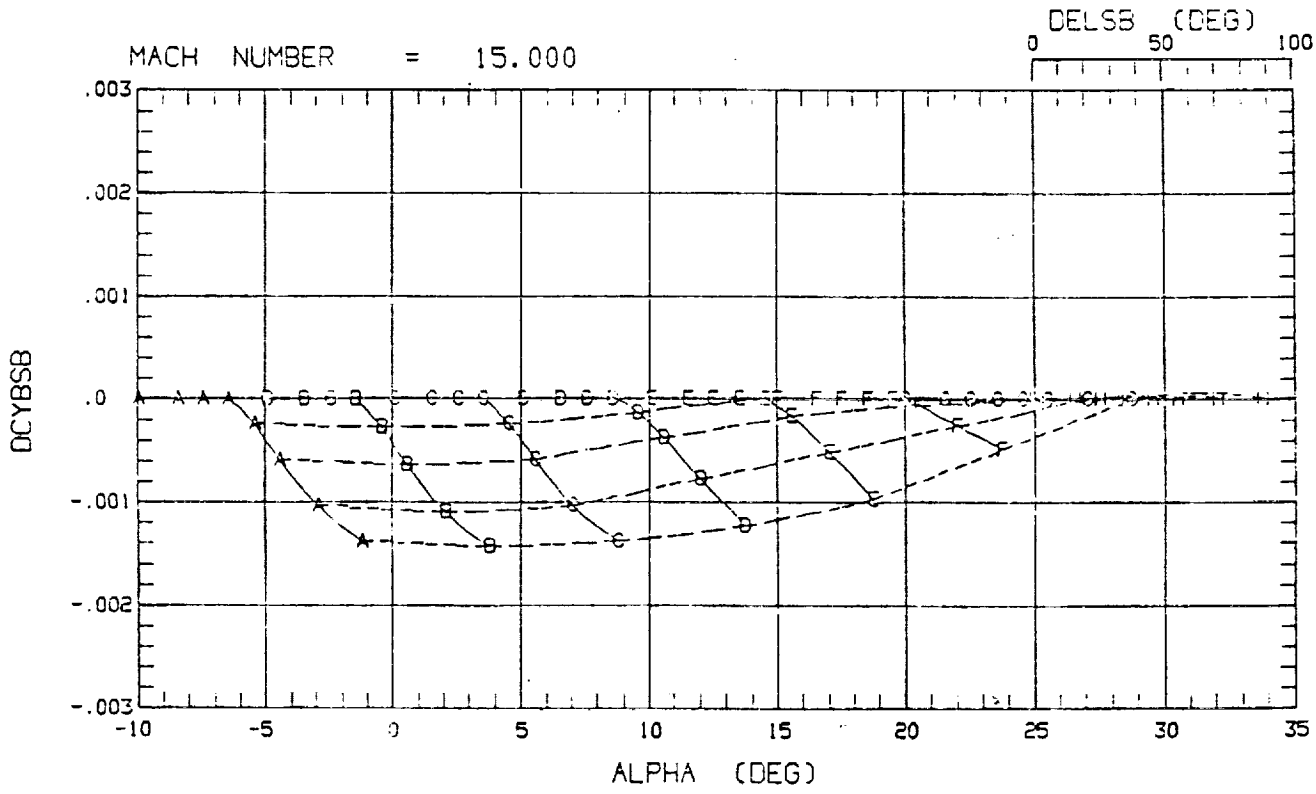
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00006	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	-0.00048	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER LL
DATE 9/13/85

FIGURE 4.2.1.1-123
EFFECT OF SPEEDBRAKE



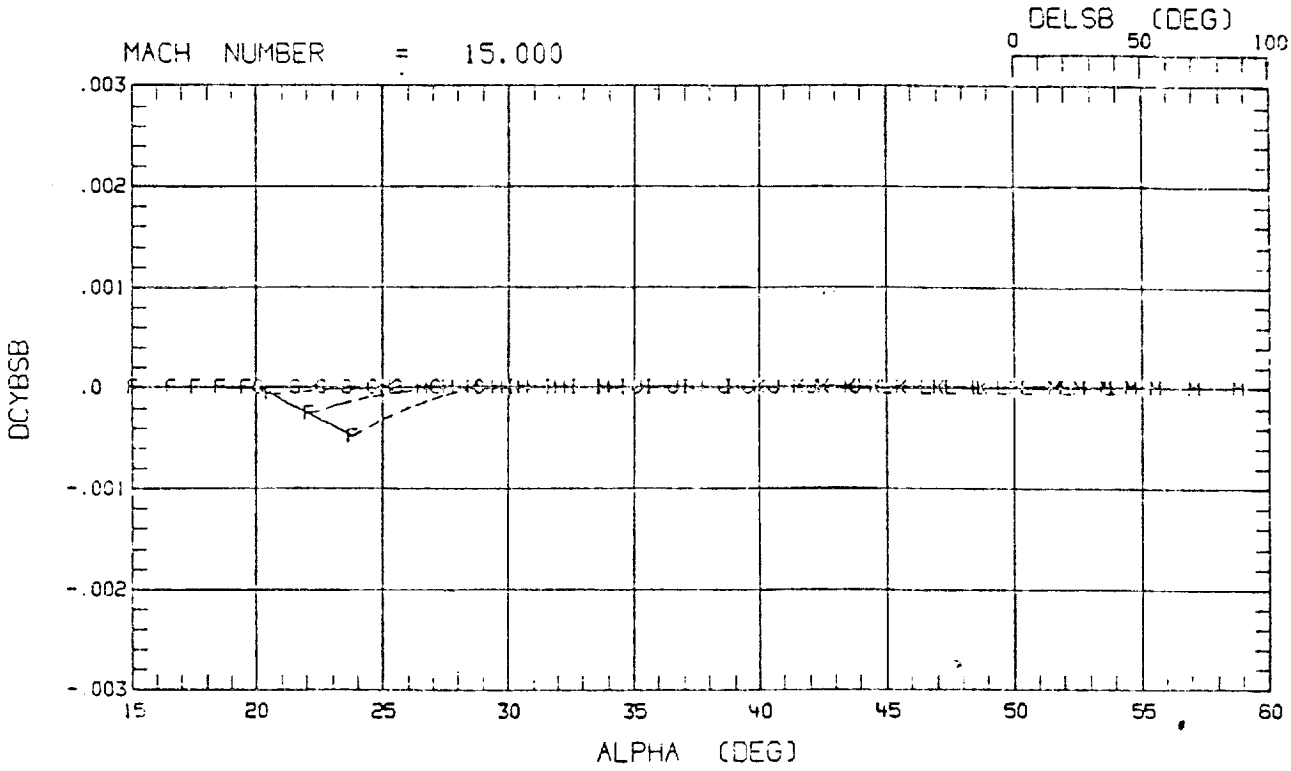
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00025	-0.00038	-0.00025	-0.00013	0.0	0.0	0.0	0.0
55.000	-0.00059	-0.00084	-0.00059	-0.00038	-0.00017	-0.00006	0.0	0.0
70.000	-0.00104	-0.00110	-0.00104	-0.00078	-0.00052	-0.00026	0.0	0.0
87.200	-0.00138	-0.00143	-0.00138	-0.00123	-0.00097	-0.00048	0.0	0.0

ENGINEER LL
DATE 7-13-78

FIGURE 4.2.1.1-124
EFFECT OF SPEEDBRAKE



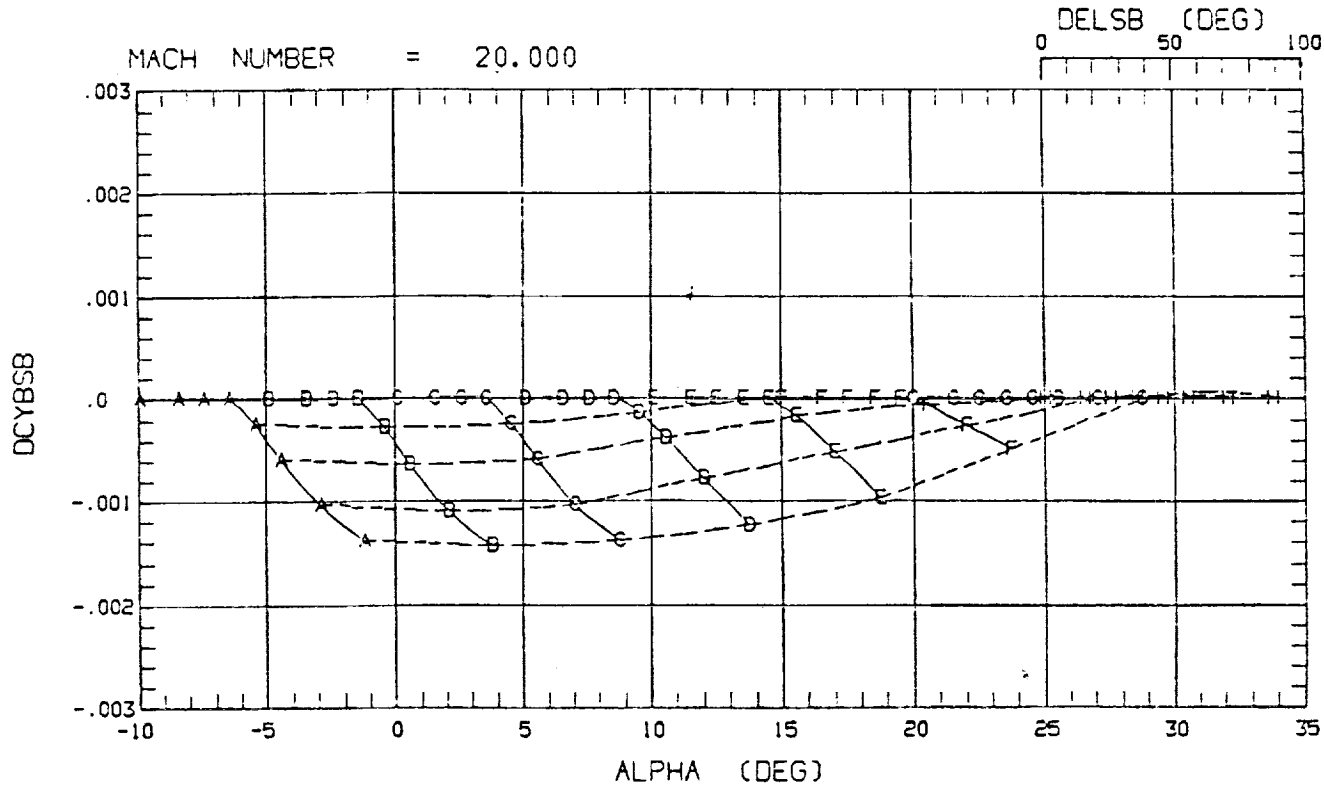
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00006	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	-0.00048	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER LL
DATE 9-13-88

FIGURE 4.2.1.1-125
EFFECT OF SPEEDBRAKE



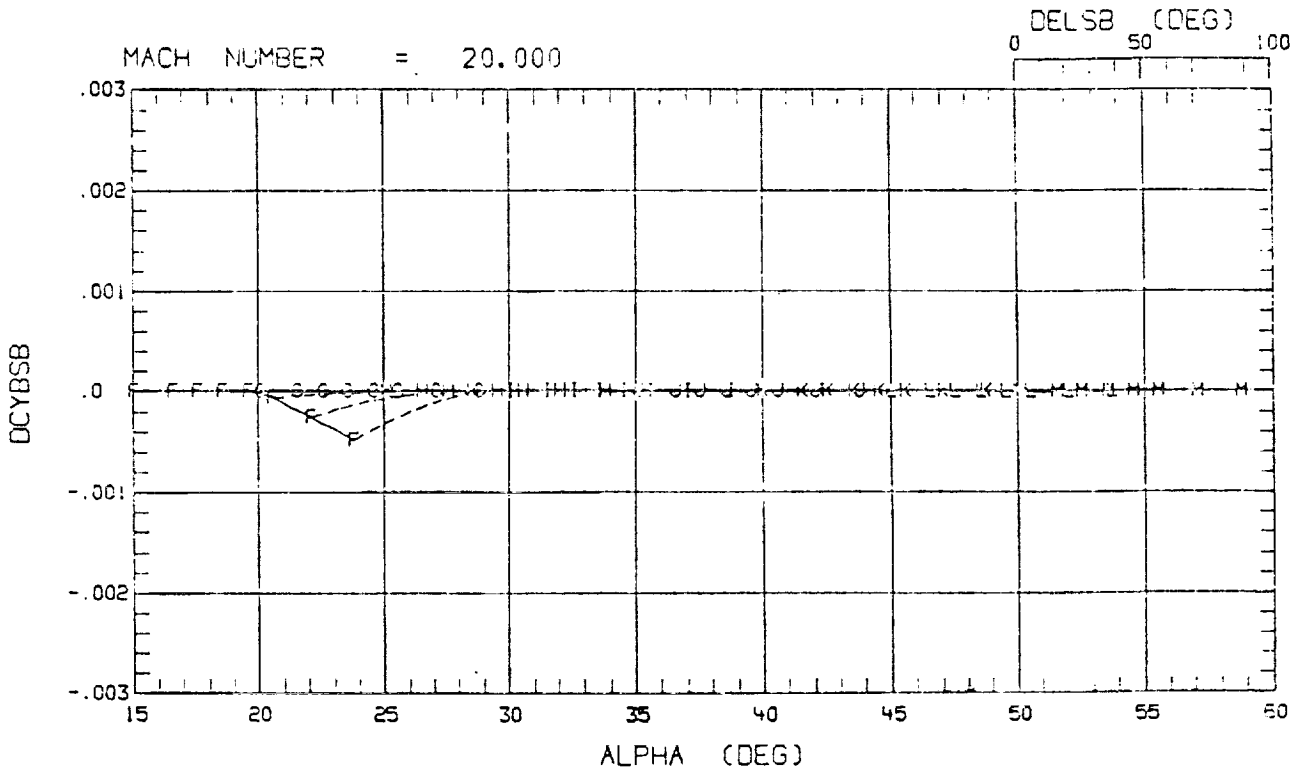
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00025	-0.00028	-0.00025	-0.00013	0.0	0.0	0.0	0.0
55.000	-0.00059	-0.00064	-0.00059	-0.00038	-0.00017	-0.00006	0.0	0.0
70.000	-0.00104	-0.00110	-0.00104	-0.00078	-0.00052	-0.00026	0.0	0.0
87.200	-0.00138	-0.00143	-0.00138	-0.00123	-0.00097	-0.00048	0.0	0.0

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.1-126
EFFECT OF SPEEDBRAKE



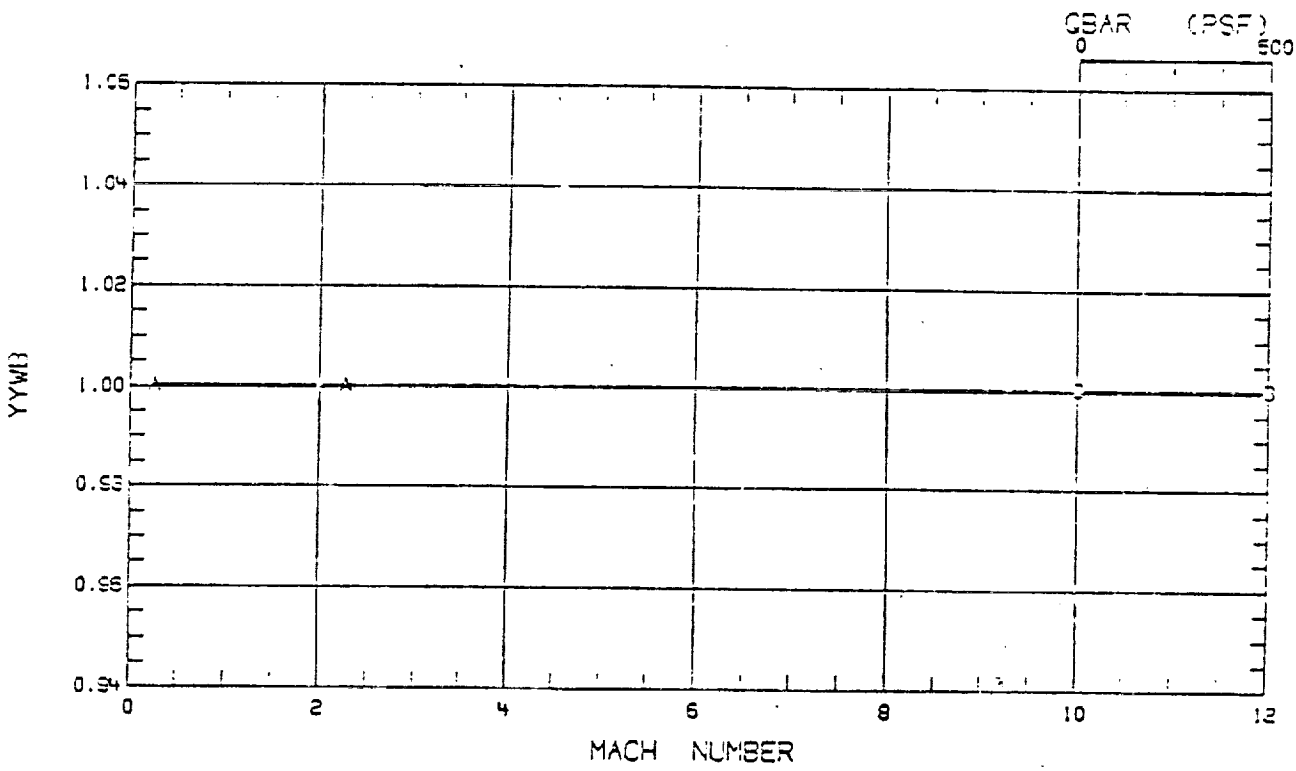
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE SIDE FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00006	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	-0.00048	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER CJ
DATE 9-13-78

FIGURE 4.2.1.1-127
EFFECT OF SPEEDBRAKE



CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

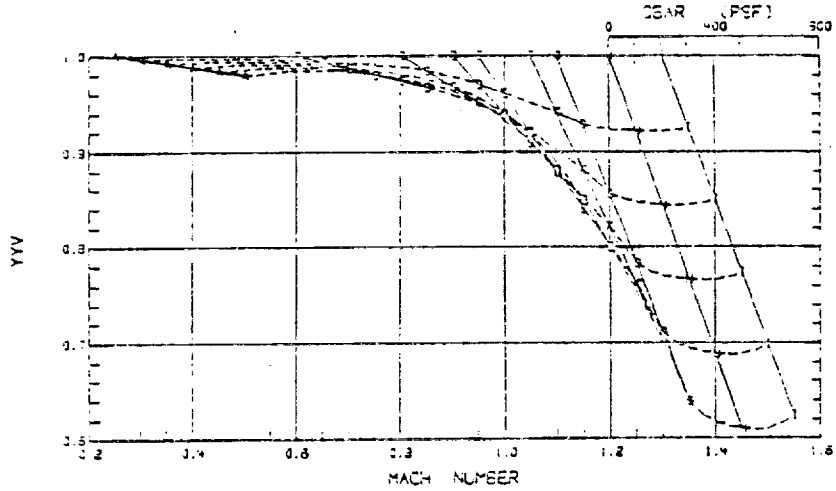
	MACH NUMBER	
	0.250	10.300
	A	B
QBAR (PSF)	F/R WING-BODY SIDE FO	
0.0	1.00000	1.00000
500.000	1.00000	1.00000

ENGINEER
DATE 7-31-72

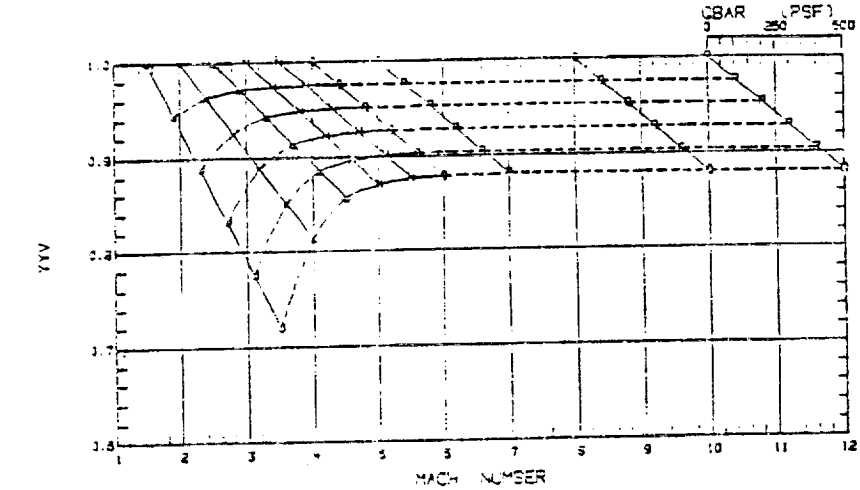
FIGURE 4.2.1.1-128
FLEXIBLE/RIGID WING-BODY SIDE FORCE DERIVATIVE

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.30 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.058 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CH = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.



QBAR (PSF)	0.850 A	0.900 B	0.930 C	0.950 D	0.975 E	1.000 F	1.100 G	1.200 H	1.200 I
				F/R VERT. TAIL SIDE FORCE DERIV.					
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.95600	0.99333	0.93387	0.96567	0.96000	0.94400	0.92787	0.92200	0.92467
200.000	0.99200	0.98667	0.93733	0.93533	0.92000	0.89000	0.85533	0.84400	0.84933
300.000	0.98800	0.98000	0.95100	0.90900	0.88000	0.82000	0.78300	0.76800	0.77400
400.000	0.98400	0.97333	0.93467	0.87867	0.84000	0.75000	0.71067	0.69200	0.69867
500.000	0.98000	0.96667	0.91800	0.87333	0.80000	0.70133	0.67233	0.61000	0.62133



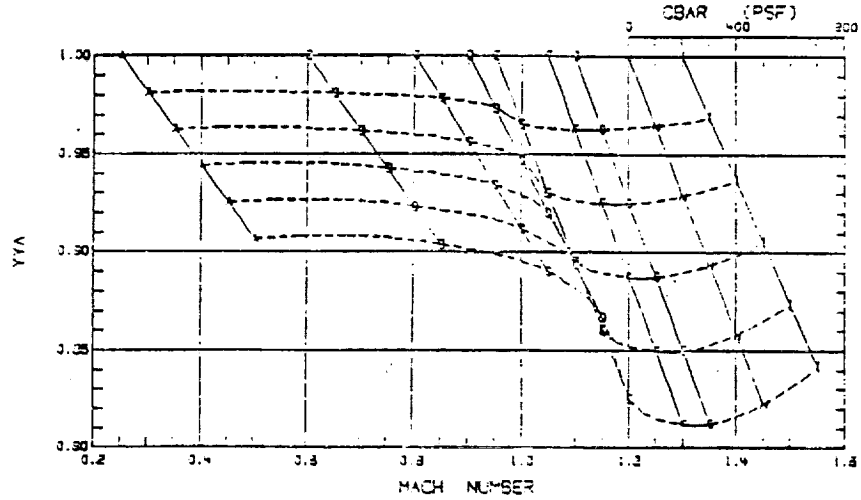
QBAR (PSF)	1.500 K	2.000 L	2.500 M	3.000 N	3.500 O	4.000 P	5.000 Q	8.000 R	10.000 S
				F/R VERT. TAIL SIDE FORCE DERIV.					
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.94400	0.95267	0.97133	0.97400	0.97733	0.97533	0.97800	0.97800	0.97800
200.000	0.88800	0.92533	0.94267	0.94800	0.95467	0.95133	0.95600	0.95600	0.95600
300.000	0.83200	0.88800	0.91400	0.92200	0.93200	0.92733	0.93400	0.93400	0.93400
400.000	0.77600	0.85067	0.88533	0.89600	0.91133	0.90267	0.91400	0.91400	0.91400
500.000	0.72000	0.81333	0.85667	0.87000	0.88933	0.87733	0.89200	0.89200	0.89200

ENGINEER [signature]
DATE 4-3-79

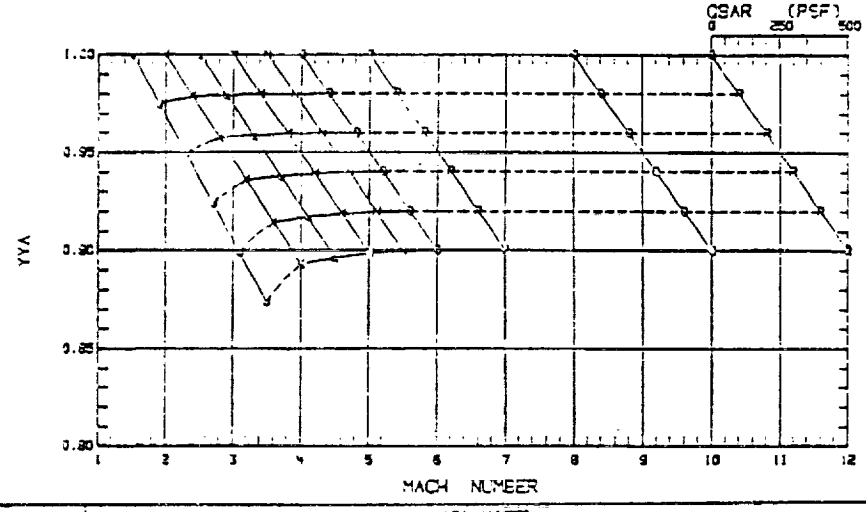
FIGURE 4.2.1.1-129
FLEXIBLE/RIGID VERTICAL TAIL SIDE FORCE DERIVATIVE

CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XC = FS 1076.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YC = BL 0.0	IN.	WING SPAN	SW = 78.056	FT.
MOMENT REFERENCE	XC = AL 575.3	IN.	M.A.C.	CM = 39.560	FT.
			BODY LENGTH	LB = 1290.7	IN.



QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300
	F/R AILERON SIDE FORCE DERIV.								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.53133	0.98057	0.97733	0.97333	0.96500	0.96233	0.96+53	0.96+50	0.96333
200.000	0.93257	0.96133	0.95537	0.94637	0.93000	0.92+67	0.92+67	0.92950	0.93037
300.000	0.94+00	0.94200	0.93350	0.92000	0.89500	0.88700	0.88730	0.89350	0.90500
400.000	0.92533	0.92257	0.91173	0.89333	0.85000	0.84+33	0.84+73	0.85800	0.87333
500.000	0.91567	0.90333	0.89057	0.86567	0.80500	0.81167	0.81217	0.82533	0.84167

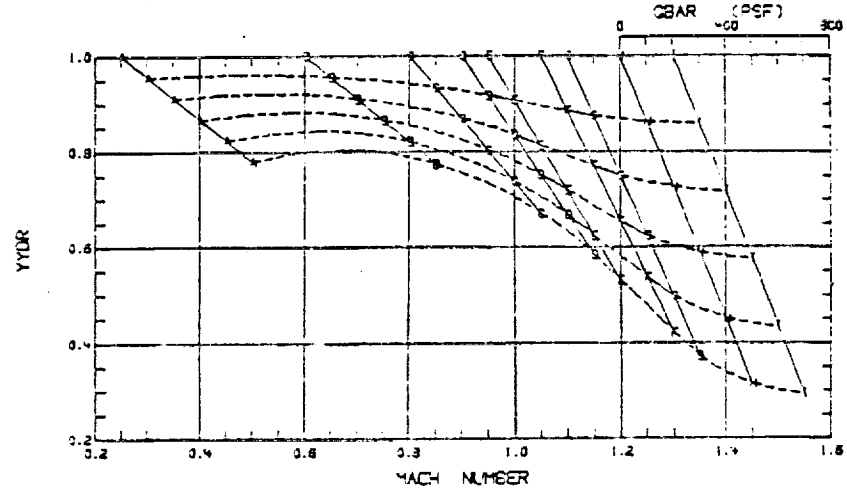


QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	6.000 Q	10.000 R
	F/R AILERON SIDE FORCE DERIV.								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97+73	0.97857	0.97567	0.97367	0.97333	0.97997	0.98000	0.98000	0.98000
200.000	0.94940	0.95713	0.95653	0.95933	0.95637	0.95993	0.96000	0.96000	0.96000
300.000	0.92410	0.93573	0.93780	0.93900	0.93520	0.93993	0.94000	0.94000	0.94000
400.000	0.89850	0.91427	0.91707	0.91887	0.91973	0.91037	0.92000	0.92000	0.92000
500.000	0.87293	0.89293	0.89733	0.89933	0.89997	0.90033	0.90000	0.90000	0.90000

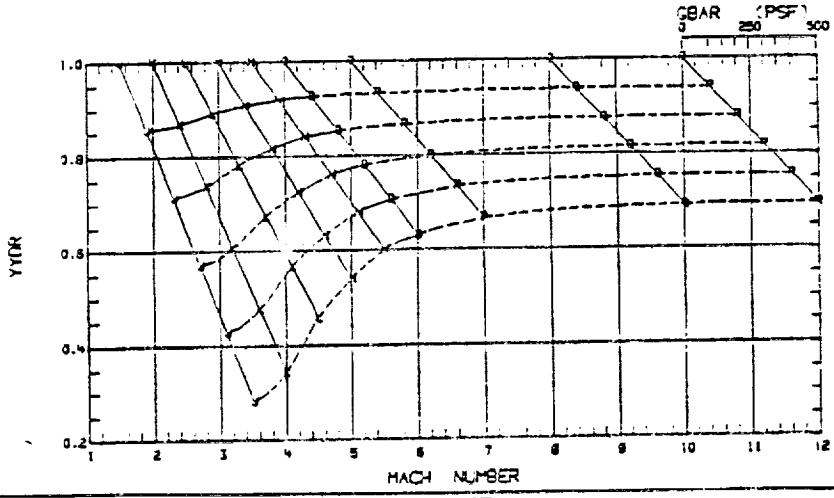
ENGINEER
DATE 11-3-77

FIGURE 4.2.1.1-130
FLEXIBLE/RIGID AILERON SIDE FORCE DERIVATIVE

CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XB = FS	1078.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YB = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZB = WL	375.0 IN.	M.A.C.	CW = 39.550	FT.
			BODY LENGTH	LB = 1290.3	IN.



	MACH NUMBER								
	0.250	0.600	0.800	0.900	0.950	1.050	1.100	1.200	1.350
	A	B	C	D	E	F	G	H	I
QBAR (PSF)	F/R RUDDER SIDE FORCE DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.95667	0.95467	0.93400	0.91667	0.90567	0.88400	0.87400	0.85267	0.85667
200.000	0.91133	0.90933	0.88800	0.83333	0.81133	0.76800	0.74800	0.72533	0.71733
300.000	0.86700	0.86400	0.80200	0.75000	0.71700	0.65200	0.62200	0.58800	0.57600
400.000	0.82267	0.81867	0.77400	0.66667	0.62267	0.53600	0.49600	0.45067	0.43467
500.000	0.77833	0.77333	0.74200	0.58333	0.62933	0.42000	0.37000	0.31333	0.29333



	MACH NUMBER								
	1.500	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	J	K	L	M	N	O	P	Q	R
QBAR (PSF)	F/R RUDDER SIDE FORCE DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.85867	0.86900	0.89167	0.92800	0.92033	0.92567	0.93333	0.93833	0.93267
200.000	0.71333	0.73800	0.78333	0.81600	0.84067	0.85333	0.86667	0.87667	0.87733
300.000	0.57000	0.60700	0.67500	0.72400	0.78100	0.78000	0.80000	0.81500	0.81600
400.000	0.42667	0.47600	0.56667	0.63200	0.68133	0.70667	0.73333	0.75333	0.75467
500.000	0.28333	0.34600	0.45333	0.54000	0.60167	0.63333	0.66667	0.69167	0.69333

ENGINEER [illegible]
DATE 4-3-79

FIGURE 4.2.1.1-131
FLEXIBLE/RIGID RUDDER SIDE FORCE DERIVATIVE

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_{cg} = FS 1076.70; Y_{cg} = BL 0.00; Z_{cg} = WL 375.30

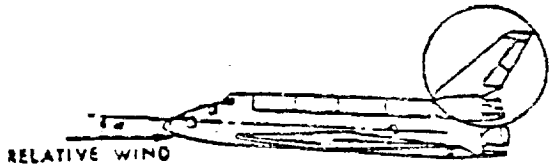
REFERENCE DIMENSIONS

AREA	S_{ref} = 2690.000 ft²
SPAN	b_{ref} = 78.056 ft
MAC	$\bar{c}_{ref}$ = 39.560 ft
BODY LENGTH	L_B = 1290.300 in.

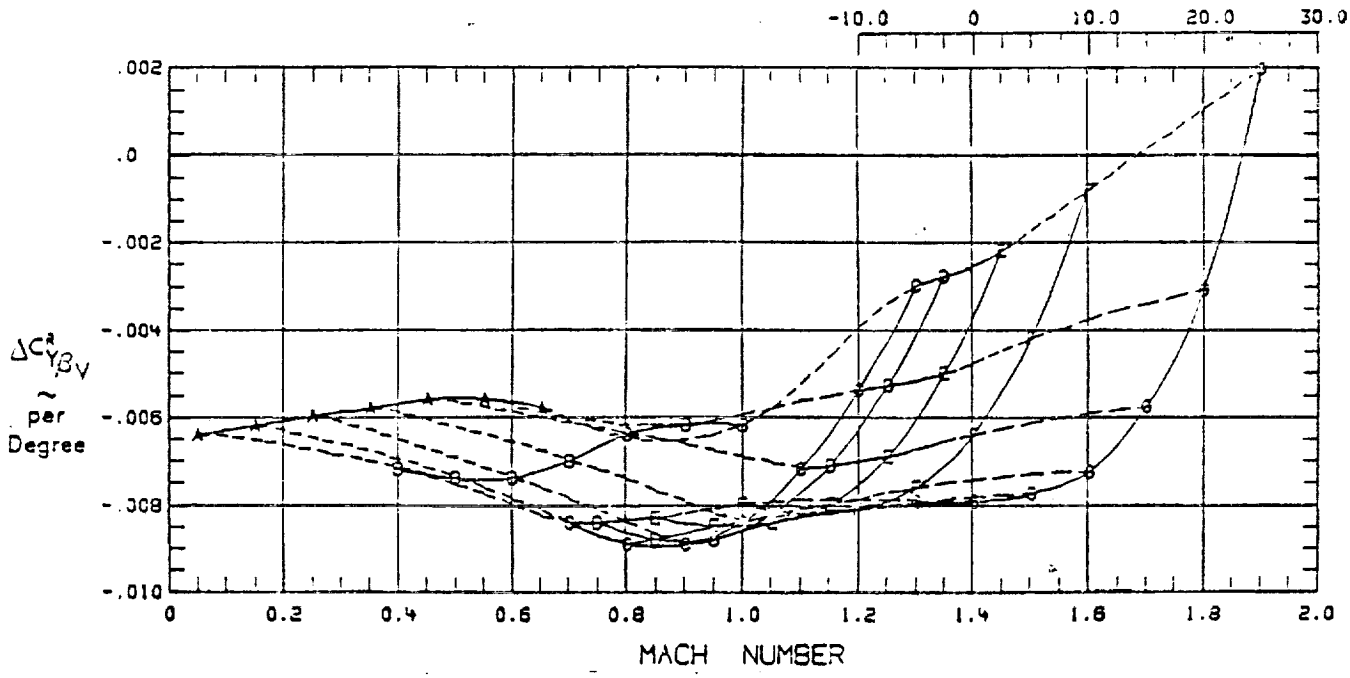
$\delta_e = 0°$

$\delta_{SF} = 0°$

$\delta_{SB} = 25°$



VERTICAL TAIL LOAD IN PRESENCE OF WING-BODY



α ~ Degrees	Mach Number						
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500
	RIGID VERTICAL TAIL SIDE FORCE COEFFICIENT DERIVATIVE						
-10.000	-0.00640	-0.00720	-0.00840	-0.00840	-0.00830	-0.00800	-0.00793
-5.000	-0.00620	-0.00740	-0.00890	-0.00880	-0.00850	-0.00820	-0.00794
0.0	-0.00600	-0.00740	-0.00890	-0.00880	-0.00840	-0.00810	-0.00775
5.000	-0.00580	-0.00700	-0.00840	-0.00820	-0.00800	-0.00760	-0.00725
10.000	-0.00560	-0.00640	-0.00720	-0.00710	-0.00690	-0.00640	-0.00577
15.000	-0.00560	-0.00620	-0.00540	-0.00530	-0.00500	-0.00420	-0.00312
20.000	-0.00580	-0.00620	-0.00300	-0.00280	-0.00220	-0.00080	0.00198
25.000							
30.000							
35.000							
40.000							

ENGINEER: DFS
DATE: 10/29/77
REVISED:

Figure 4.2.1.1-132
VERTICAL TAIL INCREMENT

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY / OR / MOMENT REFERENCE

REFERENCE DIMENSIONS

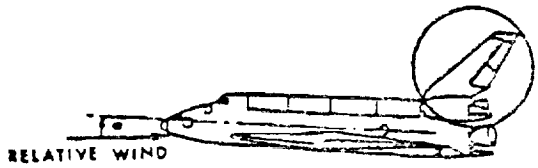
AREA

SPAN

MAC

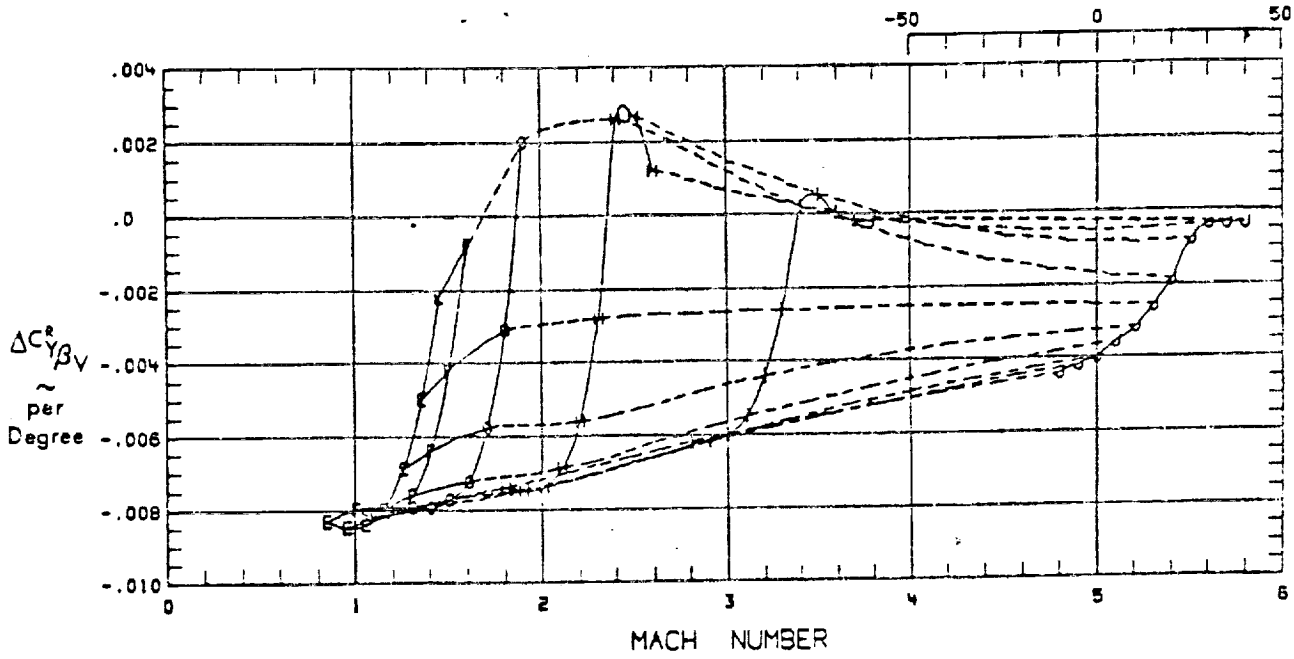
BODY LENGTH

$\delta_e = 0°$
$\delta_{BF} = 0°$
$\delta_{SB} = 25°$



VERTICAL TAIL LOAD IN PRESENCE OF WING-BODY

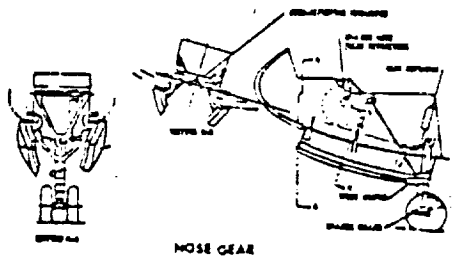
α ~ Degrees



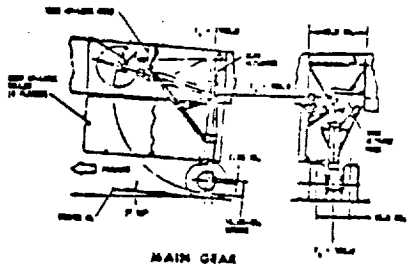
α ~ Degrees	Mach Number					
	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	RIGID VERTICAL TAIL SIDE FORCE COEFFICIENT DERIVATIVE					
-10.000	-0.00830	-0.00800	-0.00793	-0.00740	-0.00620	-0.00440
-5.000	-0.00850	-0.00820	-0.00794	-0.00750	-0.00620	-0.00420
0.0	-0.00840	-0.00810	-0.00775	-0.00740	-0.00600	-0.00400
5.000	-0.00800	-0.00760	-0.00725	-0.00690	-0.00550	-0.00360
10.000	-0.00690	-0.00640	-0.00577	-0.00560	-0.00440	-0.00320
15.000	-0.00500	-0.00420	-0.00312	-0.00280	-0.00260	-0.00260
20.000	-0.00220	-0.00080	0.00199	0.00260	0.00020	-0.00190
25.000				0.00270	0.00050	-0.00080
30.000				0.00120	0.0	-0.00040
35.000					-0.00020	-0.00040
40.000					-0.00020	-0.00040

ENGINEER: DTD
DATE: 10/29/77
REVISED:

Figure 4.2.1.1-133
VERTICAL TAIL INCREMENT



NOSE GEAR



MAIN GEAR

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE	$X_{B_{MRP}}$ FS	1076.70
	$Y_{B_{MRP}}$ BL	0.00
	$Z_{B_{MRP}}$ WL	375.00

REFERENCE DIMENSIONS

AREA	S_{REF} =	2690.000 ft²
SPAN	b_{REF} =	78.056 ft
MAC	c_{REF} =	39.360 ft
BODY LENGTH	L_B =	1290.300 in

$$\Delta C_{Y_\beta}{}_{\substack{\text{LANDING}\\\text{GEAR}}} = C_{Y}{}_{\substack{\text{GEAR}\\\text{DOWN}}} - C_{Y_\beta}{}_{\substack{\text{GEAR}\\\text{UP}}}$$

$\underset{\sim}{\alpha}$ Degrees	$\Delta C_{Y_{\beta_{LG}}}$
-10.000	-0.00750
-5.000	-0.00500
0.0	-0.00250
5.000	-0.00023
10.000	0.00002
15.000	-0.00121
20.000	-0.00350
25.000	-0.00587

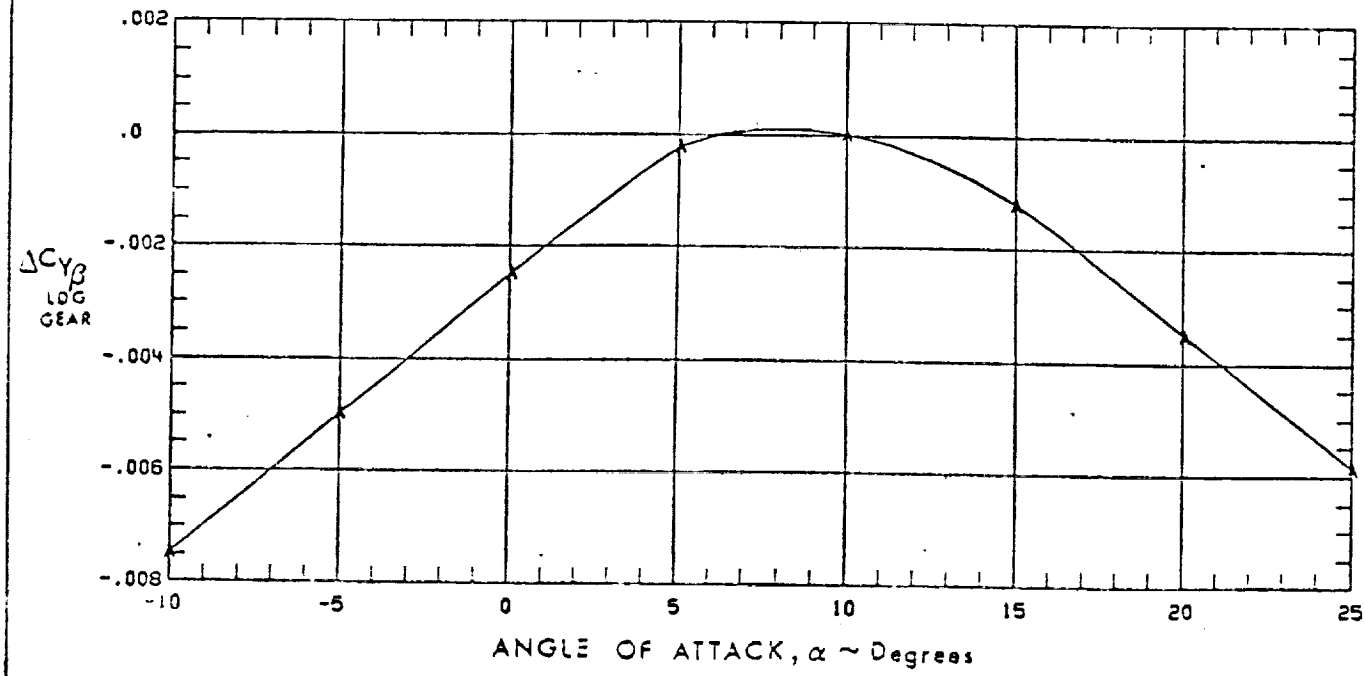
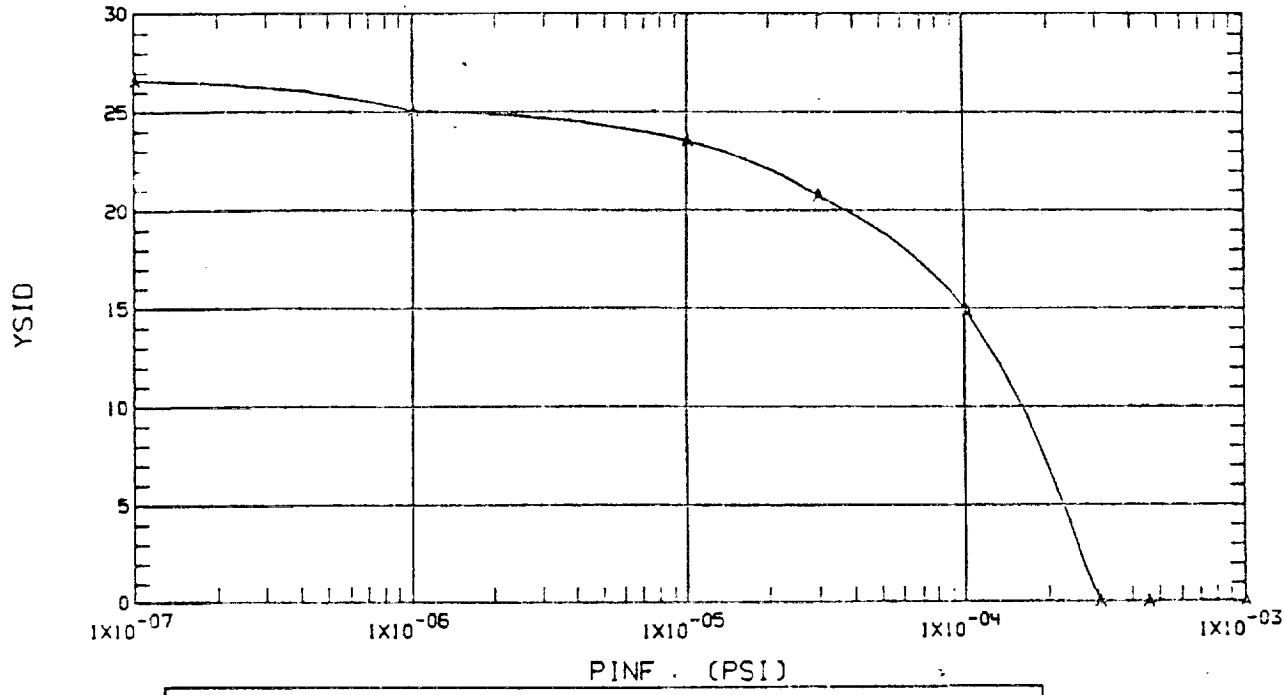


Figure 4.2.1.1-134
EFFECT OF LANDING GEAR



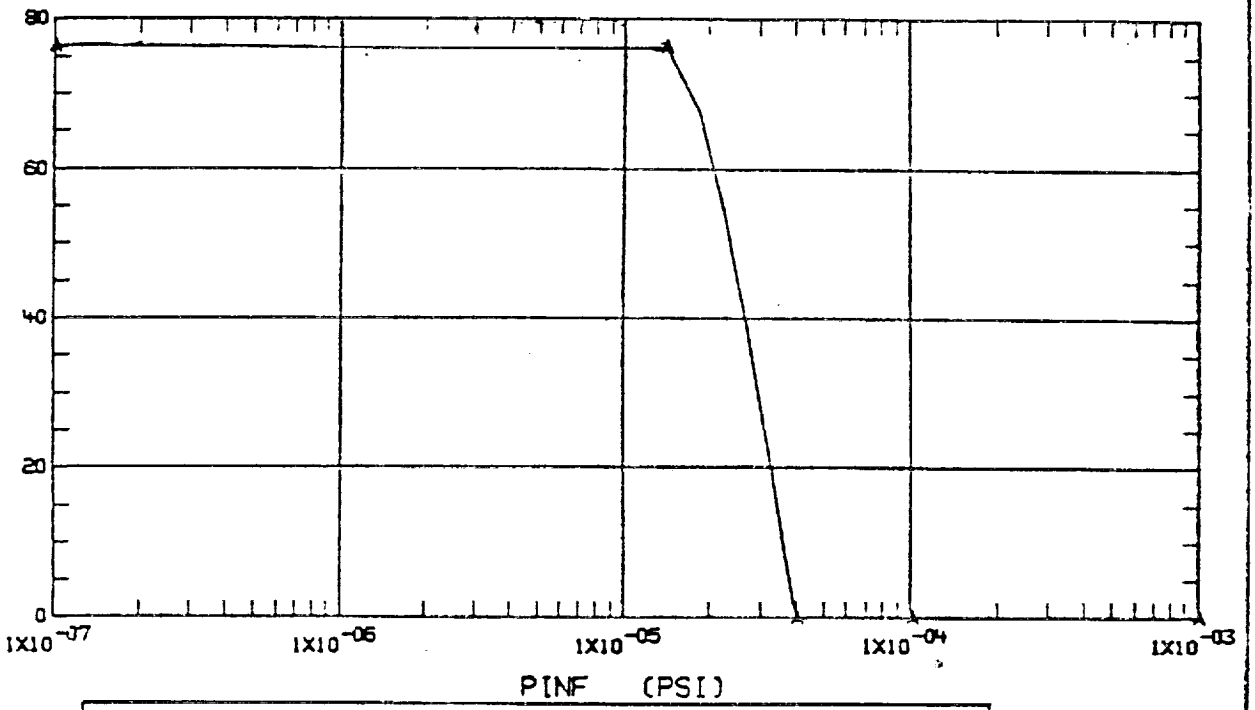
CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN

LH SHOWN
RH USE OPPOSITE SIGN

PINF (PSI)	$Y_{SURF\ IMP} \sim \frac{lb}{n}$ SIDE FORCE
1.000E-07	26.592
1.000E-06	25.058
1.000E-05	23.524
3.000E-05	20.711
1.000E-04	14.930
3.000E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

ENGINEER [illegible]
DATE 12/23/78

FIGURE 4.2.1.1-135
SIDE FORCE SURFACE IMPINGEMENT, DOWN-FIRING



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

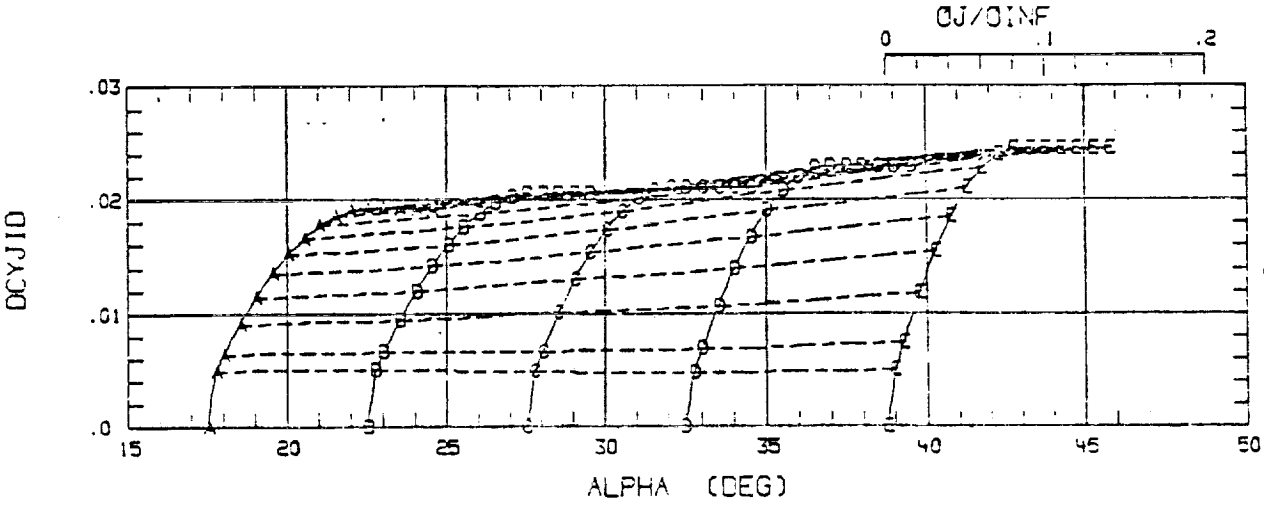
LH SHOWN
RH USE OPPOSITE SIGN

PINF (PSI)	$Y_{SURF\ IMP} \sim \frac{Lb}{n}$ SIDE FORCE
1.000E-07	76.30000
1.400E-05	76.30000
4.000E-05	0.0
1.000E-04	0.0
1.000E-03	0.0

ENGINEER [illegible]
DATE 3/25/74

FIGURE 4.2.1.1-136
SIDE FORCE SURFACE IMPINGEMENT.UP-FIRING

SL [illegible] IM



QJ/QINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	SIDE FORCE COEF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00462	0.00503	0.00484	0.00473	0.00508
0.0100	0.00637	0.00657	0.00667	0.00663	0.00746
0.0200	0.00902	0.00941	0.01000	0.01061	0.01179
0.0300	0.01137	0.01193	0.01290	0.01395	0.01599
0.0400	0.01342	0.01413	0.01526	0.01671	0.01957
0.0500	0.01518	0.01610	0.01737	0.01899	0.02253
0.0600	0.01659	0.01765	0.01896	0.02075	0.02488
0.0700	0.01769	0.01877	0.02010	0.02197	0.02660
0.0800	0.01850	0.01967	0.02080	0.02269	0.02760
0.0900	0.01901	0.02028	0.02107	0.02290	0.02790
0.1000	0.01930	0.02060	0.02107	0.02290	0.02790
0.1100	0.01930	0.02060	0.02107	0.02290	0.02790
0.1200	0.01930	0.02060	0.02107	0.02290	0.02790
0.1300	0.01930	0.02060	0.02107	0.02290	0.02790
0.1500	0.01930	0.02060	0.02107	0.02290	0.02790

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{Y_{jj}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

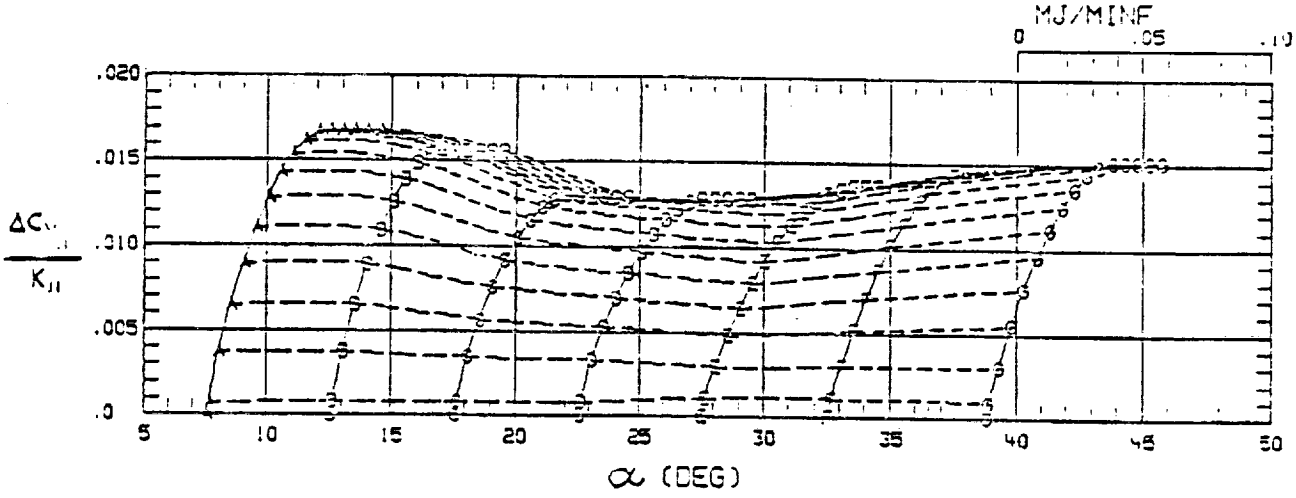
Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	SIDE FORCE COEF					
17.500	0.0034	0.3120	-1.5400	0.0	0.0050	0.1000
22.500	0.0034	0.3330	-1.6200	0.0	0.0050	0.1000
27.500	0.0029	0.4090	-2.1900	0.0	0.0050	0.0900
32.500	0.0025	0.5260	-2.9700	0.0	0.0050	0.0900
38.750	0.0026	0.5280	-3.1700	0.0	0.0050	0.0900

LH SHOWN
RH USE OPPOSITE SIGN

ENGINEER [illegible]
DATE 12/3/75

FIGURE 4.2.1.1-137
SIDE FORCE JET INTERACTION, DOWN-FIRING



MJ/MINF	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	SIDE FORCE JET SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.00070	0.00080	0.00080	0.00080	0.00110	0.00110	0.00090
0.005	0.00359	0.00370	0.00343	0.00330	0.00399	0.00300	0.00301
0.010	0.00645	0.00644	0.00559	0.00518	0.00472	0.00510	0.00545
0.015	0.00899	0.00882	0.00747	0.00687	0.00637	0.00698	0.00781
0.020	0.01100	0.01084	0.00907	0.00834	0.00785	0.00866	0.00950
0.025	0.01278	0.01251	0.01040	0.00961	0.00916	0.01012	0.01112
0.030	0.01423	0.01382	0.01145	0.01066	0.01030	0.01138	0.01246
0.035	0.01535	0.01477	0.01223	0.01150	0.01127	0.01242	0.01352
0.040	0.01615	0.01537	0.01273	0.01214	0.01207	0.01326	0.01432
0.045	0.01662	0.01561	0.01295	0.01256	0.01269	0.01388	0.01483
0.050	0.01675	0.01549	0.01290	0.01277	0.01315	0.01430	0.01507
0.055	0.01675	0.01549	0.01290	0.01277	0.01343	0.01460	0.01507
0.060	0.01675	0.01549	0.01290	0.01277	0.01355	0.01460	0.01507
0.065	0.01675	0.01549	0.01290	0.01277	0.01355	0.01460	0.01507
0.070	0.01675	0.01549	0.01290	0.01277	0.01355	0.01460	0.01507

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{\gamma}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/\gamma} = 8.296 \times 10^{-4}\left(\frac{v_\infty}{a_\infty}\right)$$

$$\Delta C_{Y_{JI}} = \left[A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) - A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3\right] K_{JI}$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	SIDE FORCE JET SF					
7.500	0.00060	0.65110	-5.56000	0.0	0.00500	0.05000
12.500	0.00050	0.65510	-7.14720	0.0	0.00500	0.05000
17.500	0.00100	0.51400	-5.52000	0.0	0.00500	0.05000
22.500	0.00120	0.44100	-4.19000	0.0	0.00500	0.05000
27.500	0.00090	0.41600	-3.42000	0.0	0.00500	0.05000
32.500	0.00070	0.46200	-4.20000	0.0	0.00500	0.05000
38.750	0.00030	0.57000	-5.49000	0.0	0.00500	0.05000

$K_{JI} = 1.0$

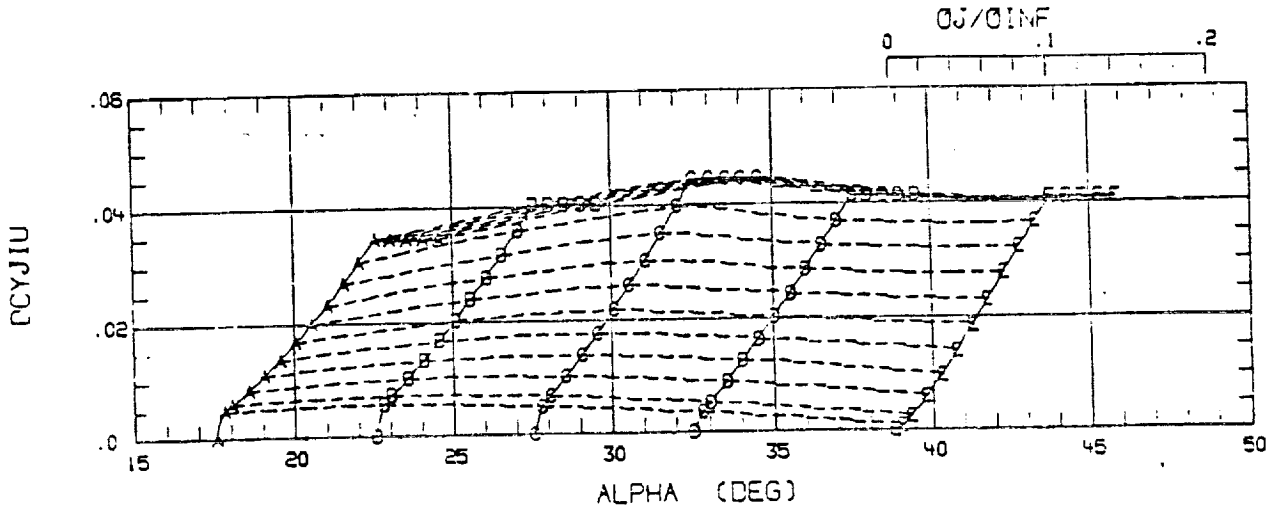
Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

LH SHOWN; RH USE OPPOSITE SIGN

ENGINEER [illegible]
DATE 4/15/74

FIGURE 4.2.1.1-138
SIDE FORCE JET INTERACTION, SIDE-FIRING



QJ/QINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	36.750 E
			SIDE FORCE VALUE		
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.004467	0.00568	0.00484	0.00332	0.00073
0.0100	0.005880	0.00711	0.00652	0.00508	0.00229
0.0200	0.008819	0.01006	0.01002	0.00888	0.00576
0.0300	0.010078	0.01343	0.01370	0.01256	0.00963
0.0400	0.010085	0.01686	0.01758	0.01616	0.01382
0.0500	0.010084	0.02004	0.02159	0.02008	0.01828
0.0600	0.010072	0.02370	0.02581	0.02410	0.02288
0.0700	0.010066	0.02753	0.03021	0.02824	0.02739
0.0800	0.010065	0.03146	0.03478	0.03249	0.03197
0.0900	0.010041	0.03571	0.03954	0.03684	0.03643
0.1000	0.010037	0.04006	0.04447	0.04131	0.04070
0.1100	0.010037	0.04006	0.04447	0.04131	0.04070
0.1200	0.010037	0.04006	0.04447	0.04131	0.04070
0.1300	0.010037	0.04006	0.04447	0.04131	0.04070
0.1400	0.010037	0.04006	0.04447	0.04131	0.04070

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{Y_{jI}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
			SIDE FORCE VALUE			
17.500	0.0036	0.2100	0.9770	0.0	0.0050	0.1000
22.500	0.0043	0.2720	0.8550	0.0	0.0050	0.1000
27.500	0.0032	0.3230	0.8870	0.0	0.0050	0.1000
32.500	0.0016	0.3420	0.9510	0.0	0.0050	0.1000
36.750	-0.0007	0.3720	2.8400	-14.2000	0.0050	0.1000

LH SHOWN
RH USE OPPOSITE SIGN

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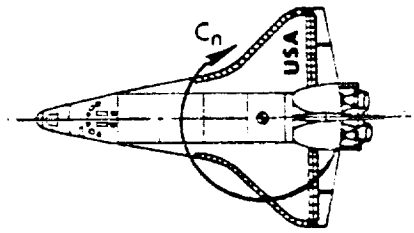
FIGURE 4.2.1.1-139
SIDE FORCE JET INTERACTION, UP-FIRING

4.2.1.2 YAWING MOMENT COEFFICIENT. The Orbiter Vehicle aerodynamic yawing moment coefficient is defined in this section. The basic aerodynamic yawing moment coefficient data are presented in three forms: 1) as a function of angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty^{1}$) from 0.0 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet through 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.2.1.2]. Uncertainties associated with the yawing moment characteristics are available in Section 6.0.



The RCS flow field interaction data are presented as a contribution to the total yawing moment ($\mathcal{N}$) rather than the coefficient (C_n) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where RCS is used in conjunction with the aerodynamic yawing moment (cf. Section 3.6); i.e., the aerodynamic yawing moment coefficient must be converted to a dimensional moment *before* adding the RCS flow field interaction effect (see also Appendix B).

The total yawing moment is:

$$\mathcal{N}_{TOTAL} = \bar{q}\, S\, b\, C_{n_{\substack{TOTAL \\ AERO}}} + \mathcal{N}_{RCS}$$

*The total aerodynamic yawing moment coefficient about a moment reference center at 65 percent of the body length (FS 1076.7, WL 375.0, BL 0.0) is obtained by the following equation:

$$C_{n_{\substack{TOTAL \\ AERO_{0.65\,l_B}}}} = C_{n_{BASIC}} + \Delta C_{n_{\beta_{ELEVON}}}\beta + C_{n_{\delta_a}}\delta_a + \Delta C_{n_{\beta_{\substack{BODY \\ FLAP}}}}\beta + \Delta C_{n_{\beta_{\substack{SPEED \\ BRAKE}}}}\beta + C_{n_{\delta_r}}\delta_r$$

$$+ C_{n_{\hat{p}}}\frac{pb}{2V} + C_{n_{\hat{r}}}\frac{rb}{2V} + C_{n_{\dot{\beta}}}\frac{\dot{\beta}b}{2V} + \Delta C_{n_{FLEX}} + \Delta C_{n_{\beta_{\substack{LANDING \\ GEAR}}}}\beta + \Delta C_{n_{\substack{GROUND \\ EFFECT}}} + \Delta C_{n_{\substack{SILTS \\ POD}}}$$

where,

*Refer to Appendix D when using digitized data.

NOTE: The increment presented in Appendix E should be added to the total from above calculations to account for OV102 manufacturing misalignment.

$C_{n_{BASIC}}$ = Basic, full-Scale, freestream, rigid-body yawing moment coefficient. (Figures 4.2.1.2-1 through -29)

NOTE: 1. Hypersonic-high altitude data given as C_{n_β} (must be multiplied by β).

2. All control surfaces neutral *except* $\delta_{SB} = 25°$.

3. For Moment Reference Center other than 0.65 L_B,

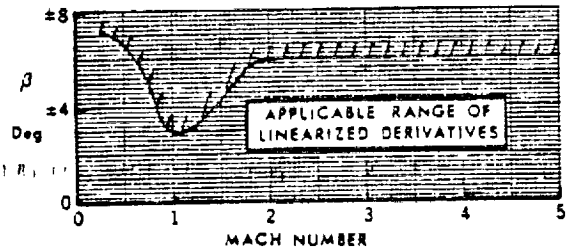
$$C_{n_{MRC}} = C_{n_{0.65L_B}} - \frac{\Delta Y}{b} C_A + \frac{\Delta X}{b} C_Y$$

where, $\Delta X = X_{MRC} - 1076.7$ inches

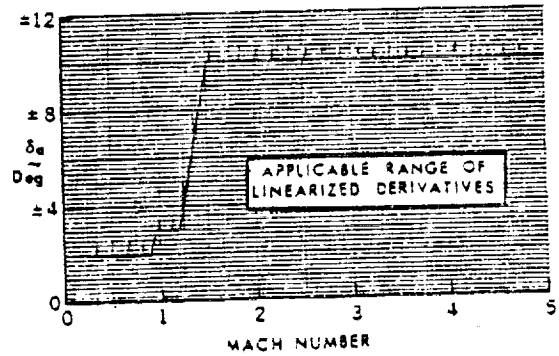
$\Delta Y = Y_{MRC}$

4. Moment transfer of (3) applies to all following increments and/or slopes except as noted.

$\Delta C_{n_{\beta_{ELEVON}}}$ = Change in yawing moment coefficient with change in sideslip (β) due to elevon deflections, δ_e. (Figures 4.2.1.2-30 through -46)



$C_{n_{\delta_a}}$ = Change in total yawing moment coefficient with change in aileron deflection, δ_a, when inboard and outboard angles are equal. (Figures 4.2.1.2-47 through -83)

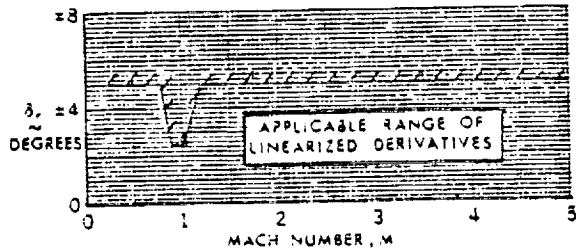


NOTE: 1. Partial span factor, K_n, to be used for elevon-body flap interconnect flight system where δ_e is limited to $\pm 5°$, and inboard and outboard angles are not equal, (Figure 4.2.1.2-84)

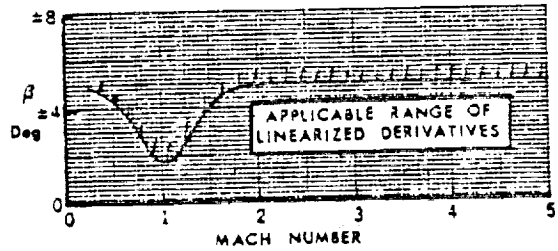
$$\Delta C_{n_{\substack{\text{AILERON} \\ \delta_{a_i} \neq \delta_{a_o}}}} = C_{n_{\delta_a}} [K_n \delta_{a_i} + (1 - K_n) \delta_{a_o}]$$

$\Delta C_{n_{\beta_{\substack{\text{BODY} \\ \text{FLAP}}}}}$ = Change in yawing moment coefficient with change in sideslip (β) due to body flap deflection, δ_{BF}. (Assume zero)

$C_{n_{\delta_r}}$ = Change in yawing moment coefficient with change in rudder deflection, δ_r. (Figures 4.2.1.2-85 through -111)



$\Delta C_{n_{\beta_{\substack{\text{SPEED} \\ \text{BRAKE}}}}}$ = Incremental change in basic yawing moment coefficient with change in sideslip angle, β, for various speed brake settings (δ_{SB}). (Figures 4.2.1.2-112 through -138)



$C_{n_{\hat{p}}}$ = Change in basic yawing moment coefficient due to roll rate, p, (per radian).* (Figures 4.2.1.2-139 and -140)

$C_{n_{\hat{r}}}$ = Change in basic yawing moment coefficient due to yaw rate, r, (per radian).* (Figures 4.2.1.2-141 and -142)

*For rotary derivative transfer equations see NASA SP-3070, "Summary of Transformation Equations, and Equations of Motion Used in Free Flight and Wind Tunnel Data Reduction and analysis," Gainer, T. G., and S. Hoffman, Langley Research Center, Hampton, Virginia (1972).

$C_{n_{\dot{\beta}}}$ Lateral Acceleration (Assume zero)

$\Delta C_{n_{FLEX}}$ = Incremental change in basic yawing moment coefficient due to aeroelastic deformation.

$$= -(1 - \eta_{n_{WB}})(C^R_{n_{BASIC}} - \Delta C^R_{n_{\beta_V}} \beta) - (1 - \eta_{n_V})(\Delta C^R_{n_{\beta_V}} + \Delta C^R_{n_{\beta_{SB}}})\beta$$

$$-(1-\eta_{n_a})\Delta C_{n_{AILERON}} - (1 - \eta_{n_R}) C^R_{n_{\delta_r}} \delta_r - (1 - \eta_{n_{\hat{p}}}) C^R_{n_{\hat{p}}} \frac{pb}{2V}$$

$$-(1 - \eta_{n_{\hat{r}}}) C^R_{n_{\hat{r}}} \frac{rb}{2V} - (1-\eta_{n_e})\Delta C_{n_{\beta_{ELEVON}}} \beta$$

where the flexible (F) to rigid (R) ratios are,

$\eta_{n_{WB}}$	= wing-body contribution	(Figure 4.2.1.2-143)
η_{n_V}	= vertical tail contribution	(Figure 4.2.1.2-144)
η_{n_a}	= aileron	(Figure 4.2.1.2-145)
η_{n_R}	= rudder	(Figure 4.2.1.2-146)
$\eta_{n_{\hat{p}}}$	= roll rate	(Figure 4.2.1.2-147)
$\eta_{n_{\hat{r}}}$	= yaw rate	(Figure 4.2.1.2-148)
η_{n_e}	= elevon	(Assume 1.0)
and, $\Delta C^R_{n_{\beta_V}}$	= incremental effect of vertical tail due to sideslip.	(Figure 4.2.1.2-149 and -150)

NOTE: 1. Detailed discussion of aeroelasticity may be obtained from Appendix A.

$\Delta C_{n_{\beta_{LANDING\ GEAR}}}$ = Change in yawing moment coefficient derivative due to extending landing gear. (Figure 4.2.1.2-151)

$\Delta C_{n_{GROUND\ EFFECT}}$ = Incremental change in basic yawing moment coefficient due to proximity of ground (f(h/b). (Assume zero)

NOTE: 1. See Section 3.4 for ground clearance and scrape attitude.

$\Delta C_{n_{\substack{SILTS \\ POD}}}$ = Change in yawing moment coefficient due to addition of SILTS pod.

$$= \Delta C_{n_{\substack{\beta_{SILTS} \\ POD}}} \beta + \Delta C_{n_{\substack{\delta r_{SILTS} \\ POD}}} \delta_r$$

where

$\Delta C_{n_{\substack{\beta_{SILTS} \\ POD}}}$ = $0.000081294 - 0.0000600923\ M + 0.0000112332\ M^2$ for $M \leq 6.0$

= zero for $M > 6.0$

$\Delta C_{n_{\substack{\delta r_{SILTS} \\ POD}}}$ = $0.00021589 - 0.00023899\ M + 0.0000527934\ M^2$ for $M \leq 6.0$

= zero for $M > 6.0$

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

*The effect of the RCS may be described as a dimensional yawing moment (foot-pounds) in terms of the significant contributing elements by:

$$\mathcal{N}_{RCS} = \mathcal{N}_{JT} + [\Delta\mathcal{N}_{SURF} + \Delta\mathcal{N}_{ELEVON} + \Delta\mathcal{N}_{\substack{BODY \\ FLAP}}]_{IMP} + \bar{q}\ S\ b[\Delta C_n + \Delta C_{n_{ELEVON}}$$

$$+ \Delta C_{n_{\substack{BODY \\ FLAP}}} + \Delta C_{n_{\substack{DOWN \\ FIRING \\ CARRYOVER \\ 2\ SIDES}}}]_{JI}$$

where,

$\mathcal{N}_{JT}$ = Yawing moment resulting from number (n) of jets being fired. (cf. Appendix B)

$$= \sum_{OJG} [\mathcal{N}_{JET} \cdot n] \sim \text{ft-lb}$$

NOTE: 1. OJG = operating jet group

2. Values given in Figure B-1 are for reference only.

*Refer to Appendix D when using digitized data.

$\Delta I_{SURF\ IMP}$ = Yawing moment resulting from jet impingement on Orbiter Vehicle surface(s). (Figures 4.2.1.2-152 and -153)

$$= \sum_{OJG} [\Delta I_{SURF\ IMP} \cdot n] \sim \text{ft-lb}$$

$\Delta \Delta I_{ELEVON\ IMP}$ = Change in yawing moment due to jet impingement on elevon effectiveness. (No effect)

$$= \sum_{OJG} \left[\frac{\partial \Delta I}{\partial \delta_e} \delta_e \cdot n\right] \sim \text{ft-lb}$$

$\Delta \Delta I_{BODY\ FLAP}$ = Change in yawing moment due to jet impingement on body flap effectiveness. (No effect)

$$= \sum_{OJG} \left[\frac{\partial \Delta I}{\partial \delta_{BF}} \delta_{BF} \cdot n\right] \sim \text{ft-lb}$$

$\Delta C_{n_{JI}}$ = Change in yawing moment coefficient due to jet interaction. (Figures 4.2.1.2-154 through -156)

$$= \sum_{OJG} [\Delta C_{n_{JI}}]$$

$\Delta C_{n_{ELEVON\ JI}}$ = Change in yawing moment coefficient due to jet interaction effect on elevon effectiveness. (No effect)

$$= \sum_{OJG} [(\Delta C_n)_{\delta_{e_{REF}}} \cdot (\delta_e/\delta_{e_{REF}})^{0.75}]$$

$\Delta C_{n_{BODY\ FLAP}}$ = Change in yawing moment coefficient due to jet interaction effect on body flap effectiveness. (No effect)

$$= \sum_{OJG} [(\Delta C_n)_{\delta_{BF_{REF}}} \cdot (\delta_{BF}/\delta_{BF_{REF}})^{0.75}]$$

$\Delta C_{n_{DOWN\ FIRING\ CARRYOVER\ JI\ 2\ SIDES}}$ = Effect of carry-over between left- and right-down firing jet groups due to jet interaction. (No effect)

$$= \left[\frac{\partial C_{n_{JI}}}{\partial (q_j/q_\infty)}\right] [(\overline{q_j/q_\infty})]$$

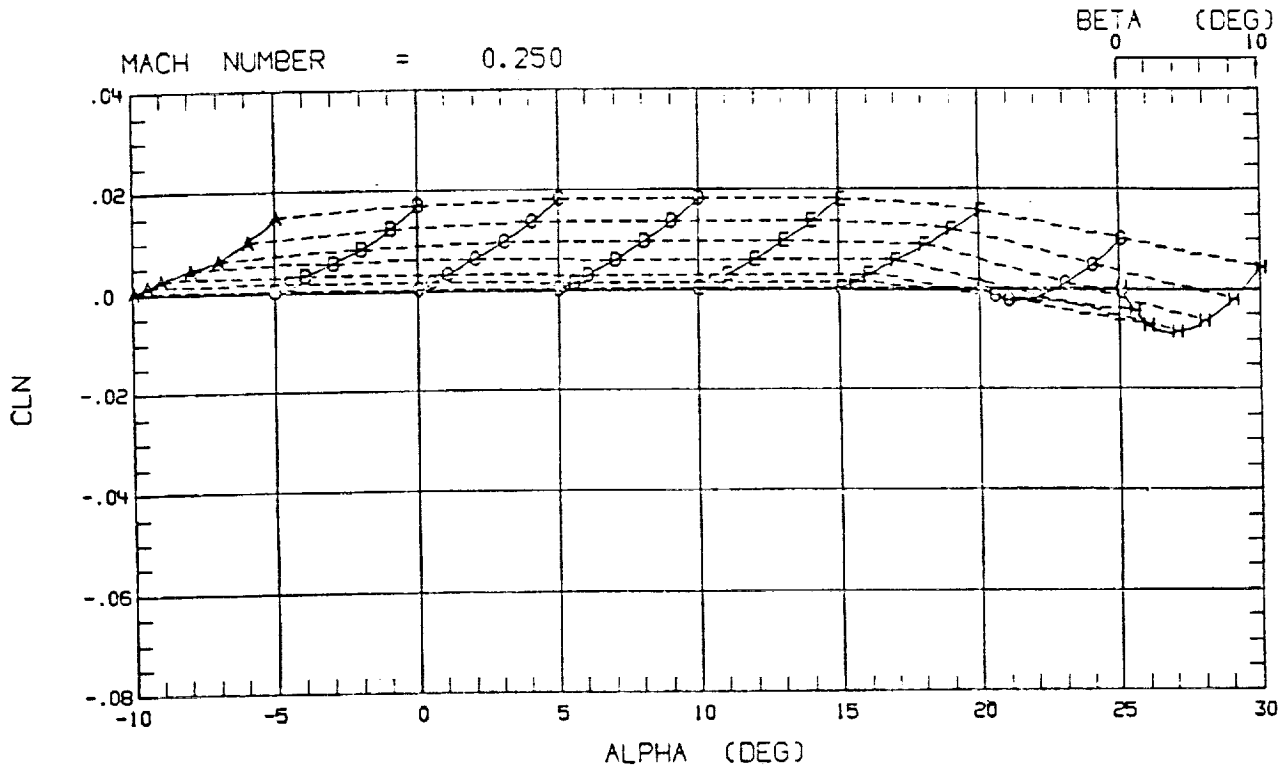
NOTE: 1. $\phi_j/\phi_\infty = (0.1543/\overline{q}_\infty)\ n$

2. This term is zero if down-firing jet group is inoperative on one side.

3. $(\overline{\phi_j/\phi_\infty}) = \frac{1}{2}\left[(\phi_j/\phi_\infty)_{LD} + (\phi_j/\phi_\infty)_{RD}\right]$

where: $0 < (\overline{\phi_j/\phi_\infty}) < 0.03$

The total RCS effect, ΔV_{RCS}, during thrust build-up and decay is obtained by reducing the full thrust value by the ratio of momentary thrust (see Ref. 4-3) to full thrust.



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00136	0.00153	0.00155	0.00142	0.00142	0.00139	-0.00154	-0.00447
2.000	0.00260	0.00300	0.00310	0.00290	0.00290	0.00290	-0.00240	-0.00760
4.000	0.00445	0.00571	0.00622	0.00599	0.00599	0.00565	-0.00159	-0.00883
6.000	0.00630	0.00837	0.00940	0.00940	0.00940	0.00860	0.00100	-0.00660
8.000	0.00987	0.01222	0.01341	0.01344	0.01340	0.01180	0.00469	-0.00242
10.000	0.01460	0.01687	0.01800	0.01800	0.01790	0.01520	0.00970	0.00420

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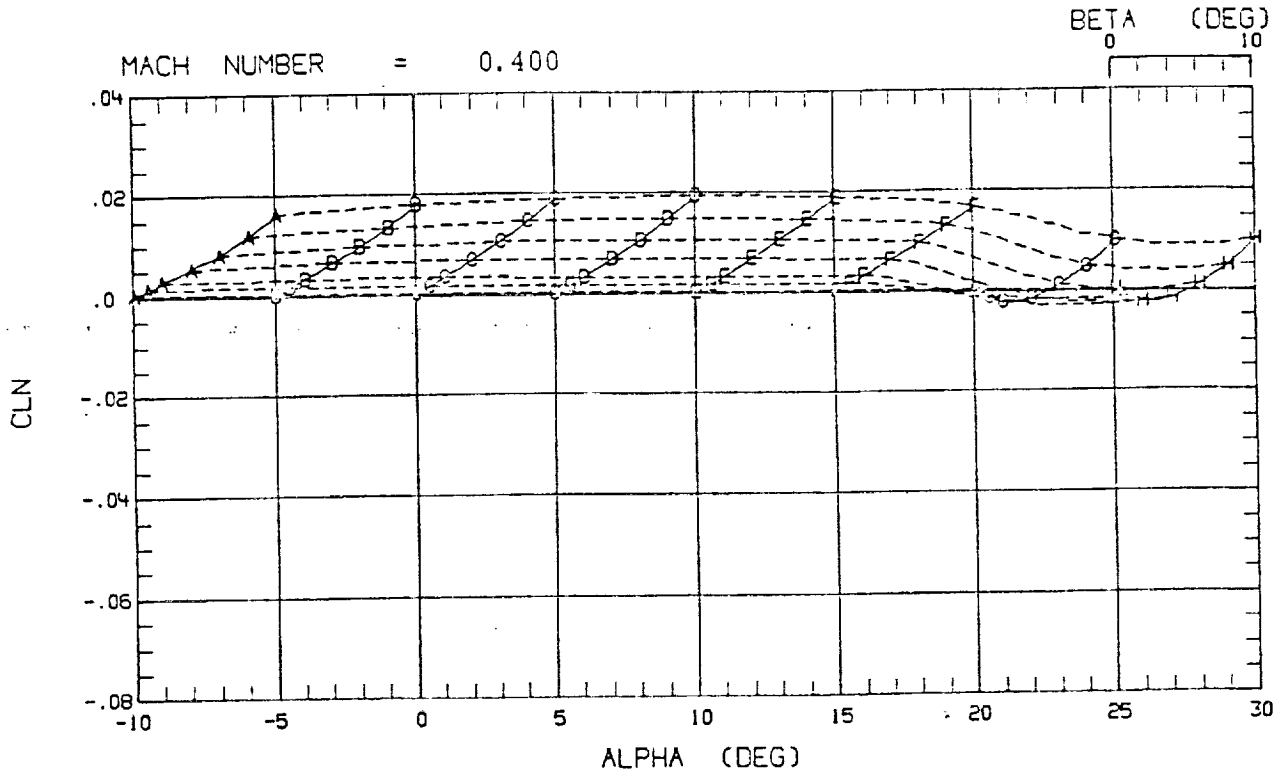
FIGURE 4.2.1.2-1
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00135	0.00165	0.00159	0.00153	0.00158	0.00154	-0.00138	-0.00138
2.000	0.00270	0.00320	0.00336	0.00319	0.00320	0.00301	-0.00240	-0.00240
4.000	0.00540	0.00635	0.00681	0.00681	0.00668	0.00629	-0.00159	-0.00159
6.000	0.00810	0.00947	0.01034	0.01050	0.01034	0.00950	0.00100	0.00100
8.000	0.01168	0.01332	0.01437	0.01471	0.01438	0.01300	0.00469	0.00469
10.000	0.01597	0.01769	0.01877	0.01920	0.01871	0.01660	0.00970	0.00970

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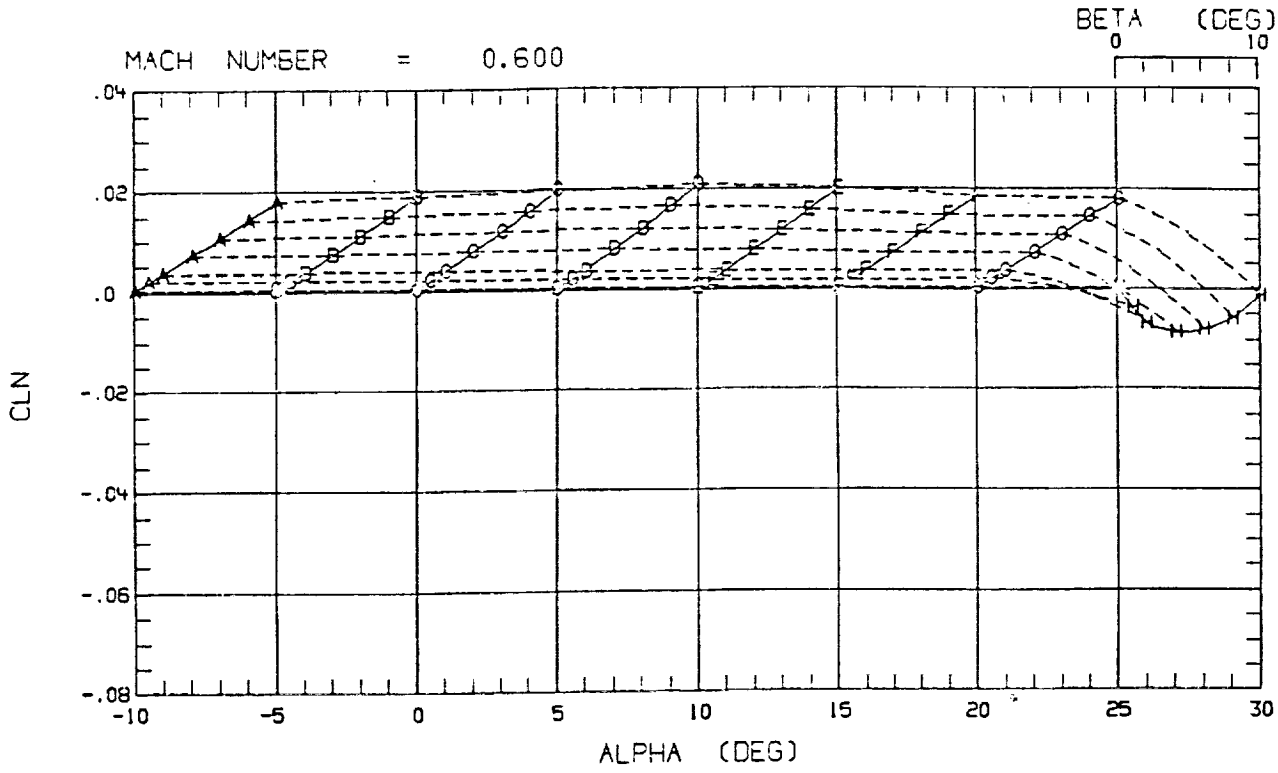
FIGURE 4.2.1.2-2
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00181	0.00180	0.00183	0.00179	0.00177	0.00160	0.00178	-0.00397
2.000	0.00360	0.00360	0.00370	0.00358	0.00360	0.00330	0.00356	-0.00690
4.000	0.00705	0.00720	0.00760	0.00790	0.00760	0.00715	0.00700	-0.00871
6.000	0.01050	0.01090	0.01160	0.01200	0.01160	0.01100	0.01070	-0.00820
8.000	0.01410	0.01477	0.01566	0.01640	0.01570	0.01460	0.01430	-0.00585
10.000	0.01780	0.01880	0.01980	0.02080	0.01990	0.01850	0.01780	-0.00150

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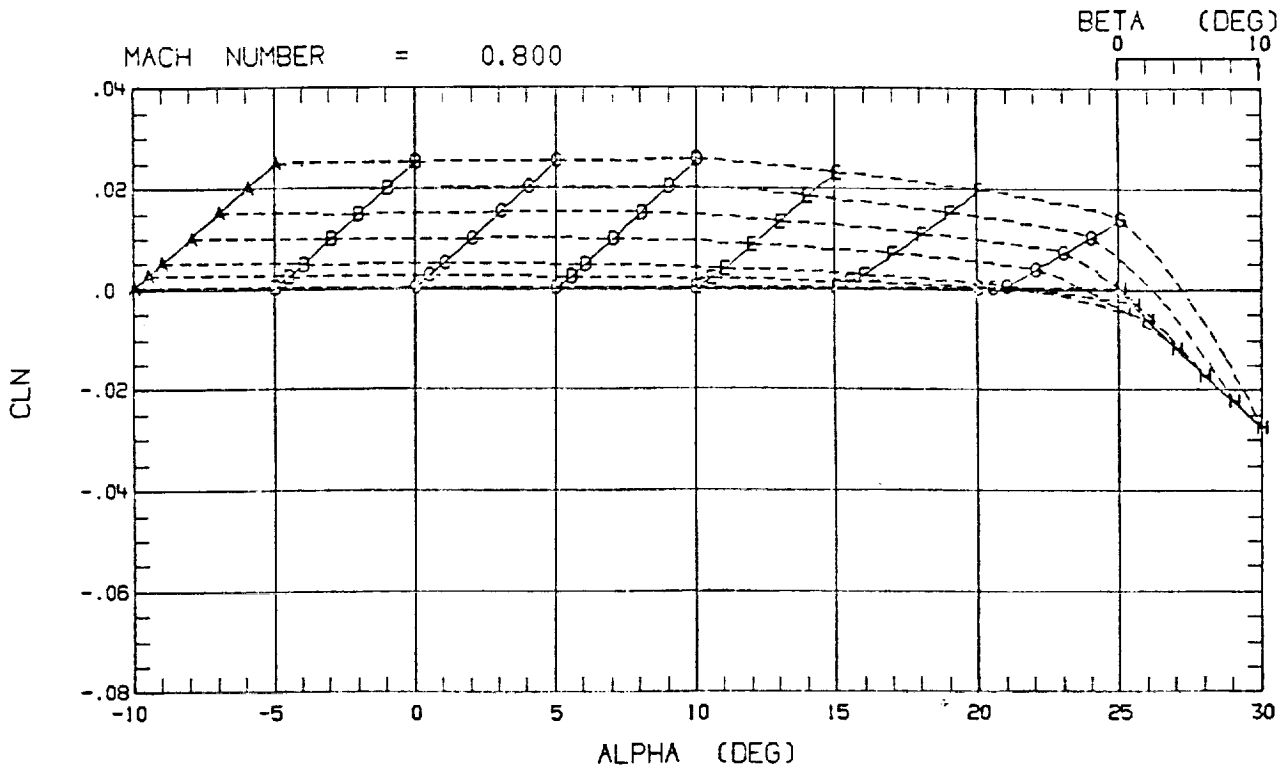
FIGURE 4.2.1.2-3
BASIC YAWING MOMENT COEFFICIENT

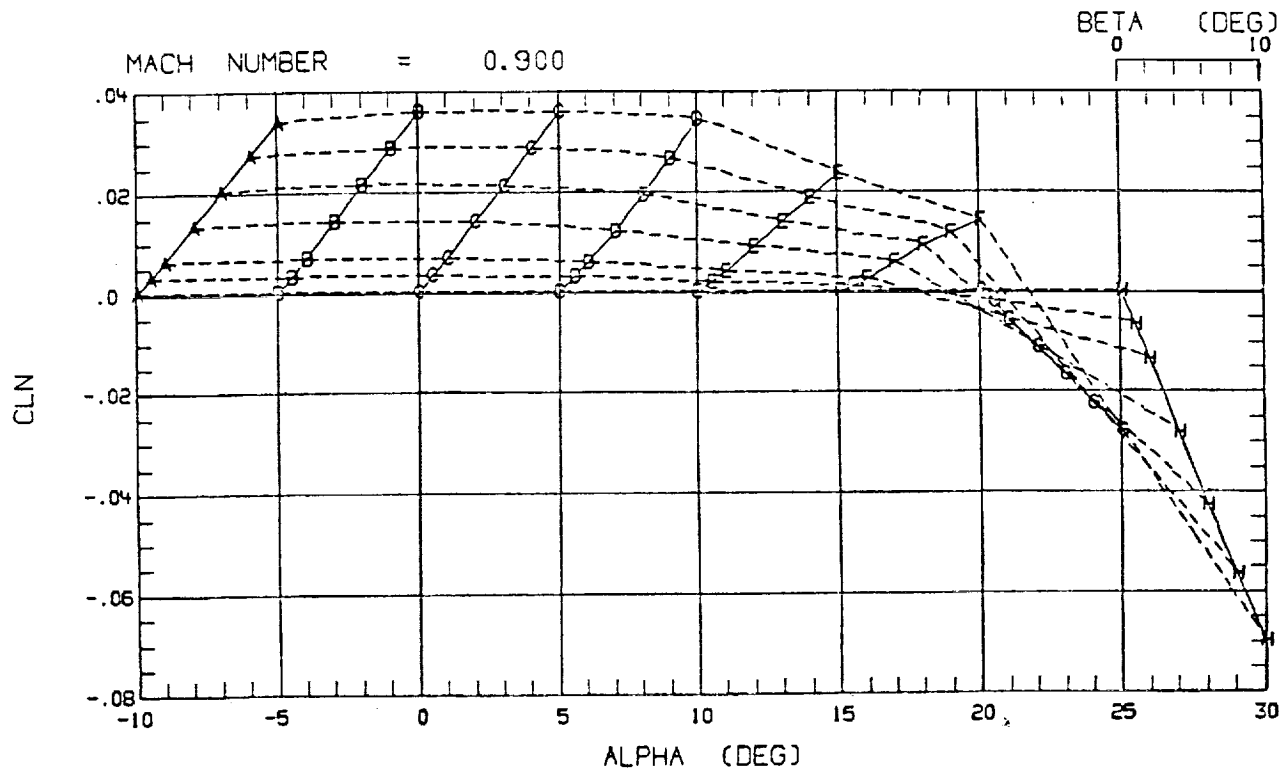


CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00250	0.00238	0.00244	0.00231	0.00195	0.00117	0.00020	-0.00328
2.000	0.00500	0.00480	0.00488	0.00470	0.00390	0.00260	0.00040	-0.00640
4.000	0.01000	0.00978	0.01000	0.00988	0.00870	0.00670	0.00370	-0.01185
6.000	0.01500	0.01487	0.01520	0.01510	0.01330	0.01080	0.00700	-0.01720
8.000	0.01996	0.01999	0.02020	0.02034	0.01830	0.01500	0.01030	-0.02249
10.000	0.02490	0.02517	0.02540	0.02560	0.02300	0.01950	0.01370	-0.02770

ENGINEER CLL
DATE 9-22-78

FIGURE 4.2.1.2-4
BASIC YAWING MOMENT COEFFICIENT

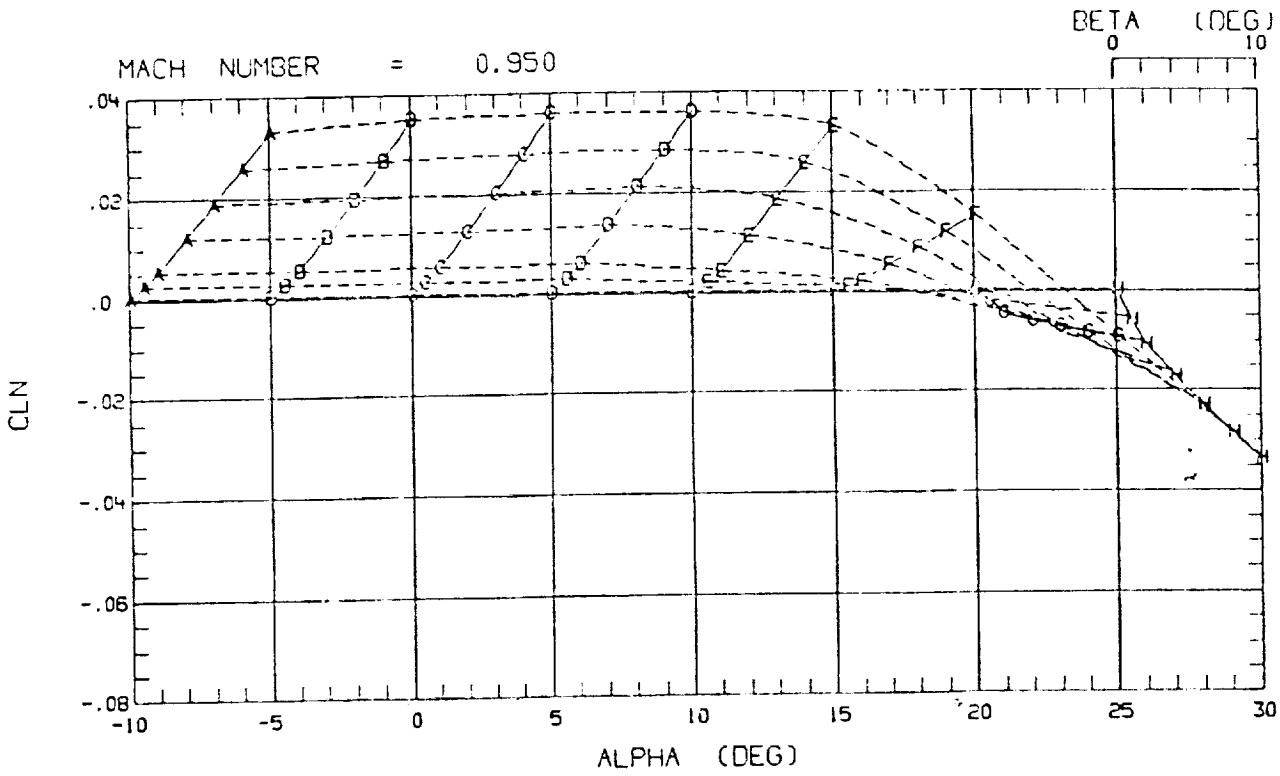


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00303	0.00328	0.00333	0.00300	0.00205	0.00112	-0.00216	-0.00672
2.000	0.00620	0.00668	0.00666	0.00600	0.00420	0.00240	-0.00560	-0.01360
4.000	0.01320	0.01411	0.01400	0.01200	0.00905	0.00575	-0.01120	-0.02815
6.000	0.02020	0.02150	0.02120	0.01920	0.01390	0.00910	-0.01680	-0.04270
8.000	0.02712	0.02879	0.02870	0.02660	0.01875	0.01177	-0.02240	-0.05657
10.000	0.03400	0.03600	0.03600	0.03450	0.02360	0.01400	-0.02800	-0.07000

ENGINEER LL
DATE 9-12-73

FIGURE 4.2.1.2-5
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00260	0.00254	0.00250	0.00275	0.00190	0.00090	-0.00212	-0.00591
2.000	0.00540	0.00537	0.00550	0.00580	0.00410	0.00200	-0.00450	-0.01100
4.000	0.01186	0.01211	0.01263	0.01340	0.01120	0.00525	-0.00606	-0.01737
6.000	0.01870	0.01943	0.02020	0.02100	0.01850	0.00850	-0.00730	-0.02310
8.000	0.02572	0.02703	0.02796	0.02852	0.02580	0.01175	-0.00844	-0.02862
10.000	0.03300	0.03500	0.03600	0.03600	0.03300	0.01500	-0.00940	-0.03380

ENGINEER LLL
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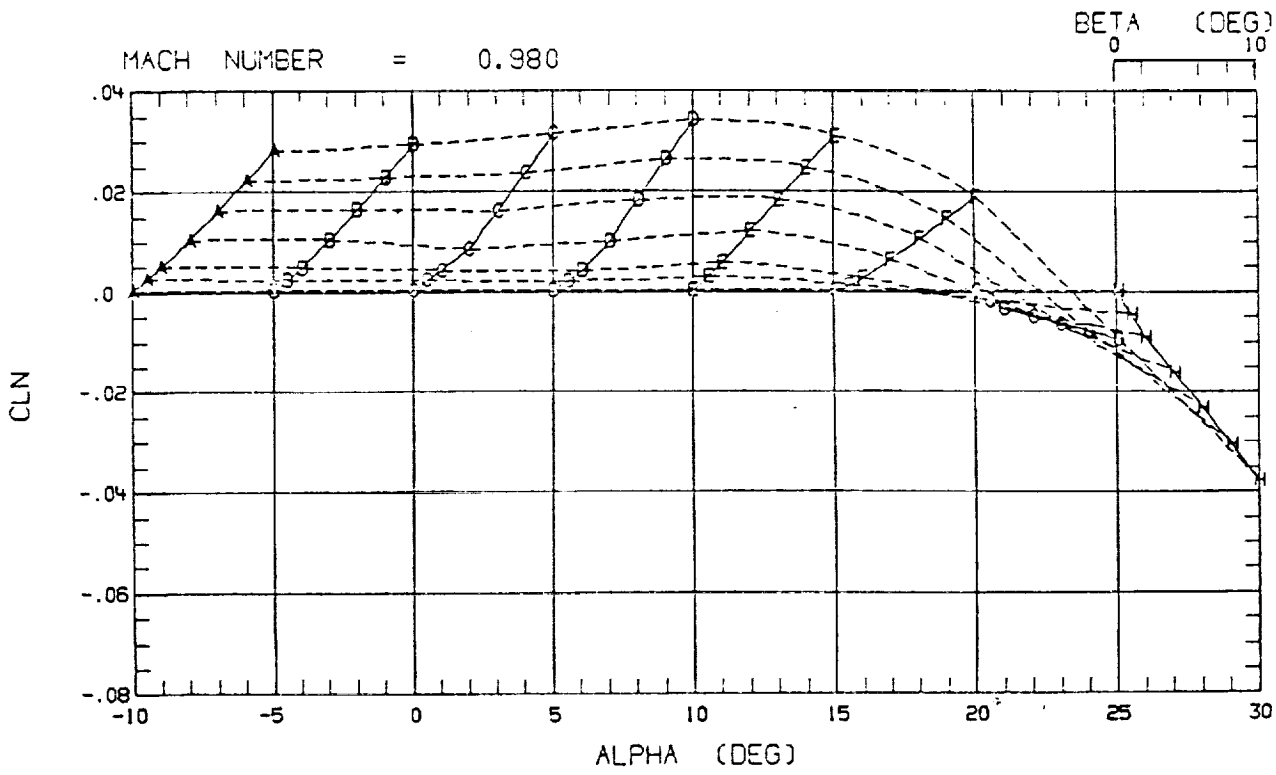
FIGURE 4.2.1.2-6
BASIC YAWING MOMENT COEFFICIENT

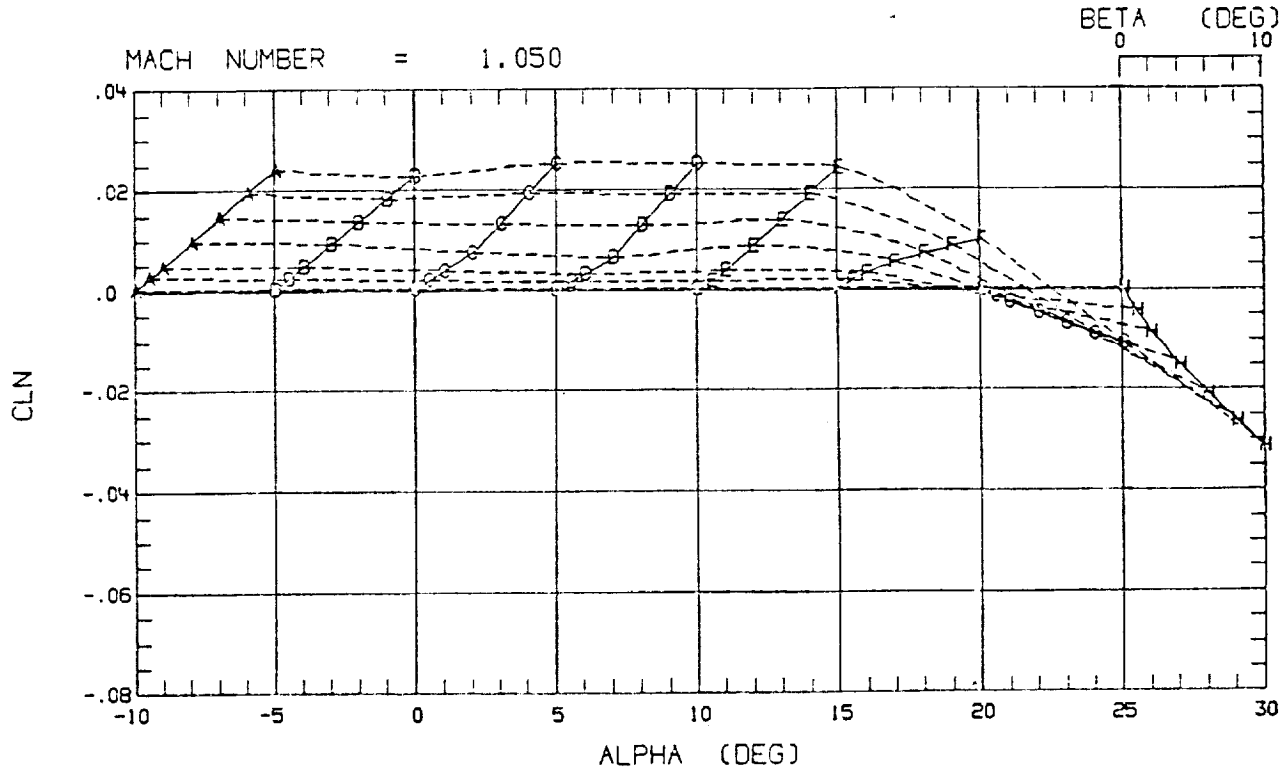


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00240	0.00232	0.00209	0.00200	0.00274	0.00107	-0.00192	-0.00490
2.000	0.00490	0.00480	0.00418	0.00400	0.00560	0.00240	-0.00350	-0.00940
4.000	0.01030	0.01027	0.00836	0.01000	0.01185	0.00631	-0.00500	-0.01631
6.000	0.01600	0.01627	0.01600	0.01820	0.01820	0.01040	-0.00650	-0.02340
8.000	0.02189	0.02260	0.02360	0.02620	0.02457	0.01455	-0.00804	-0.03062
10.000	0.02800	0.02933	0.03140	0.03420	0.03100	0.01880	-0.00960	-0.03800

ENGINEER LLL
DATE 9-12-78

FIGURE 4.2.1.2-7
BASIC YAWING MOMENT COEFFICIENT



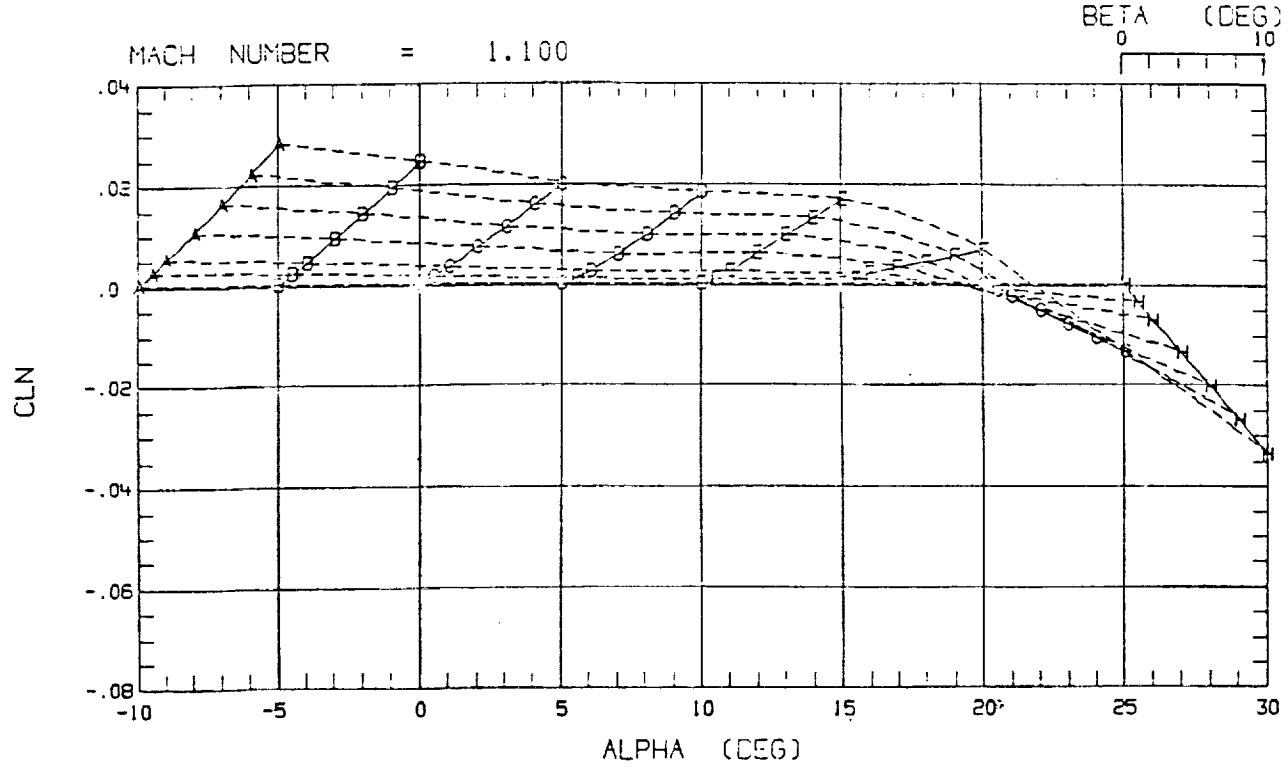
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00240	0.00229	0.00186	0.00150	0.00173	0.00175	-0.00140	-0.00455
2.000	0.00480	0.00457	0.00372	0.00300	0.00370	0.00320	-0.00270	-0.00860
4.000	0.00960	0.00910	0.00744	0.00650	0.00875	0.00530	-0.00484	-0.01499
6.000	0.01440	0.01363	0.01310	0.01280	0.01390	0.00700	-0.00690	-0.02080
8.000	0.01920	0.01818	0.01930	0.01890	0.01907	0.00849	-0.00892	-0.02634
10.000	0.02400	0.02273	0.02520	0.02500	0.02430	0.00970	-0.01090	-0.03150

ENGINEER LL
DATE 9-12-75

FIGURE 4.2.1.2-8
BASIC YAWING MOMENT COEFFICIENT

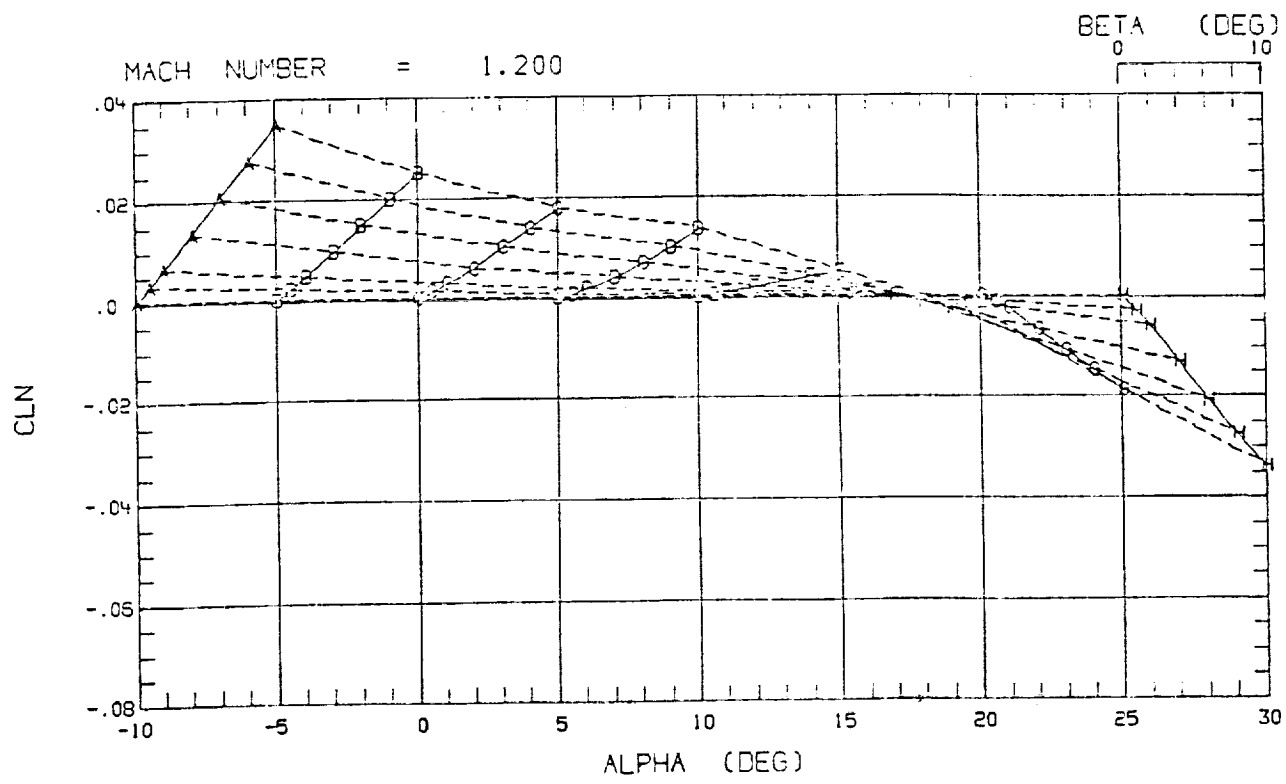


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00258	0.00221	0.00173	0.00121	0.00100	0.00100	-0.00117	-0.00359
2.000	0.00520	0.00447	0.00346	0.00260	0.00240	0.00230	-0.00240	-0.00710
4.000	0.01055	0.00916	0.00740	0.00604	0.00610	0.00340	-0.00515	-0.01370
6.000	0.01610	0.01407	0.01150	0.00990	0.00970	0.00450	-0.00790	-0.02030
8.000	0.02192	0.01918	0.01580	0.01400	0.01332	0.00564	-0.01065	-0.02694
10.000	0.02800	0.02450	0.02000	0.01840	0.01700	0.00680	-0.01340	-0.03360

ENGINEER LL
DATE 10-3-75

FIGURE 4.2.1.2-9
BASIC YAWING MOMENT COEFFICIENT



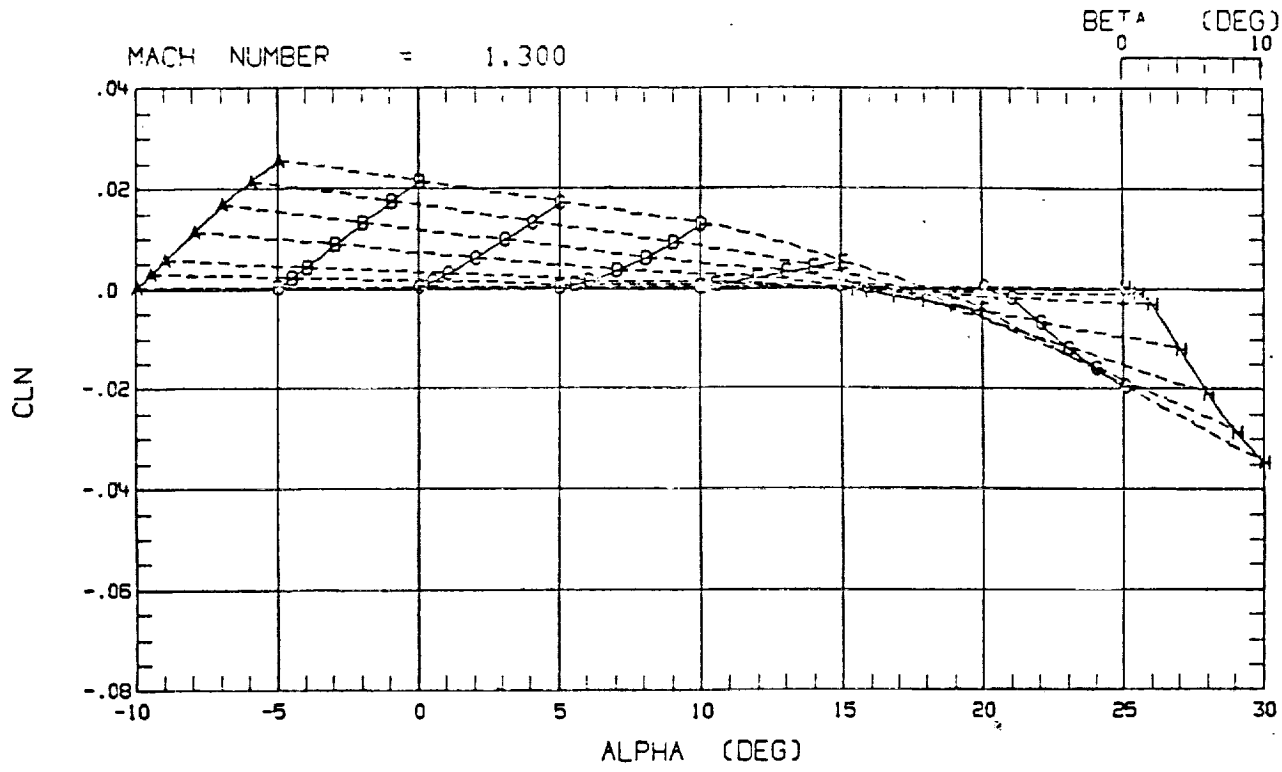
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00315	0.00222	0.00150	0.00084	0.00050	0.00050	-0.00105	-0.00292
2.000	0.00640	0.00453	0.00300	0.00180	0.00100	0.00100	-0.00240	-0.00590
4.000	0.01330	0.00950	0.00600	0.00408	0.00200	0.00014	-0.00665	-0.01344
6.000	0.02040	0.01463	0.01010	0.00680	0.00300	-0.00100	-0.01090	-0.02080
8.000	0.02759	0.01961	0.01391	0.00990	0.00400	-0.00220	-0.01492	-0.02765
10.000	0.03490	0.02507	0.01790	0.01340	0.00500	-0.00350	-0.01880	-0.03410

ENGINEER LL
DATE 10-3-78

FIGURE 4.2.1.2-10
BASIC YAWING MOMENT COEFFICIENT

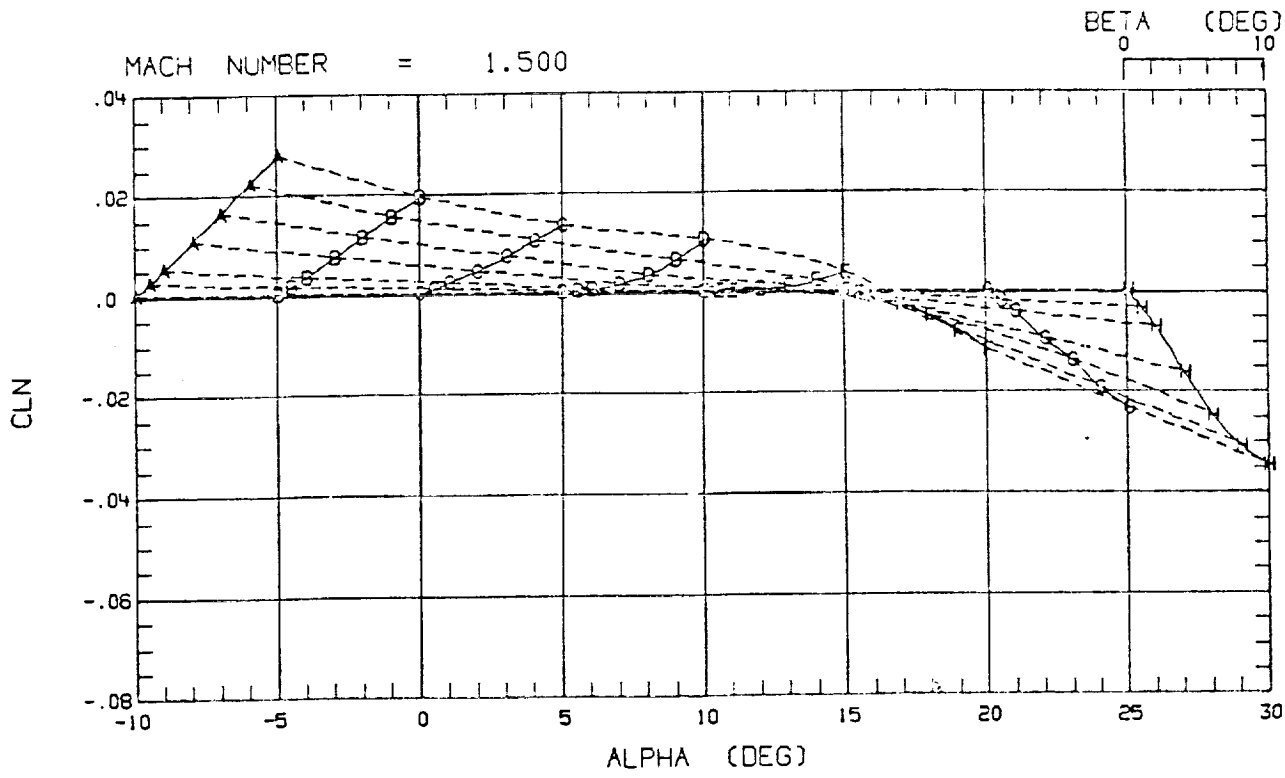


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00274	0.00205	0.00136	0.00067	0.00056	-0.00045	-0.00101	-0.00117
2.000	0.00548	0.00414	0.00280	0.00146	0.00110	-0.00090	-0.00210	-0.00330
4.000	0.01107	0.00852	0.00597	0.00341	0.00205	-0.00180	-0.00705	-0.01230
6.000	0.01640	0.01290	0.00940	0.00590	0.00300	-0.00270	-0.01200	-0.02130
8.000	0.02118	0.01711	0.01304	0.00897	0.00402	-0.00364	-0.01616	-0.02869
10.000	0.02550	0.02120	0.01690	0.01260	0.00510	-0.00460	-0.01980	-0.03500

ENGINEER CH
DATE 9-12-78

FIGURE 4.2.1.2-11
BASIC YAWING MOMENT COEFFICIENT

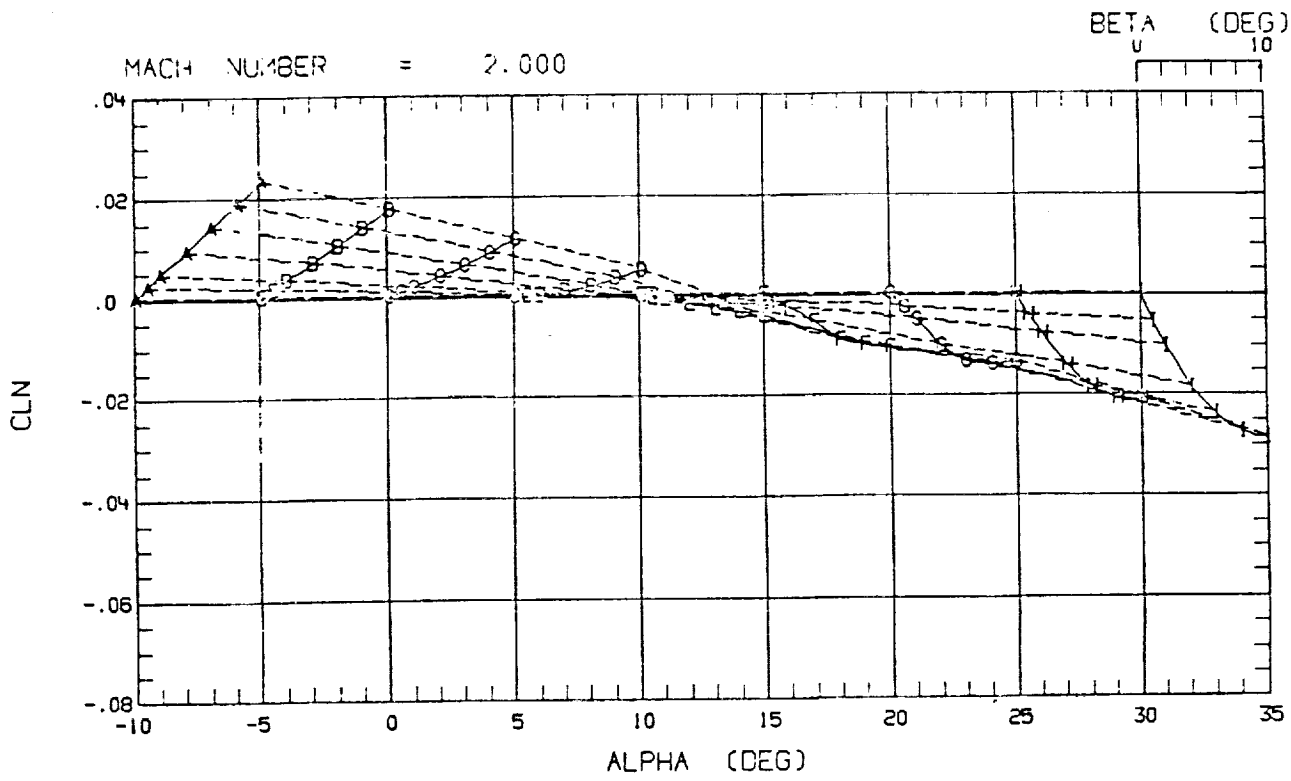


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00254	0.00169	0.00112	0.00028	0.00006	-0.00059	-0.00190	-0.00351
2.000	0.00516	0.00347	0.00224	0.00068	0.00016	-0.00128	-0.00428	-0.00728
4.000	0.01073	0.00743	0.00448	0.00174	0.00041	-0.00286	-0.00961	-0.01636
6.000	0.01638	0.01143	0.00734	0.00344	0.00088	-0.00494	-0.01394	-0.02494
8.000	0.02216	0.01548	0.01052	0.00639	0.00210	-0.00797	-0.01944	-0.03092
10.000	0.02780	0.01937	0.01360	0.01040	0.00390	-0.01180	-0.02340	-0.03500

ENGINEER [illegible]
DATE 6-12-78

FIGURE 4.2.1.2-12
BASIC YAWING MOMENT COEFFICIENT



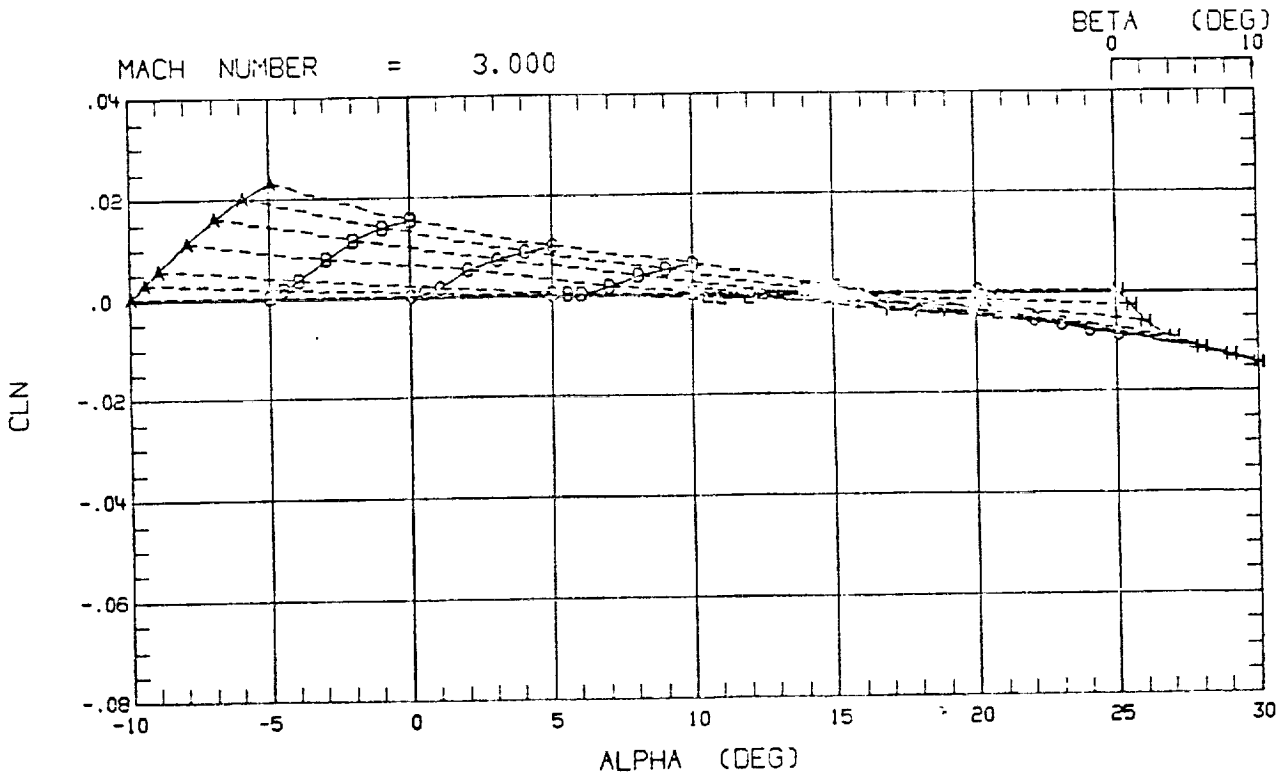
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00225	0.00167	0.00097	0.00007	-0.00043	-0.00133	-0.00249	-0.00409	-0.00559
2.000	0.00474	0.00335	0.00194	0.00024	-0.00086	-0.00266	-0.00498	-0.00778	-0.01054
4.000	0.00928	0.00688	0.00400	0.00096	-0.00172	-0.00532	-0.01020	-0.01414	-0.01871
6.000	0.01402	0.01026	0.00622	0.00196	-0.00260	-0.00900	-0.01334	-0.01957	-0.02398
8.000	0.01855	0.01383	0.00870	0.00334	-0.00340	-0.01000	-0.01380	-0.02083	-0.02747
10.000	0.02320	0.01747	0.01140	0.00510	-0.00430	-0.01070	-0.01350	-0.02100	-0.02680

ENGINEER LLL
DATE 9-12-78

FIGURE 4.2.1.2-13
BASIC YAWING MOMENT COEFFICIENT



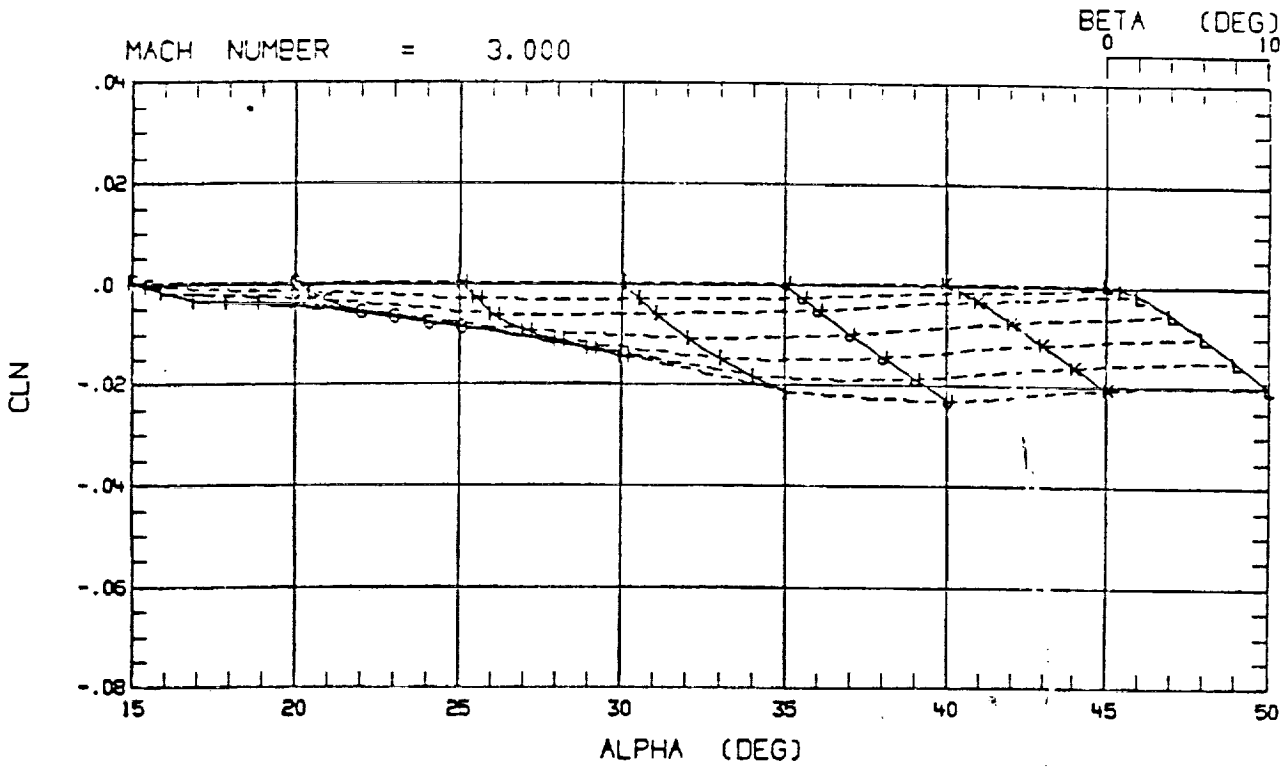
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00290	0.00173	0.00075	-0.00002	-0.00042	-0.00094	-0.00177	-0.00309
2.000	0.00570	0.00354	0.00166	-0.00004	-0.00084	-0.00188	-0.00354	-0.00618
4.000	0.01102	0.00762	0.00520	0.00170	-0.00070	-0.00356	-0.00558	-0.00948
6.000	0.01580	0.01152	0.00720	0.00368	0.0	-0.00374	-0.00672	-0.01142
8.000	0.01975	0.01392	0.00860	0.00496	0.00040	-0.00382	-0.00776	-0.01296
10.000	0.02300	0.01527	0.00970	0.00600	0.00110	-0.00390	-0.00870	-0.01450

ENGINEER LLL
DATE 9-12-78

FIGURE 4.2.1.2-14
BASIC YAWING MOMENT COEFFICIENT

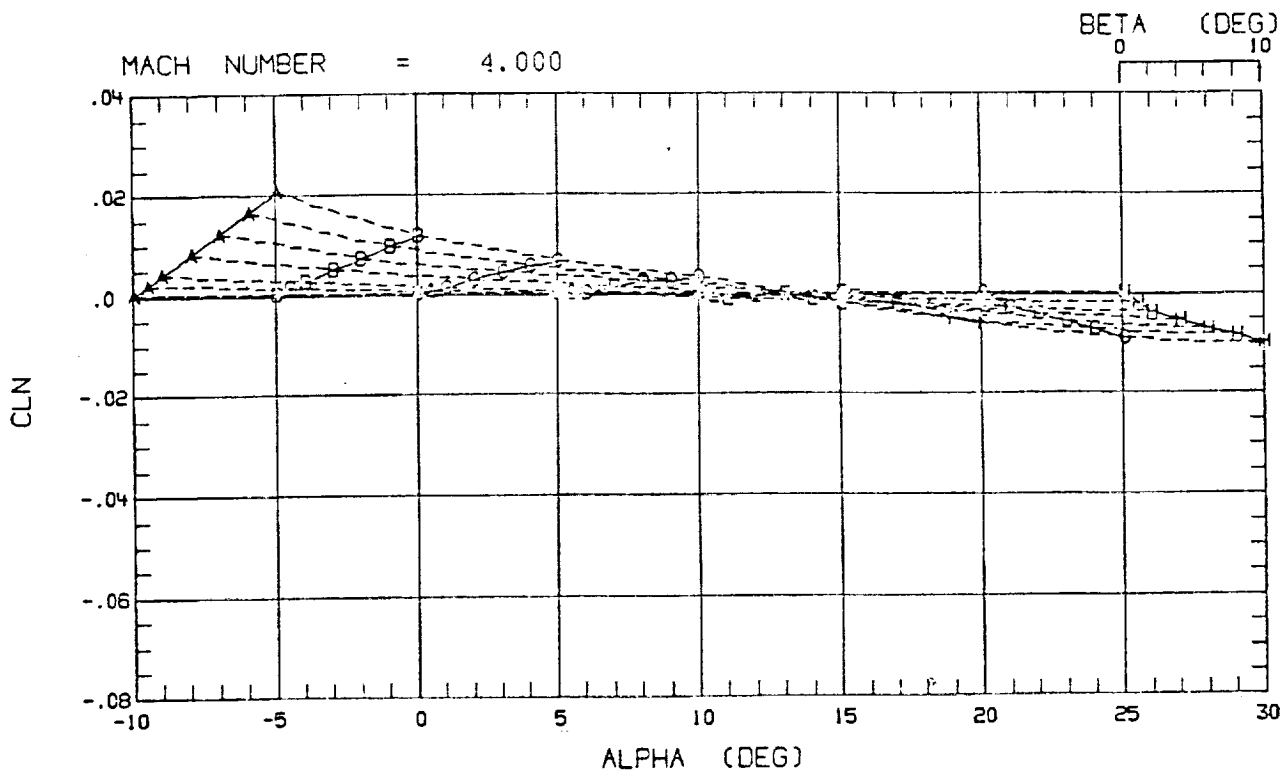


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00094	-0.00177	-0.00309	-0.00309	-0.00265	-0.00153	-0.00075
2.000	-0.00188	-0.00354	-0.00618	-0.00594	-0.00521	-0.00324	-0.00189
4.000	-0.00356	-0.00558	-0.00948	-0.01075	-0.00995	-0.00746	-0.00582
6.000	-0.00374	-0.00672	-0.01142	-0.01482	-0.01439	-0.01182	-0.01032
8.000	-0.00382	-0.00776	-0.01296	-0.01840	-0.01871	-0.01622	-0.01513
10.000	-0.00390	-0.00870	-0.01450	-0.02140	-0.02307	-0.02070	-0.02035

ENGINEER LL
TE 9-12-78

FIGURE 4.2.1.2-15
BASIC YAWING MOMENT COEFFICIENT

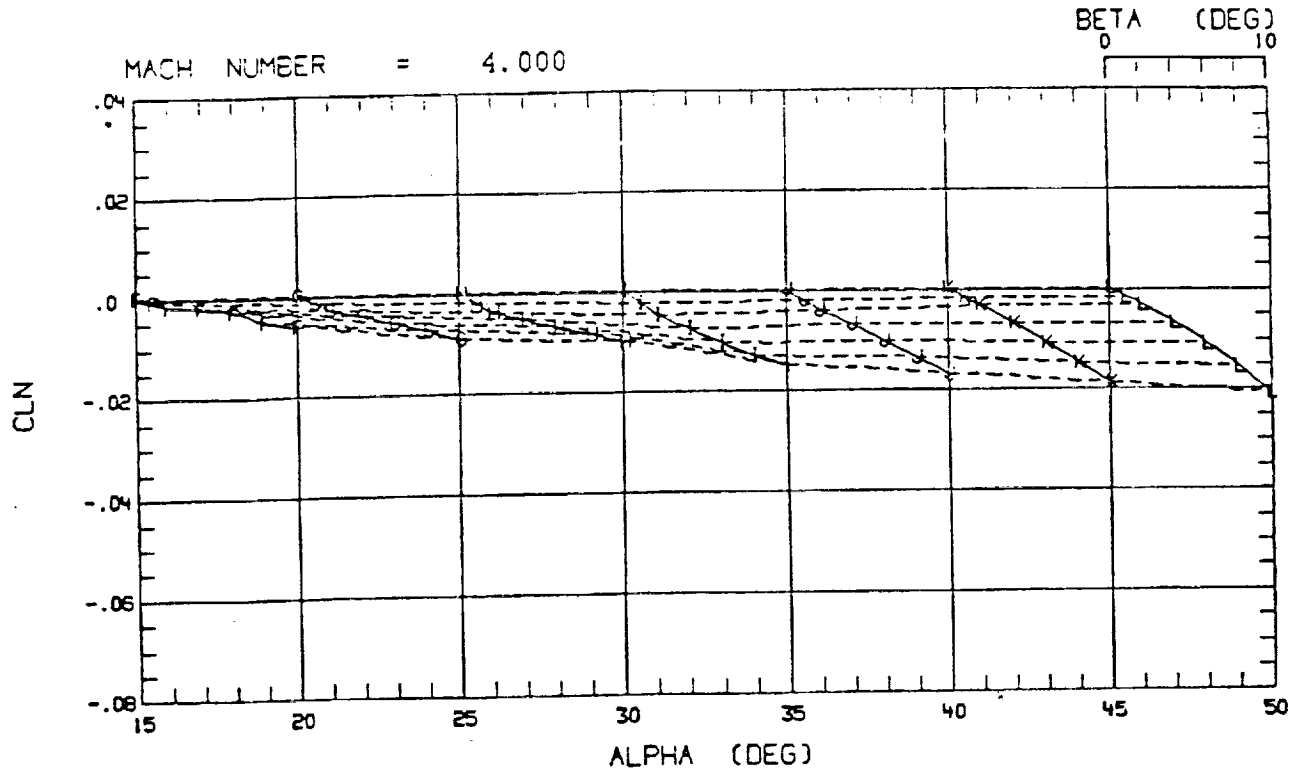


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00199	0.00124	0.00066	0.00006	-0.00050	-0.00083	-0.00144	-0.00195
2.000	0.00400	0.00246	0.00132	0.00012	-0.00100	-0.00166	-0.00298	-0.00390
4.000	0.00805	0.00485	0.00294	0.00134	-0.00060	-0.00208	-0.00416	-0.00550
6.000	0.01213	0.00719	0.00436	0.00246	-0.00020	-0.00282	-0.00574	-0.00710
8.000	0.01625	0.00946	0.00548	0.00268	-0.00100	-0.00516	-0.00732	-0.00840
10.000	0.02040	0.01167	0.00650	0.00300	-0.00200	-0.00610	-0.00910	-0.01010

ENGINEER [illegible]
DATE 9-12-78

FIGURE 4.2.1.2-16
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00083	-0.00144	-0.00195	-0.00236	-0.00206	-0.00170	-0.00161
2.000	-0.00166	-0.00288	-0.00390	-0.00472	-0.00412	-0.00340	-0.00322
4.000	-0.00208	-0.00416	-0.00550	-0.00764	-0.00681	-0.00696	-0.00685
6.000	-0.00282	-0.00574	-0.00710	-0.01040	-0.01028	-0.01073	-0.01103
8.000	-0.00516	-0.00732	-0.00940	-0.01300	-0.01359	-0.01471	-0.01577
10.000	-0.00610	-0.00910	-0.01010	-0.01480	-0.01683	-0.01890	-0.02105

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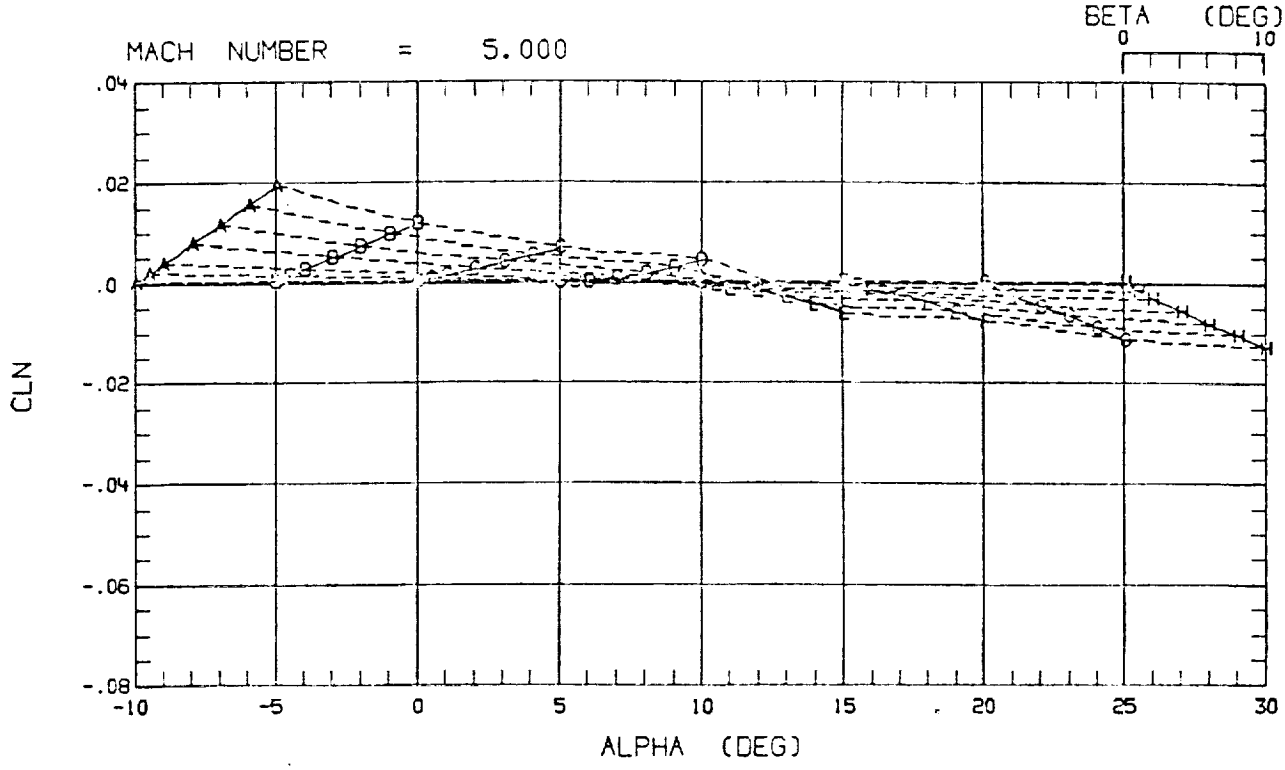
FIGURE 4.2.1.2-17
BASIC YAWING MOMENT COEFFICIENT

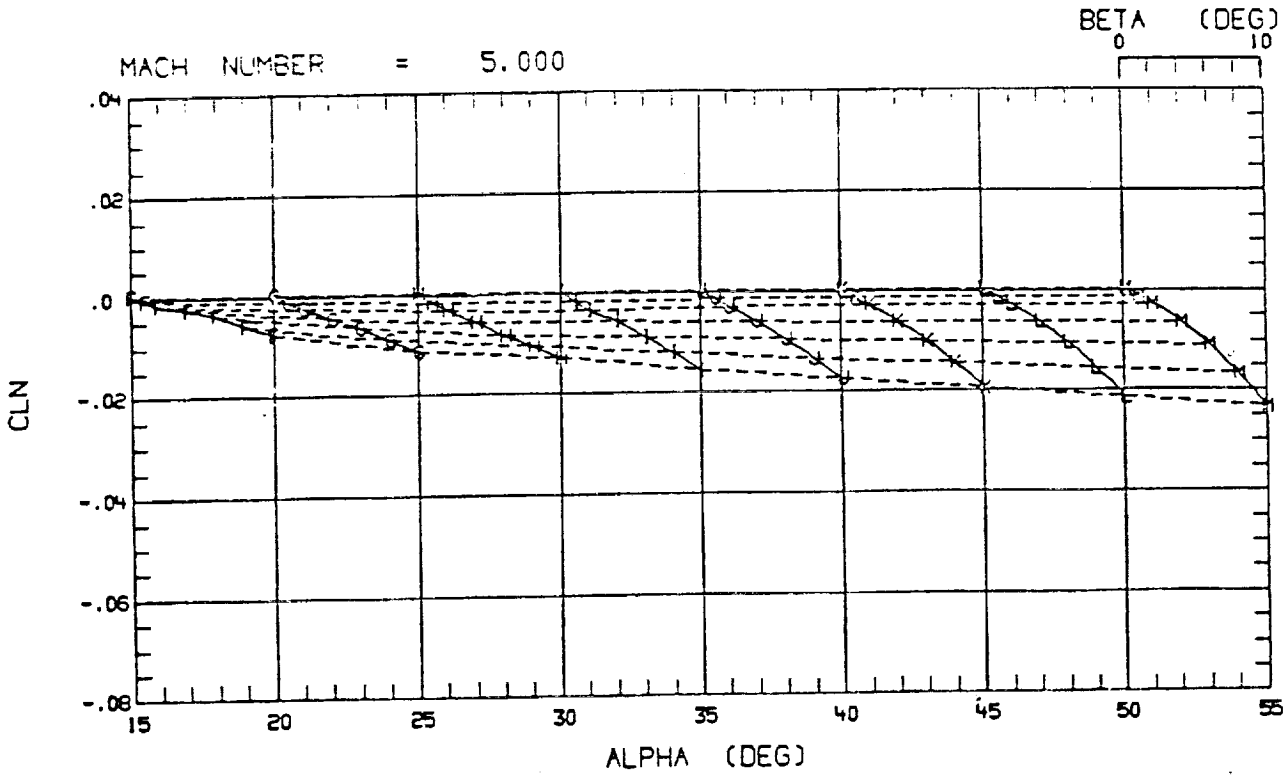


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00190	0.00123	0.00062	0.00005	-0.00065	-0.00090	-0.00135	-0.00165
2.000	0.00380	0.00245	0.00126	0.00023	-0.00130	-0.00180	-0.00270	-0.00330
4.000	0.00762	0.00484	0.00257	0.00082	-0.00180	-0.00250	-0.00468	-0.00572
6.000	0.01146	0.00717	0.00391	0.00171	-0.00300	-0.00390	-0.00662	-0.00830
8.000	0.01532	0.00943	0.00529	0.00290	-0.00450	-0.00590	-0.00906	-0.01062
10.000	0.01920	0.01163	0.00670	0.00440	-0.00620	-0.00770	-0.01140	-0.01300

ENGINEER ///
DATE 9-12-78

FIGURE 4.2.1.2-18
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00090	-0.00135	-0.00165	-0.00180	-0.00155	-0.00148	-0.00146	-0.00143
2.000	-0.00180	-0.00270	-0.00330	-0.00360	-0.00310	-0.00296	-0.00292	-0.00286
4.000	-0.00250	-0.00468	-0.00572	-0.00580	-0.00613	-0.00632	-0.00642	-0.00649
6.000	-0.00390	-0.00662	-0.00830	-0.00891	-0.00965	-0.01021	-0.01070	-0.01116
8.000	-0.00590	-0.00906	-0.01062	-0.01218	-0.01351	-0.01464	-0.01576	-0.01686
10.000	-0.00770	-0.01140	-0.01300	-0.01560	-0.01770	-0.01960	-0.02160	-0.02360

ENGINEER LLL
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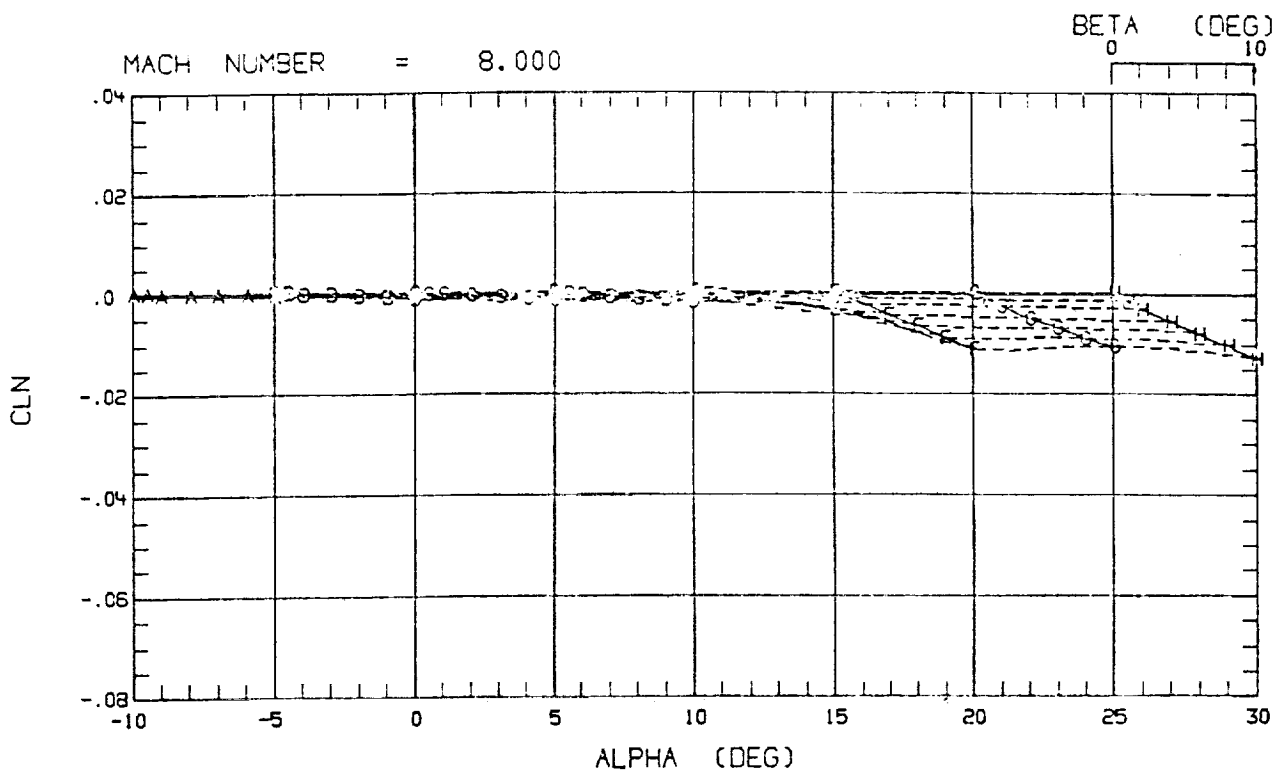
FIGURE 4.2.1.2-19
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00005	-0.00004	-0.00009	-0.00021	-0.00036	-0.00111	-0.00132	-0.00158
2.000	-0.00010	-0.00010	-0.00020	-0.00041	-0.00072	-0.00222	-0.00264	-0.00316
4.000	-0.00019	-0.00026	-0.00045	-0.00078	-0.00142	-0.00446	-0.00494	-0.00560
6.000	-0.00027	-0.00048	-0.00076	-0.00111	-0.00210	-0.00672	-0.00690	-0.00900
8.000	-0.00034	-0.00075	-0.00110	-0.00140	-0.00276	-0.00900	-0.00890	-0.01040
10.000	-0.00040	-0.00108	-0.00150	-0.00165	-0.00340	-0.01130	-0.01070	-0.01300

ENGINEER ///
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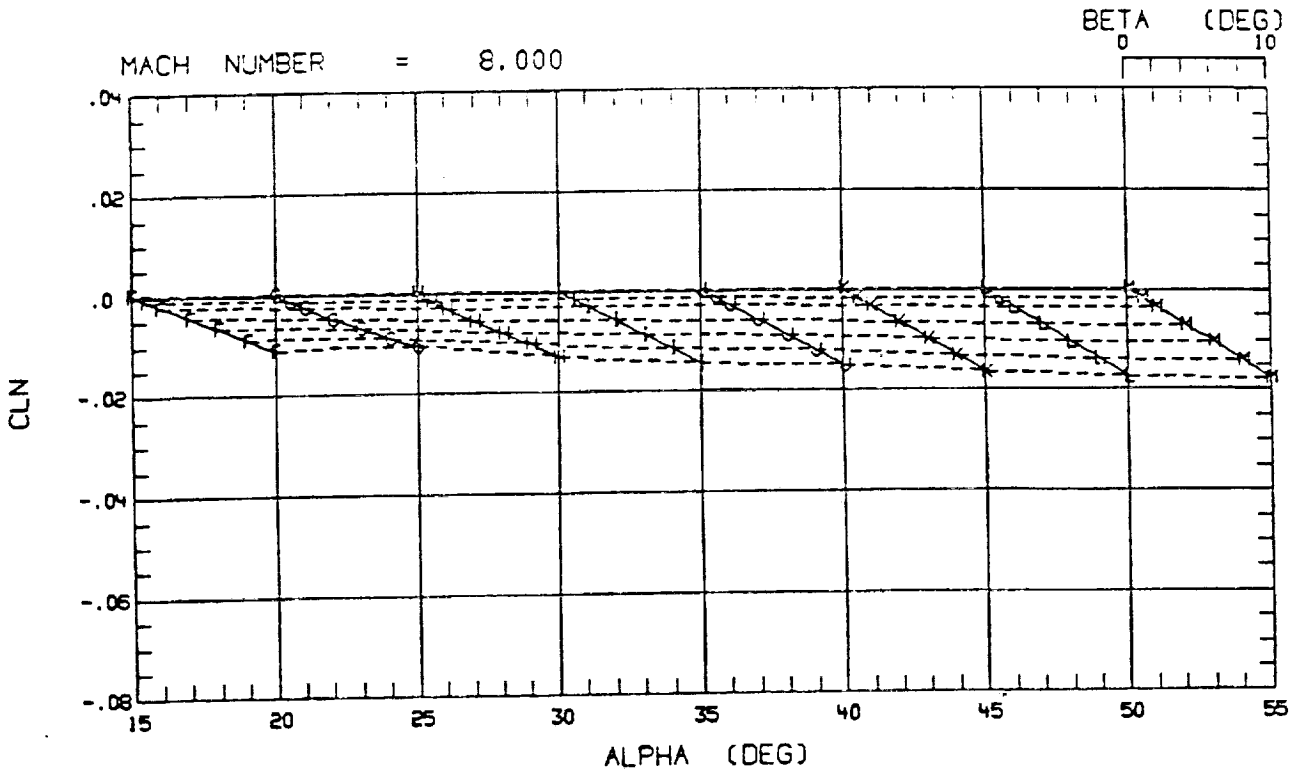
FIGURE 4.2.1.2-20
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00111	-0.00132	-0.00158	-0.00145	-0.00150	-0.00165	-0.00175	-0.00178
2.000	-0.00222	-0.00264	-0.00316	-0.00290	-0.00300	-0.00330	-0.00350	-0.00356
4.000	-0.00446	-0.00494	-0.00560	-0.00560	-0.00600	-0.00660	-0.00700	-0.00712
6.000	-0.00672	-0.00690	-0.00800	-0.00870	-0.00900	-0.00990	-0.01050	-0.01068
8.000	-0.00900	-0.00890	-0.01040	-0.01160	-0.01200	-0.01320	-0.01400	-0.01424
10.000	-0.01130	-0.01070	-0.01300	-0.01450	-0.01500	-0.01650	-0.01750	-0.01780

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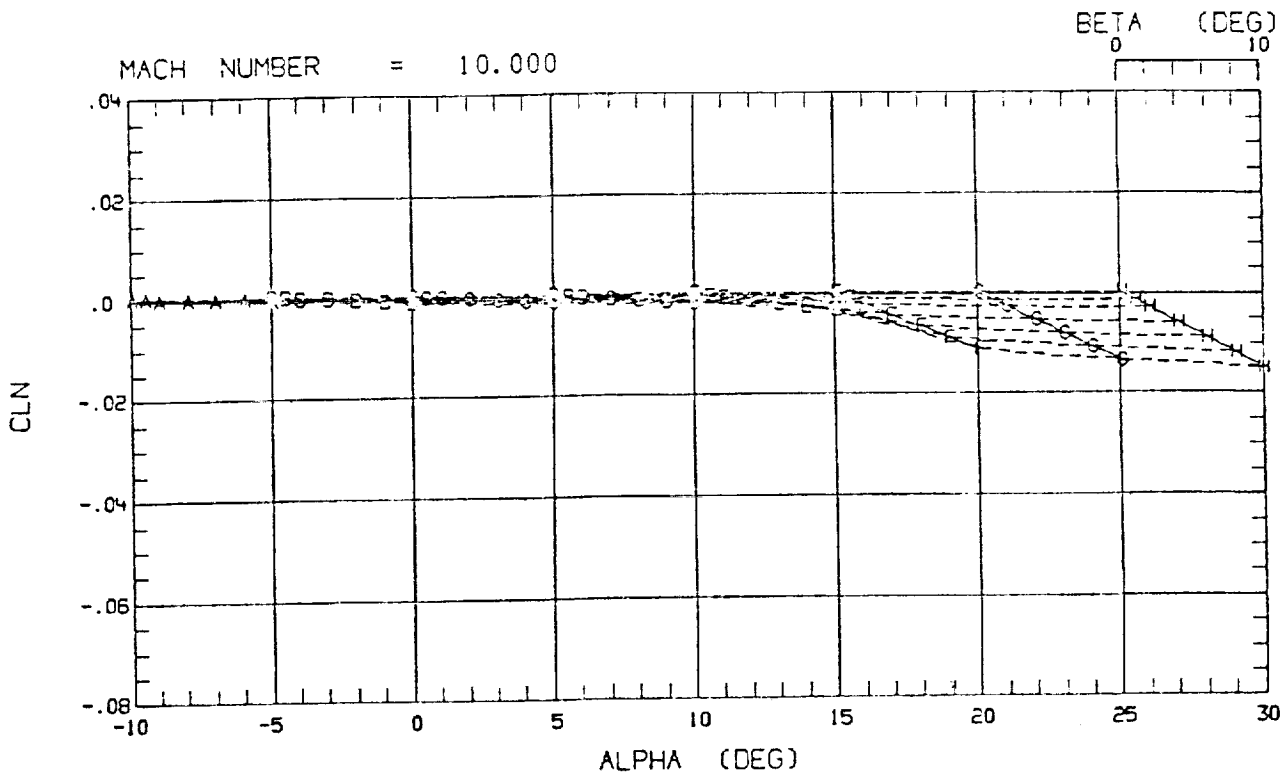
FIGURE 4.2.1.2-21
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00005	-0.00004	-0.00009	-0.00021	-0.00036	-0.00111	-0.00135	-0.00150
2.000	-0.00010	-0.00010	-0.00020	-0.00041	-0.00072	-0.00222	-0.00270	-0.00300
4.000	-0.00019	-0.00026	-0.00045	-0.00078	-0.00142	-0.00446	-0.00540	-0.00600
6.000	-0.00027	-0.00048	-0.00076	-0.00111	-0.00210	-0.00672	-0.00810	-0.00900
8.000	-0.00034	-0.00075	-0.00110	-0.00140	-0.00276	-0.00900	-0.01080	-0.01200
10.000	-0.00040	-0.00109	-0.00150	-0.00165	-0.00340	-0.01130	-0.01350	-0.01500

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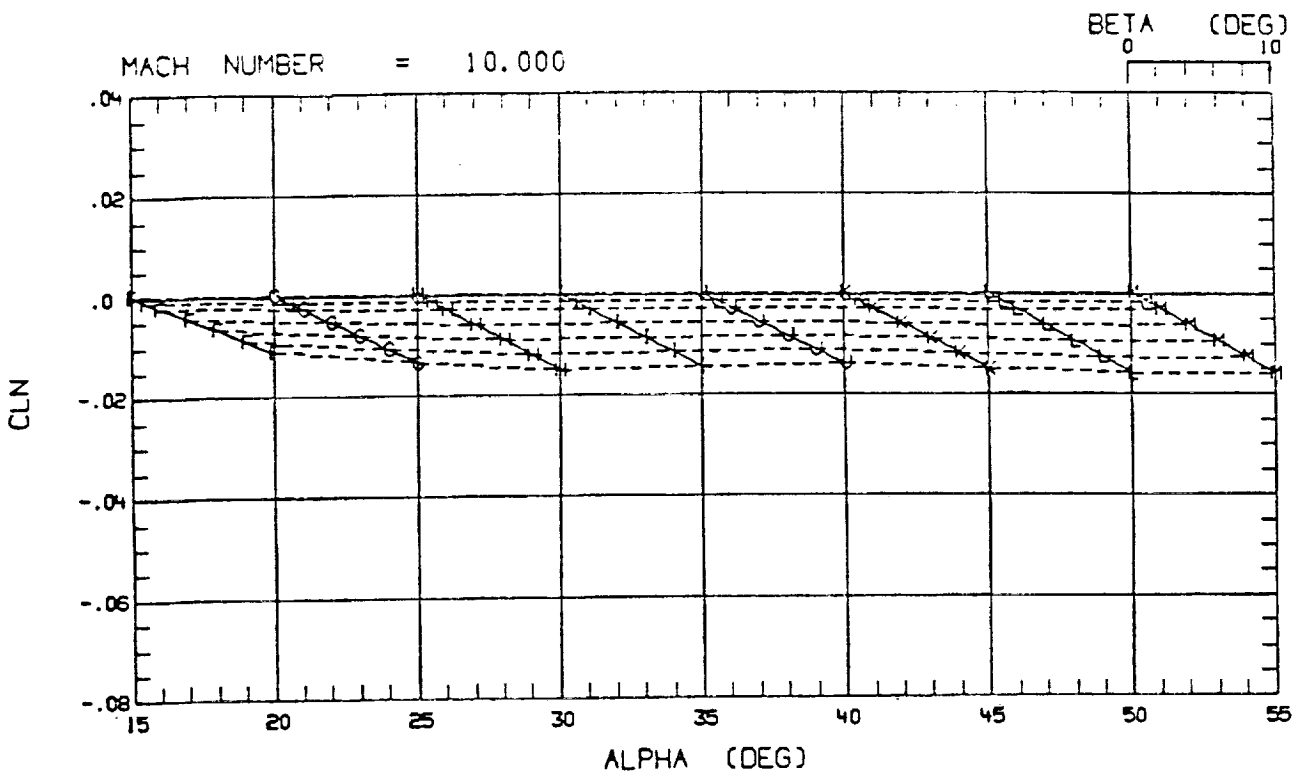
DATE 10-3-25

FIGURE 4.2.1.2-22
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00111	-0.00135	-0.00150	-0.00145	-0.00140	-0.00150	-0.00160	-0.00160
2.000	-0.00222	-0.00270	-0.00300	-0.00290	-0.00280	-0.00300	-0.00320	-0.00320
4.000	-0.00446	-0.00540	-0.00600	-0.00580	-0.00560	-0.00600	-0.00640	-0.00640
6.000	-0.00672	-0.00810	-0.00900	-0.00870	-0.00840	-0.00900	-0.00960	-0.00960
8.000	-0.00900	-0.01080	-0.01200	-0.01160	-0.01120	-0.01200	-0.01280	-0.01280
10.000	-0.01130	-0.01350	-0.01500	-0.01450	-0.01400	-0.01500	-0.01600	-0.01600

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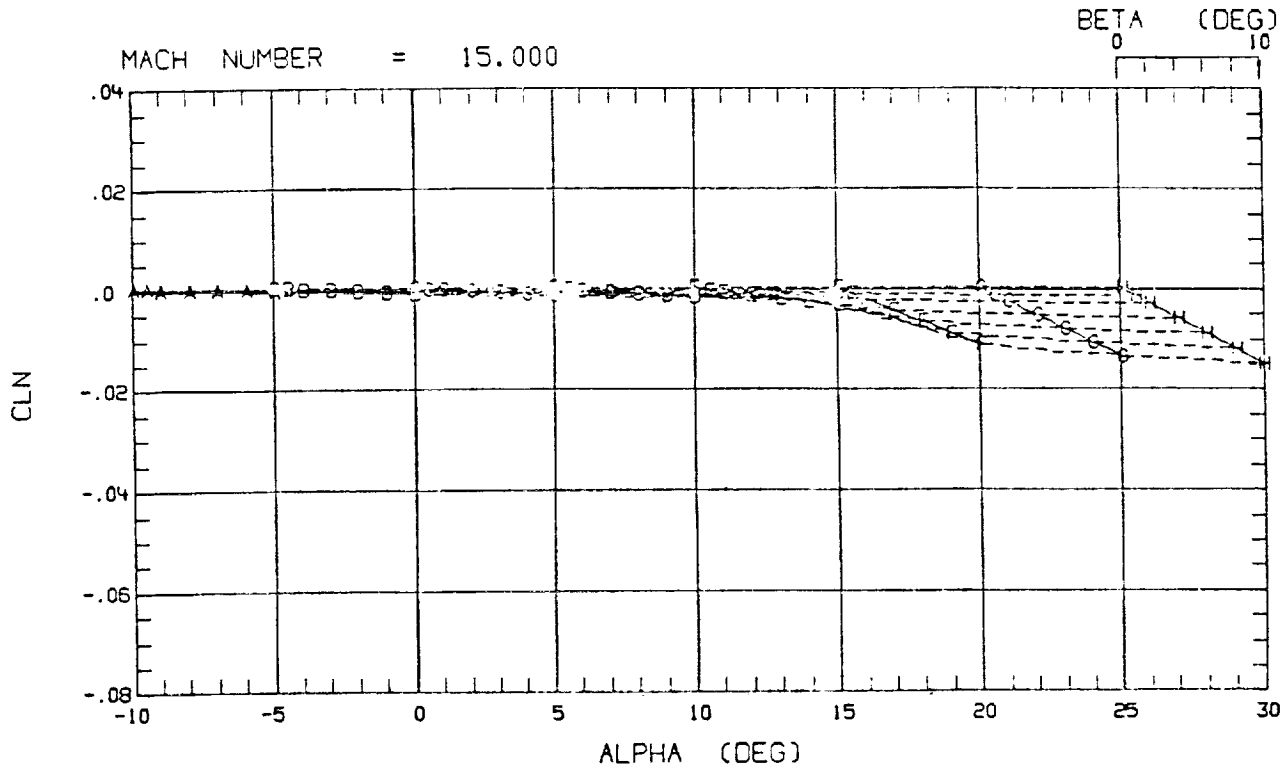
FIGURE 4.2.1.2-23
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00005	-0.00004	-0.00009	-0.00021	-0.00036	-0.00111	-0.00135	-0.00150
2.000	-0.00010	-0.00010	-0.00020	-0.00041	-0.00072	-0.00222	-0.00270	-0.00300
4.000	-0.00019	-0.00026	-0.00045	-0.00078	-0.00142	-0.00446	-0.00540	-0.00600
6.000	-0.00027	-0.00048	-0.00076	-0.00111	-0.00210	-0.00672	-0.00810	-0.00900
8.000	-0.00034	-0.00075	-0.00110	-0.00140	-0.00276	-0.00900	-0.01080	-0.01200
10.000	-0.00040	-0.00108	-0.00150	-0.00165	-0.00340	-0.01130	-0.01350	-0.01500

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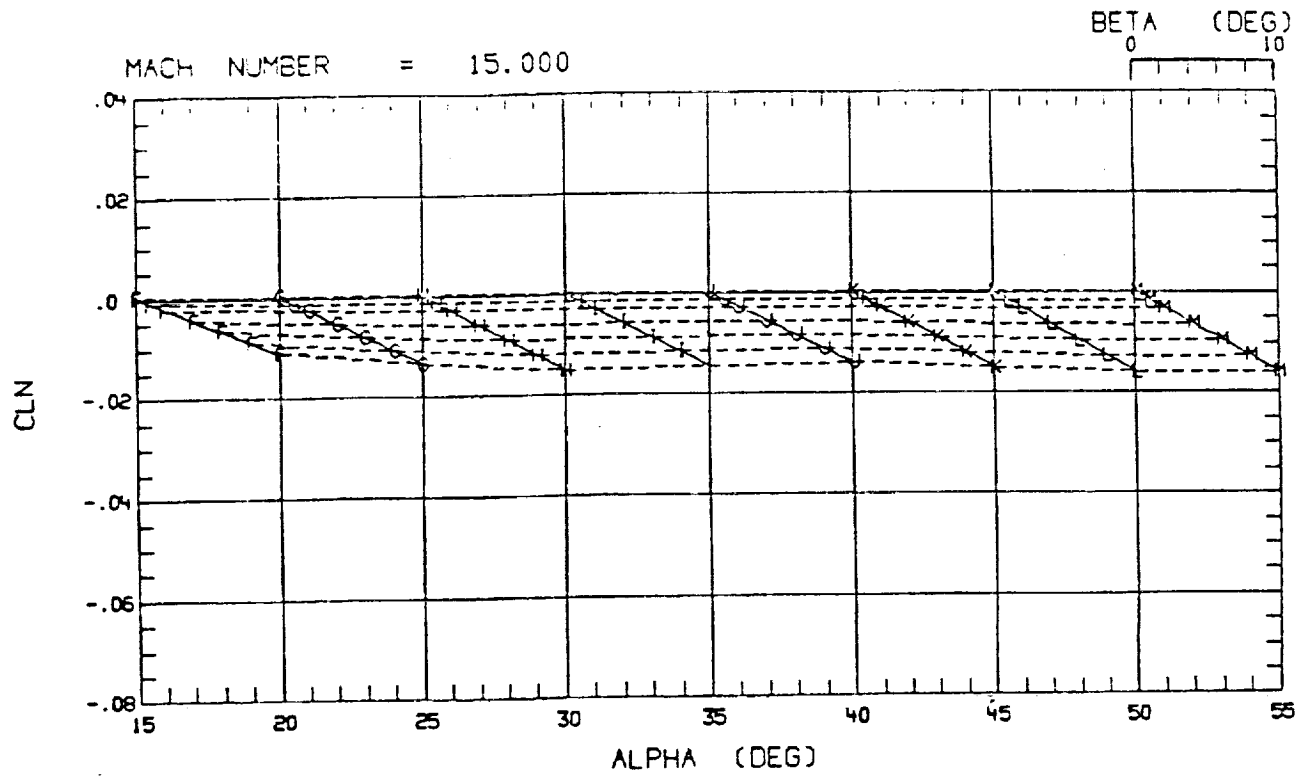
FIGURE 4.2.1.2-24
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00111	-0.00135	-0.00150	-0.00145	-0.00140	-0.00150	-0.00160	-0.00160
2.000	-0.00222	-0.00270	-0.00300	-0.00290	-0.00280	-0.00300	-0.00320	-0.00320
4.000	-0.00446	-0.00540	-0.00600	-0.00580	-0.00560	-0.00600	-0.00640	-0.00640
6.000	-0.00672	-0.00810	-0.00900	-0.00870	-0.00840	-0.00900	-0.00960	-0.00960
8.000	-0.00900	-0.01080	-0.01200	-0.01160	-0.01120	-0.01200	-0.01280	-0.01280
10.000	-0.01130	-0.01350	-0.01500	-0.01450	-0.01400	-0.01500	-0.01600	-0.01600

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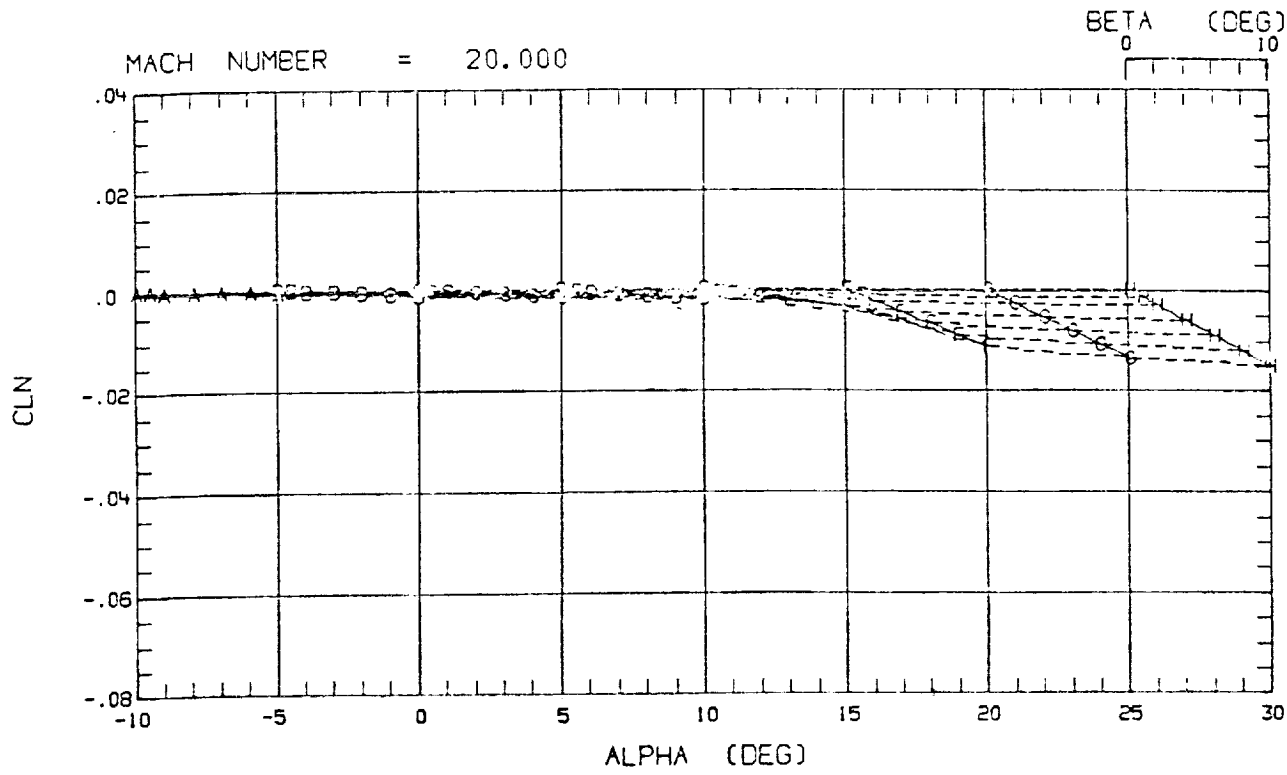
FIGURE 4.2.1.2-25
BASIC YAWING MOMENT COEFFICIENT

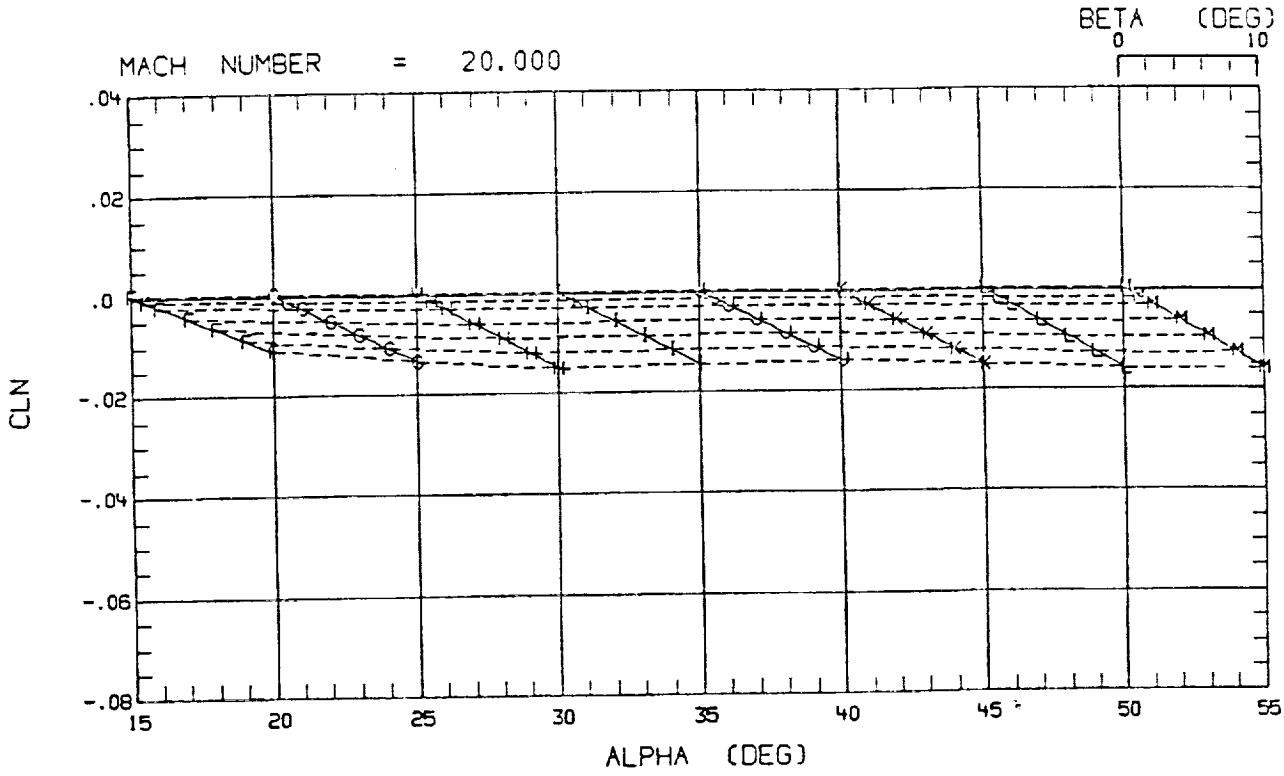


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00005	-0.00004	-0.00009	-0.00021	-0.00036	-0.00111	-0.00135	-0.00150
2.000	-0.00010	-0.00010	-0.00020	-0.00041	-0.00072	-0.00222	-0.00270	-0.00300
4.000	-0.00019	-0.00026	-0.00045	-0.00078	-0.00142	-0.00446	-0.00540	-0.00600
6.000	-0.00027	-0.00048	-0.00076	-0.00111	-0.00210	-0.00672	-0.00810	-0.00900
8.000	-0.00034	-0.00075	-0.00110	-0.00140	-0.00276	-0.00900	-0.01080	-0.01200
10.000	-0.00040	-0.00108	-0.00150	-0.00165	-0.00340	-0.01130	-0.01350	-0.01500

ENGINEER
DATE 6-3-78

FIGURE 4.2.1.2-26
BASIC YAWING MOMENT COEFFICIENT

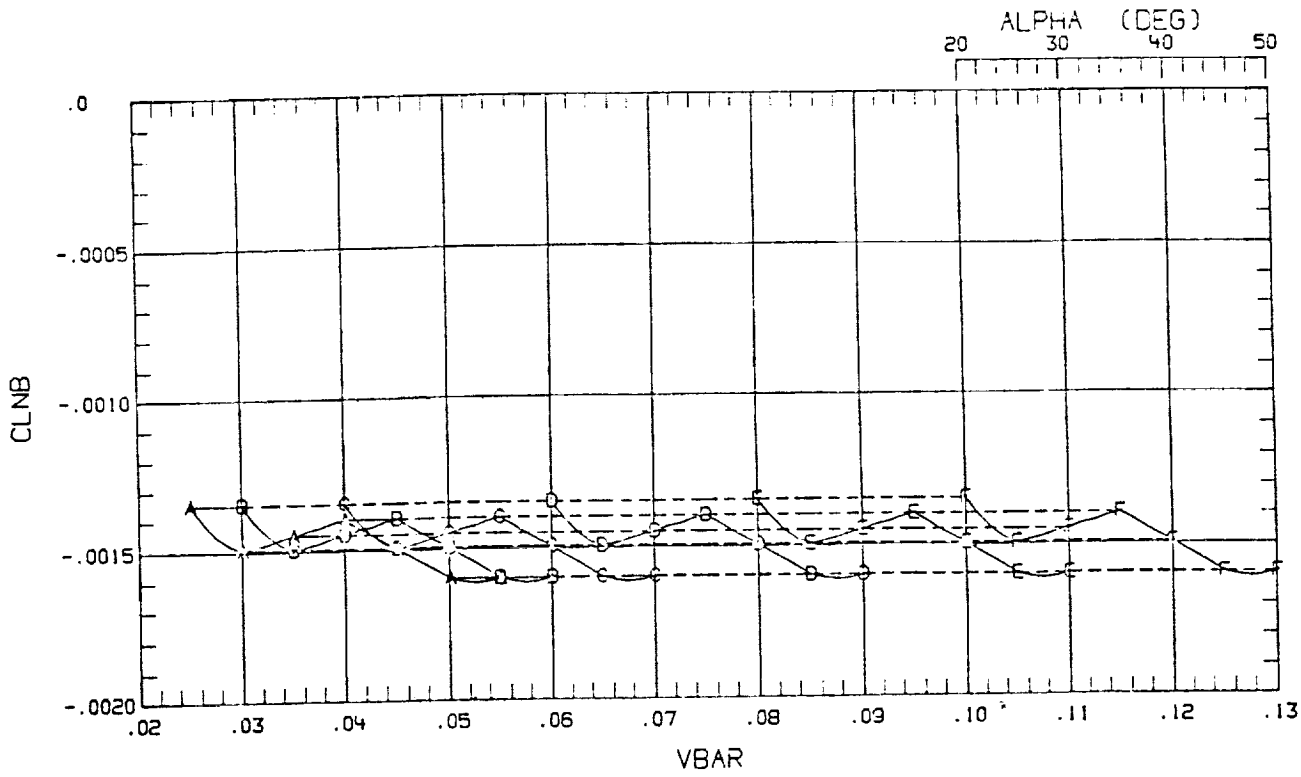


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC YAWING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00111	-0.00135	-0.00150	-0.00145	-0.00140	-0.00150	-0.00160	-0.00160
2.000	-0.00222	-0.00270	-0.00300	-0.00290	-0.00280	-0.00300	-0.00320	-0.00320
4.000	-0.00446	-0.00540	-0.00600	-0.00580	-0.00560	-0.00600	-0.00640	-0.00640
6.000	-0.00672	-0.00810	-0.00900	-0.00870	-0.00840	-0.00900	-0.00960	-0.00960
8.000	-0.00900	-0.01080	-0.01200	-0.01160	-0.01120	-0.01200	-0.01280	-0.01280
10.000	-0.01130	-0.01350	-0.01500	-0.01450	-0.01400	-0.01500	-0.01600	-0.01600

ENGINEER LL
DATE 6-2-28

FIGURE 4.2.1.2-27
BASIC YAWING MOMENT COEFFICIENT



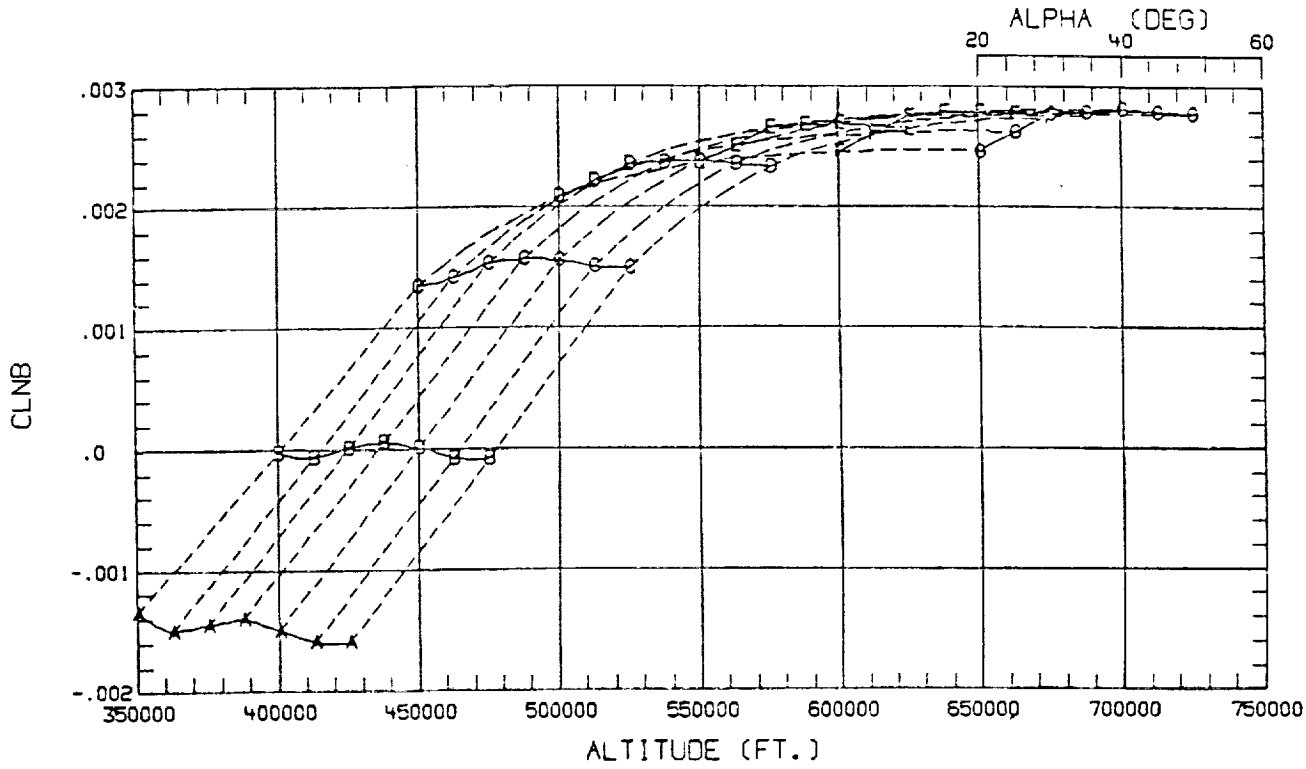
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005 A	0.010 B	0.020 C	0.040 D	0.060 E	0.080 F
ALPHA (DEG)	VISCOUS YAWING MOMENT DERIVATIVE					
20.000	-0.00135	-0.00135	-0.00135	-0.00135	-0.00135	-0.00135
25.000	-0.00150	-0.00150	-0.00150	-0.00150	-0.00150	-0.00150
30.000	-0.00145	-0.00145	-0.00145	-0.00145	-0.00145	-0.00145
35.000	-0.00140	-0.00140	-0.00140	-0.00140	-0.00140	-0.00140
40.000	-0.00150	-0.00150	-0.00150	-0.00150	-0.00150	-0.00150
45.000	-0.00160	-0.00160	-0.00160	-0.00160	-0.00160	-0.00160
50.000	-0.00160	-0.00160	-0.00160	-0.00160	-0.00160	-0.00160

ENGINEER NASA
DATE

FIGURE 4.2.1.2-28
BASIC YAWING MOMENT COEFFICIENT

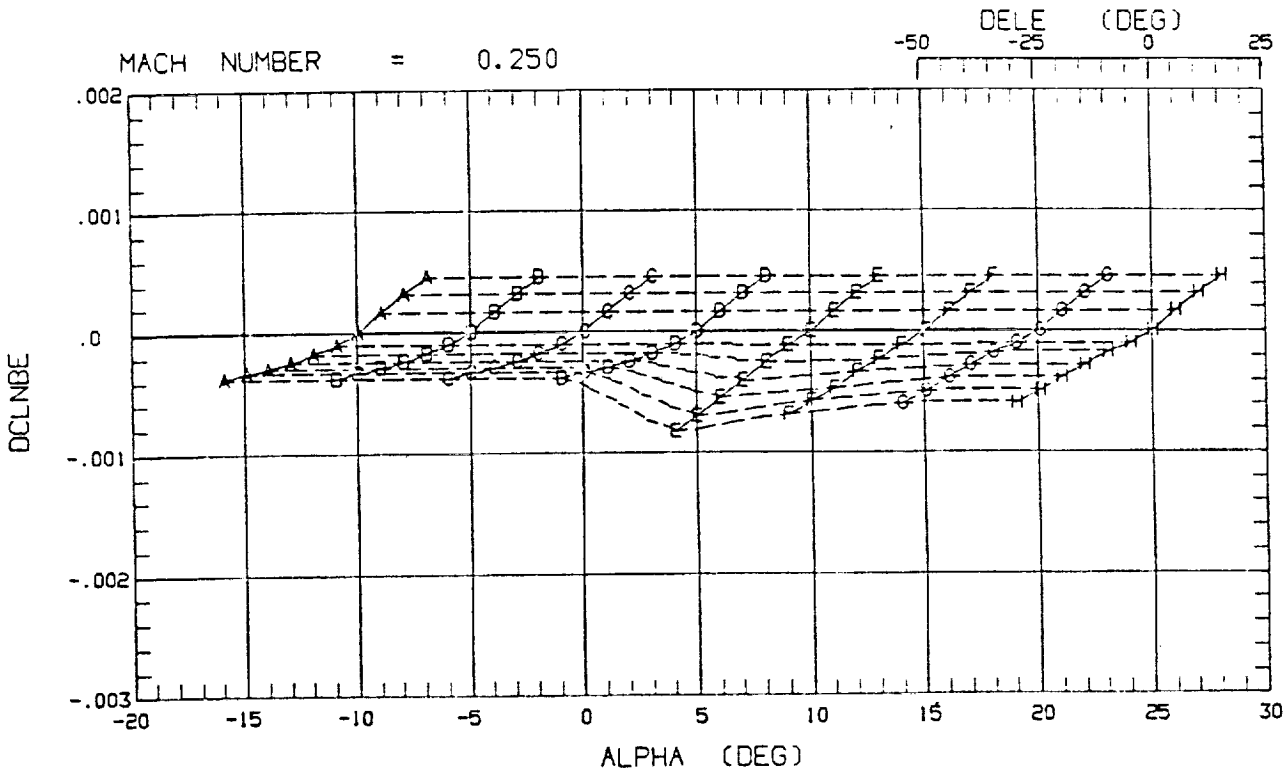


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALT. YAWING MOMENT DERIVATI						
20.000	-0.00135	-0.00003	0.00134	0.00208	0.00236	0.00245	0.00246
25.000	-0.00150	-0.00007	0.00141	0.00221	0.00251	0.00261	0.00262
30.000	-0.00145	0.00001	0.00153	0.00235	0.00266	0.00275	0.00277
35.000	-0.00140	0.00005	0.00156	0.00237	0.00268	0.00278	0.00279
40.000	-0.00150	0.0	0.00155	0.00238	0.00269	0.00279	0.00281
45.000	-0.00160	-0.00008	0.00150	0.00235	0.00267	0.00277	0.00279
50.000	-0.00160	-0.00009	0.00149	0.00233	0.00265	0.00275	0.00277

ENGINEER NASA
DATE

FIGURE 4.2.1.2-29
BASIC YAWING MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

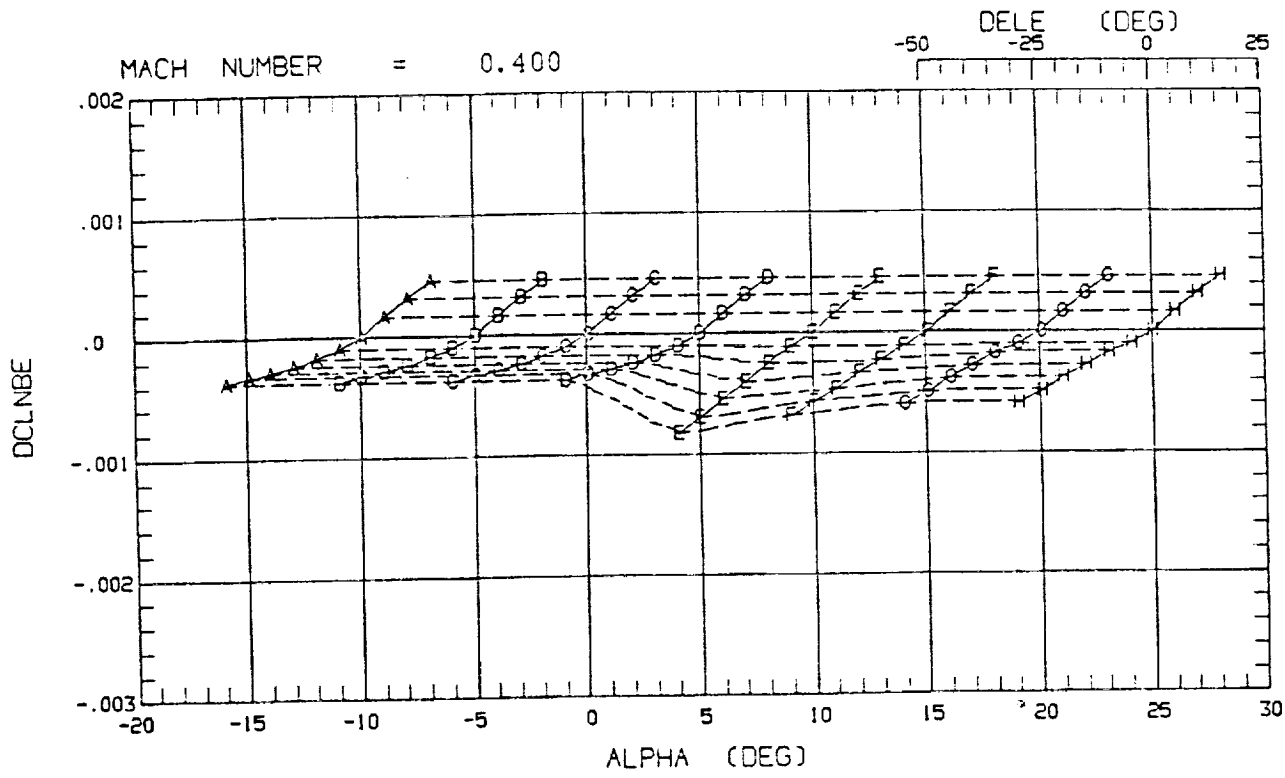
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	-0.00038	-0.00038	-0.00038	-0.00038	-0.00083	-0.00069	-0.00060	-0.00060
-25.000	-0.00034	-0.00034	-0.00034	-0.00034	-0.00070	-0.00058	-0.00050	-0.00050
-20.000	-0.00030	-0.00030	-0.00030	-0.00030	-0.00055	-0.00047	-0.00039	-0.00039
-15.000	-0.00025	-0.00025	-0.00025	-0.00025	-0.00041	-0.00034	-0.00029	-0.00029
-10.000	-0.00018	-0.00018	-0.00018	-0.00018	-0.00026	-0.00023	-0.00018	-0.00018
-5.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00012	-0.00012	-0.00011	-0.00011
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
10.000	0.00031	0.00031	0.00031	0.00031	0.00031	0.00031	0.00031	0.00031
15.000	0.00045	0.00045	0.00045	0.00045	0.00045	0.00045	0.00045	0.00045

ENGINEER HP
DATE 2/5/78

FIGURE 4.2.1.2-30
EFFECT OF ELEVON



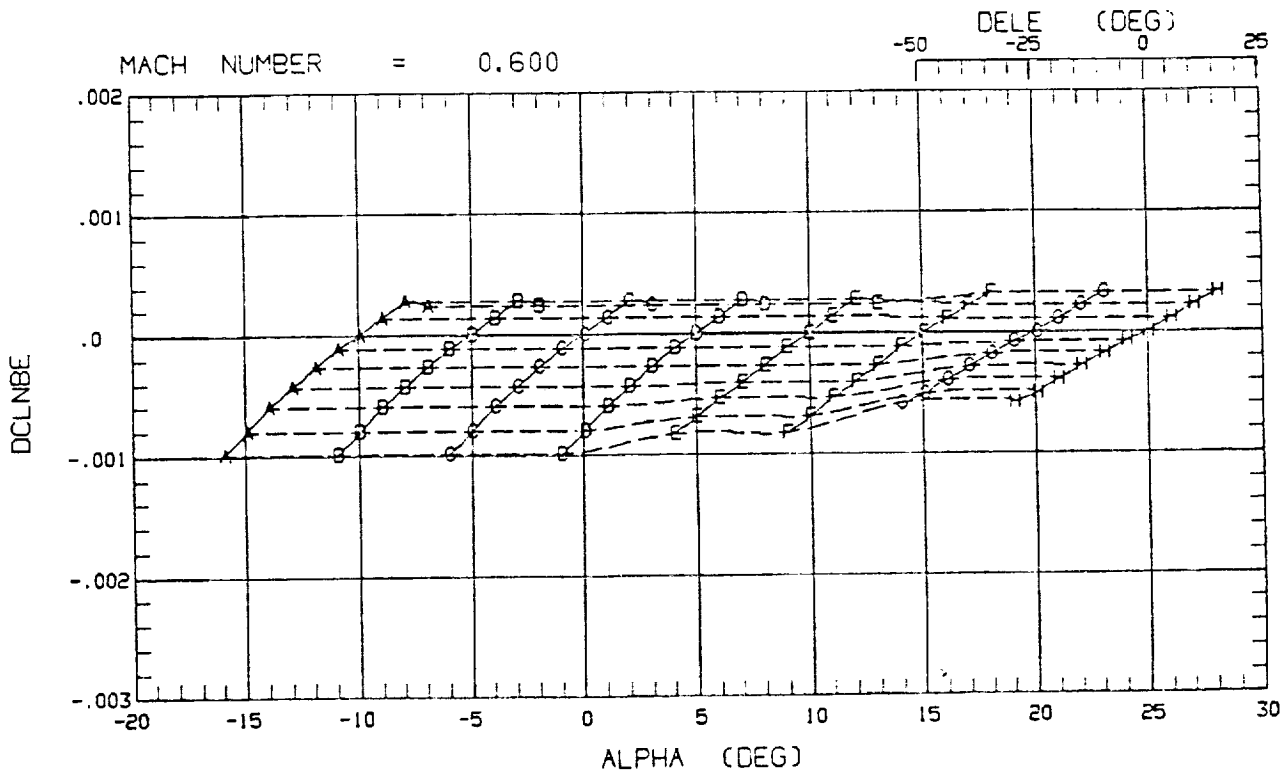
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	-0.00038	-0.00038	-0.00038	-0.00038	-0.00083	-0.00069	-0.00060	-0.00060
-25.000	-0.00034	-0.00034	-0.00034	-0.00034	-0.00070	-0.00058	-0.00050	-0.00050
-20.000	-0.00030	-0.00030	-0.00030	-0.00030	-0.00055	-0.00047	-0.00039	-0.00039
-15.000	-0.00025	-0.00025	-0.00025	-0.00025	-0.00041	-0.00034	-0.00029	-0.00029
-10.000	-0.00018	-0.00018	-0.00018	-0.00018	-0.00026	-0.00023	-0.00018	-0.00018
-5.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00012	-0.00012	-0.00011	-0.00011
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
10.000	0.00031	0.00031	0.00031	0.00031	0.00031	0.00031	0.00031	0.00031
15.000	0.00045	0.00045	0.00045	0.00045	0.00045	0.00045	0.00045	0.00045

ENGINEER HP
DATE 10/2/78

FIGURE 4.2.1.2-31
EFFECT OF ELEVON

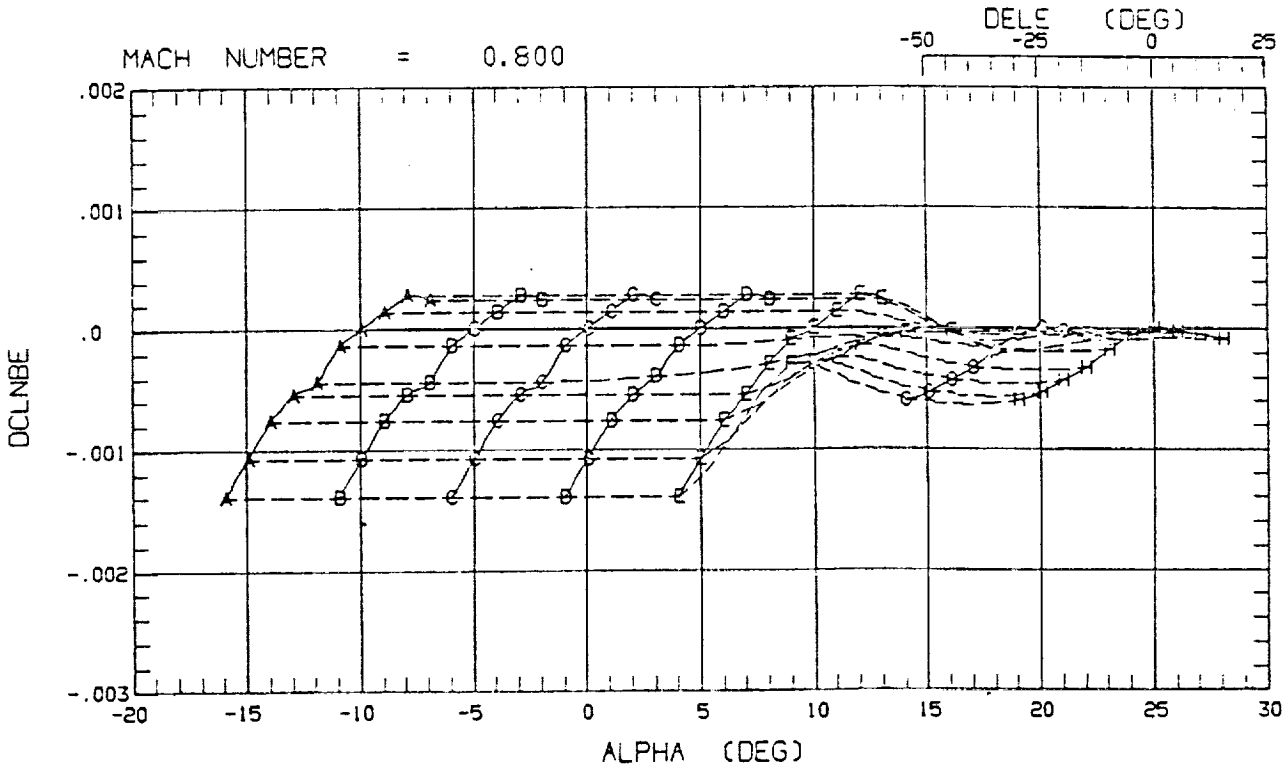


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	-0.00100	-0.00100	-0.00100	-0.00100	-0.00083	-0.00083	-0.00059	-0.00059
-25.000	-0.00080	-0.00080	-0.00080	-0.00080	-0.00069	-0.00069	-0.00051	-0.00051
-20.000	-0.00060	-0.00060	-0.00060	-0.00060	-0.00054	-0.00054	-0.00040	-0.00040
-15.000	-0.00044	-0.00044	-0.00044	-0.00044	-0.00041	-0.00041	-0.00029	-0.00029
-10.000	-0.00027	-0.00027	-0.00027	-0.00027	-0.00027	-0.00027	-0.00018	-0.00018
-5.000	-0.00012	-0.00012	-0.00012	-0.00012	-0.00012	-0.00012	-0.00008	-0.00008
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00014	0.00014	0.00014	0.00014	0.00014	0.00011	0.00011	0.00011
10.000	0.00027	0.00027	0.00027	0.00027	0.00027	0.00022	0.00022	0.00022
15.000	0.00024	0.00024	0.00024	0.00024	0.00024	0.00032	0.00032	0.00032

ENGINEER HP
DATE 10/2/75

FIGURE 4.2.1.2-32
EFFECT OF ELEVON



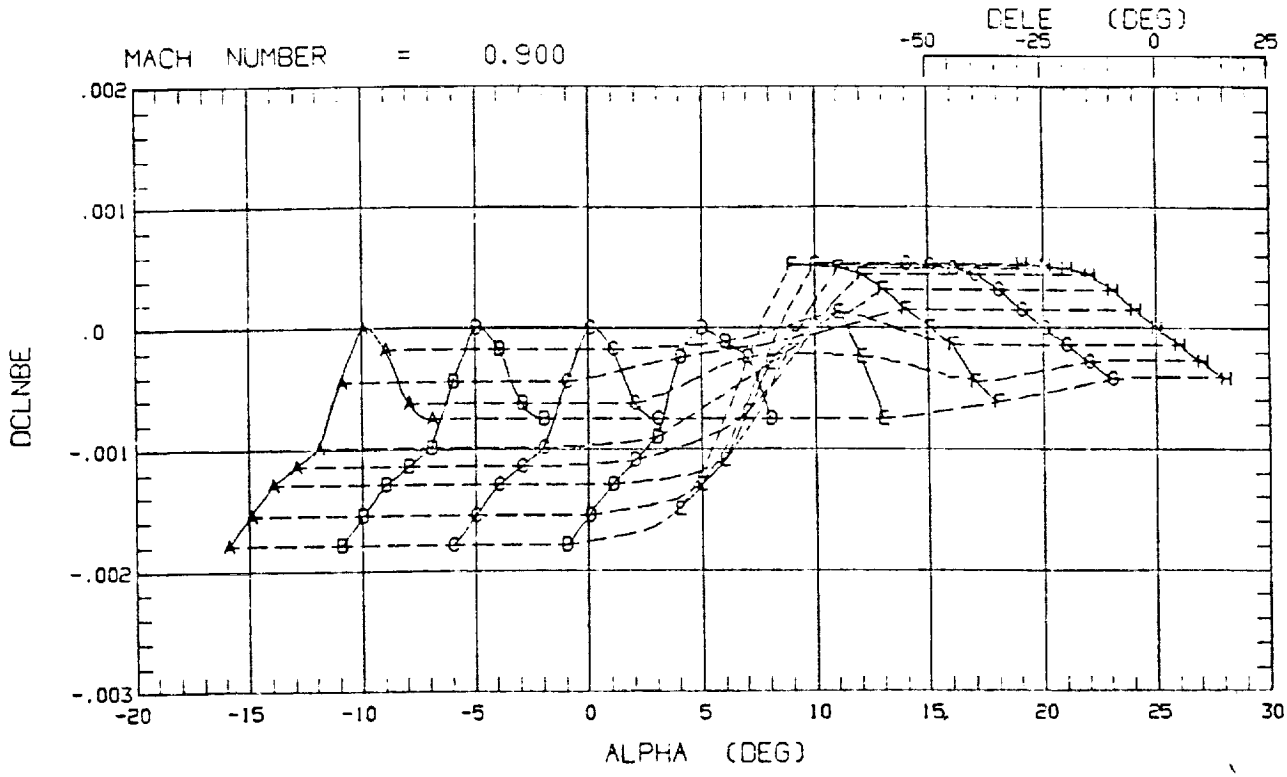
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	-0.00140	-0.00140	-0.00140	-0.00140	-0.00140	-0.00030	-0.00060	-0.00060
-25.000	-0.00108	-0.00108	-0.00108	-0.00108	-0.00108	-0.00028	-0.00054	-0.00054
-20.000	-0.00077	-0.00077	-0.00077	-0.00077	-0.00077	-0.00025	-0.00044	-0.00044
-15.000	-0.00055	-0.00055	-0.00055	-0.00055	-0.00055	-0.00015	-0.00033	-0.00033
-10.000	-0.00045	-0.00045	-0.00045	-0.00040	-0.00030	-0.00008	-0.00018	-0.00018
-5.000	-0.00015	-0.00015	-0.00015	-0.00015	-0.00010	-0.00004	-0.00006	-0.00006
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00014	0.00014	0.00014	0.00014	0.00014	-0.00003	-0.00003	-0.00003
10.000	0.00027	0.00027	0.00027	0.00027	0.00027	-0.00011	-0.00005	-0.00005
15.000	0.00024	0.00024	0.00024	0.00024	0.00024	-0.00021	-0.00010	-0.00010

ENGINEER MP
DATE 10/2/78

FIGURE 4.2.1.2- 33
EFFECT OF ELEVON



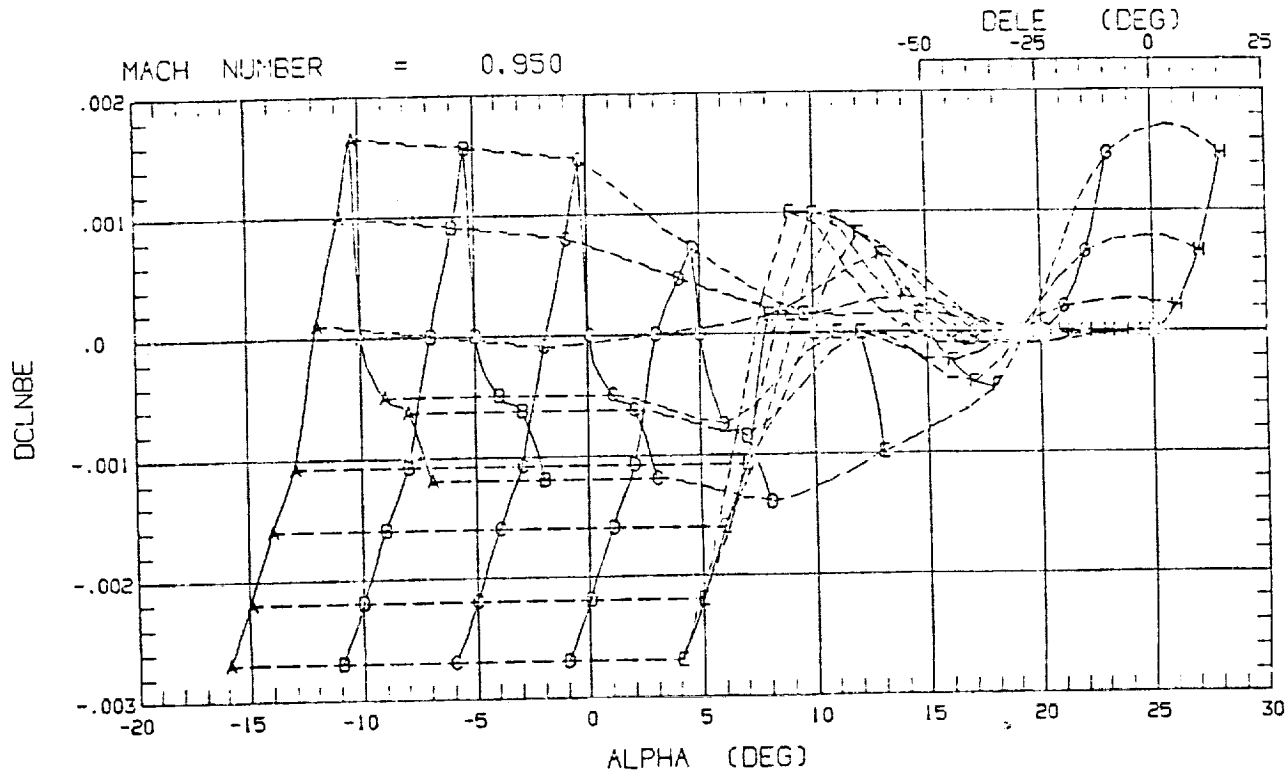
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XC = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YC = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZC = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	-0.00180	-0.00180	-0.00180	-0.00180	-0.00150	0.00051	0.00053	0.00053
-25.000	-0.00155	-0.00155	-0.00155	-0.00155	-0.00130	0.00051	0.00051	0.00051
-20.000	-0.00130	-0.00130	-0.00130	-0.00130	-0.00110	0.00049	0.00049	0.00049
-15.000	-0.00115	-0.00115	-0.00115	-0.00110	-0.00070	0.00044	0.00044	0.00044
-10.000	-0.00100	-0.00100	-0.00100	-0.00090	-0.00030	0.00031	0.00031	0.00031
-5.000	-0.00045	-0.00045	-0.00045	-0.00025	-0.00010	0.00015	0.00015	0.00015
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00018	-0.00018	-0.00018	-0.00012	0.00012	-0.00015	-0.00015	-0.00015
10.000	-0.00063	-0.00063	-0.00063	-0.00025	-0.00025	-0.00045	-0.00029	-0.00029
15.000	-0.00075	-0.00075	-0.00075	-0.00075	-0.00075	-0.00061	-0.00043	-0.00043

ENGINEER HP
DATE 12/2/13

FIGURE 4.2.1.2-34
EFFECT OF ELEVON



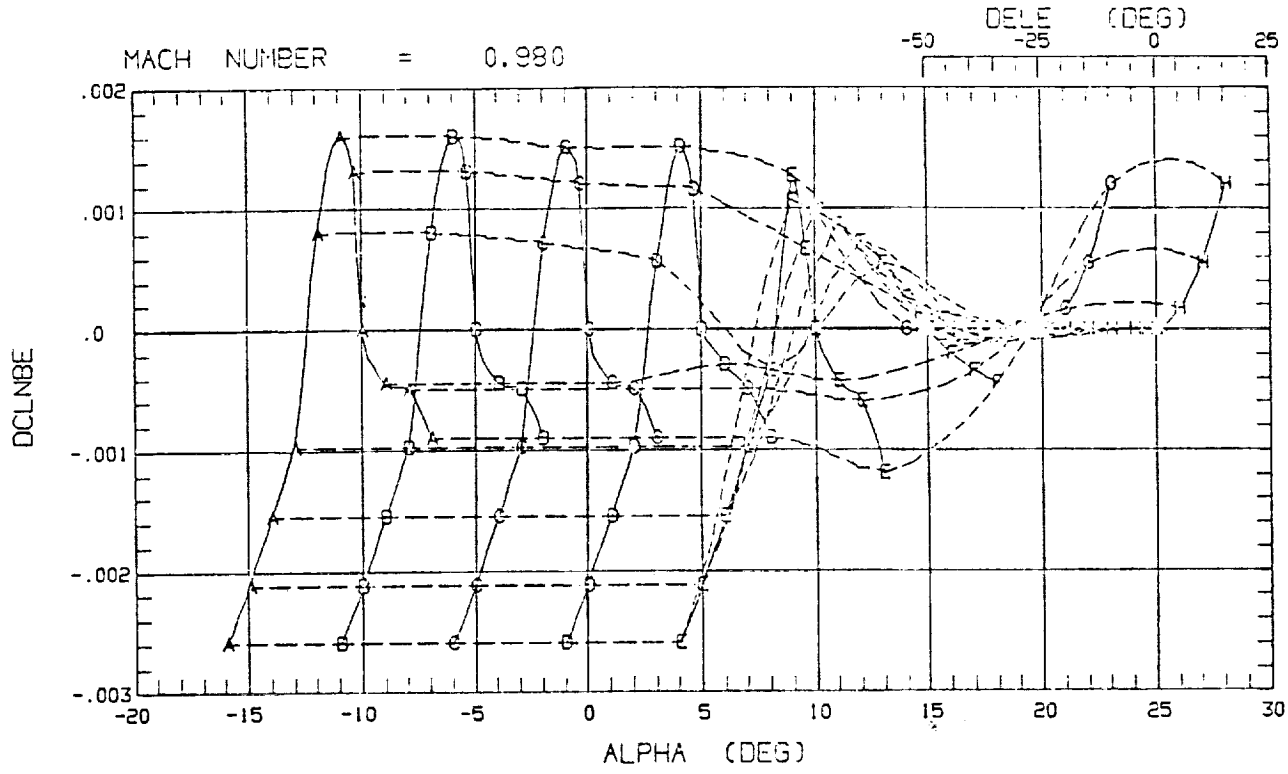
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	-0.00270	-0.00270	-0.00270	-0.00270	-0.00270	0.00100	0.0	0.0
-25.000	-0.00220	-0.00220	-0.00220	-0.00220	-0.00220	0.00099	0.0	0.0
-20.000	-0.00160	-0.00160	-0.00160	-0.00160	-0.00160	0.00095	0.0	0.0
-15.000	-0.00108	-0.00108	-0.00108	-0.00108	-0.00108	0.00082	0.0	0.0
-10.000	0.00010	0.0	-0.00010	0.0	0.00015	0.00064	0.0	0.0
-5.000	0.00100	0.00090	0.00080	0.00045	0.00015	0.00029	0.0	0.0
-2.000	0.00165	0.00155	0.00145	0.00070	0.00015	0.00015	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00050	-0.00050	-0.00050	-0.00075	0.0	-0.00026	0.00020	0.00020
10.000	-0.00063	-0.00063	-0.00063	-0.00085	0.0	-0.00042	0.00065	0.00065
15.000	-0.00120	-0.00120	-0.00120	-0.00140	-0.00100	-0.00045	0.00147	0.00147

ENGINEER AO
DATE 3/22/78

FIGURE 4.2.1.2-35
EFFECT OF ELEVON



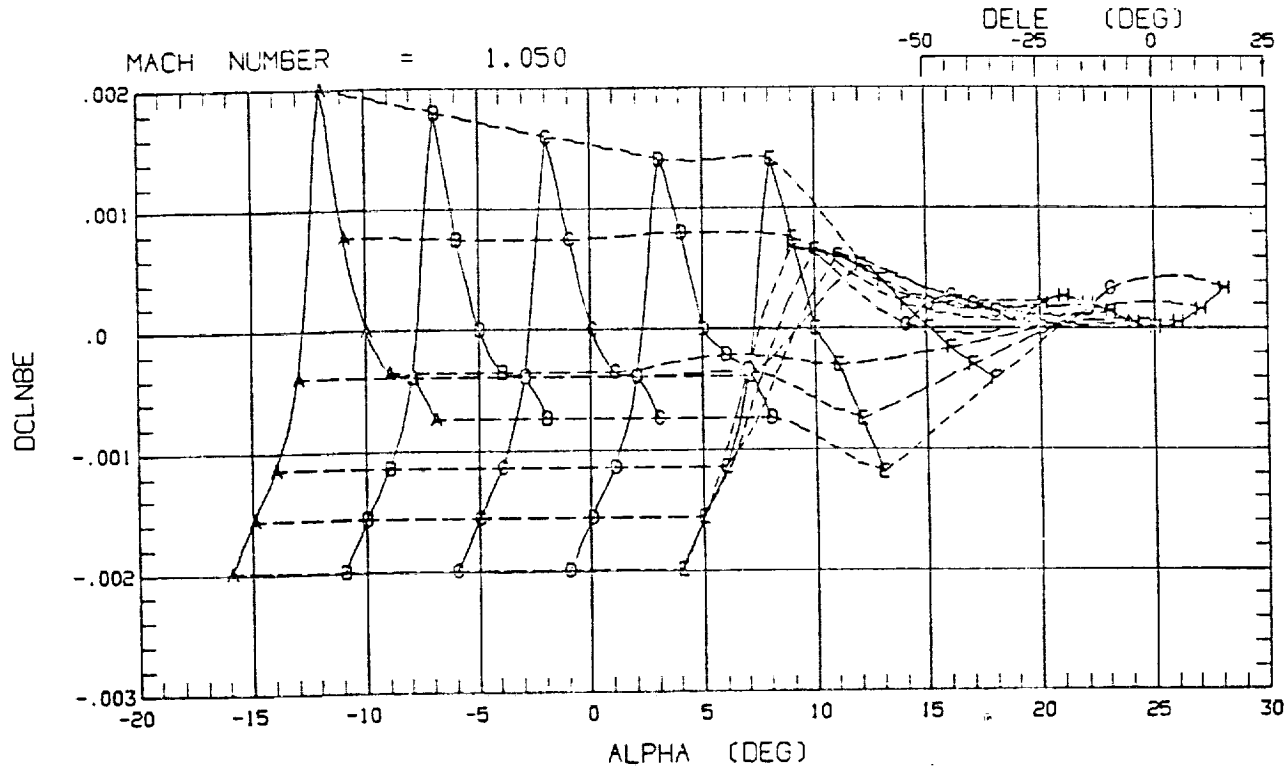
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	-0.00260	-0.00250	-0.00260	-0.00260	-0.00260	0.00106	0.0	0.0
-25.000	-0.00212	-0.00212	-0.00212	-0.00212	-0.00212	0.00097	0.0	0.0
-20.000	-0.00155	-0.00155	-0.00155	-0.00155	-0.00155	0.00086	0.0	0.0
-15.000	-0.00098	-0.00098	-0.00098	-0.00098	-0.00098	0.00072	0.0	0.0
-10.000	0.00080	0.00080	0.00070	0.00055	-0.00035	0.00054	0.0	0.0
-5.000	0.00160	0.00160	0.00150	0.00150	0.00126	0.00025	0.0	0.0
-2.000	0.00130	0.00130	0.00120	0.00115	0.00065	0.00012	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00045	-0.00045	-0.00045	-0.00030	-0.00044	-0.00021	0.00016	0.00016
10.000	-0.00050	-0.00050	-0.00050	-0.00050	-0.00080	-0.00035	0.00054	0.00054
15.000	-0.00090	-0.00090	-0.00090	-0.00090	-0.00120	-0.00045	0.00120	0.00120

ENGINEER HP
DATE 8/20/79

FIGURE 4.2.1.2-36
EFFECT OF ELEVON



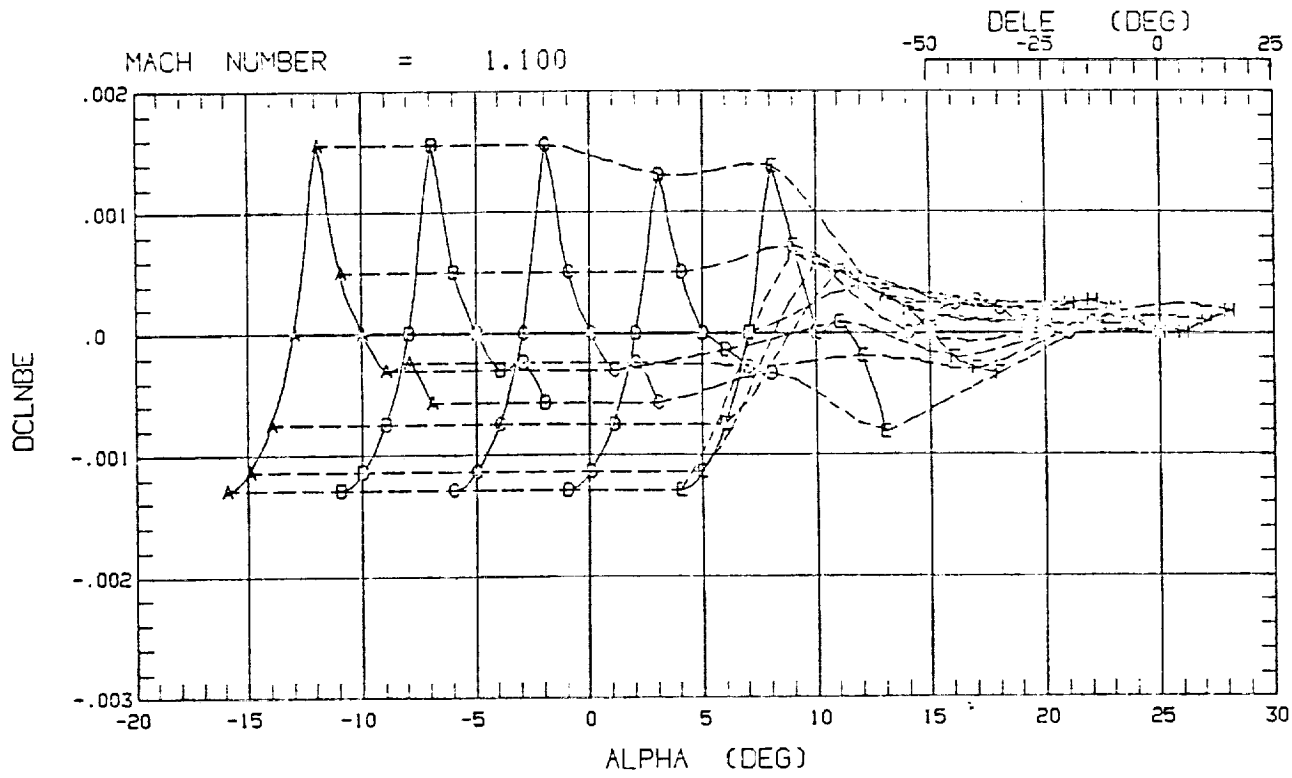
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	-0.00200	-0.00200	-0.00200	-0.00200	-0.00200	0.00067	0.00002	0.00002
-25.000	-0.00157	-0.00157	-0.00157	-0.00157	-0.00157	0.00064	0.00020	0.00020
-20.000	-0.00115	-0.00115	-0.00115	-0.00115	-0.00115	0.00059	0.00026	0.00026
-15.000	-0.00040	-0.00040	-0.00040	-0.00040	-0.00040	0.00051	0.00020	0.00020
-10.000	0.00200	0.00180	0.00160	0.00140	0.00140	0.00039	0.00013	0.00013
-5.000	0.00077	0.00075	0.00075	0.00080	0.00075	0.00018	0.00004	0.00004
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00036	-0.00036	-0.00036	-0.00022	-0.00031	-0.00017	0.00004	0.00004
10.000	-0.00040	-0.00040	-0.00040	-0.00035	-0.00075	-0.00031	0.00015	0.00015
15.000	-0.00074	-0.00074	-0.00074	-0.00074	-0.00120	-0.00042	0.00033	0.00033

ENGINEER MP
DATE 10/2/73

FIGURE 4.2.1.2-37
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

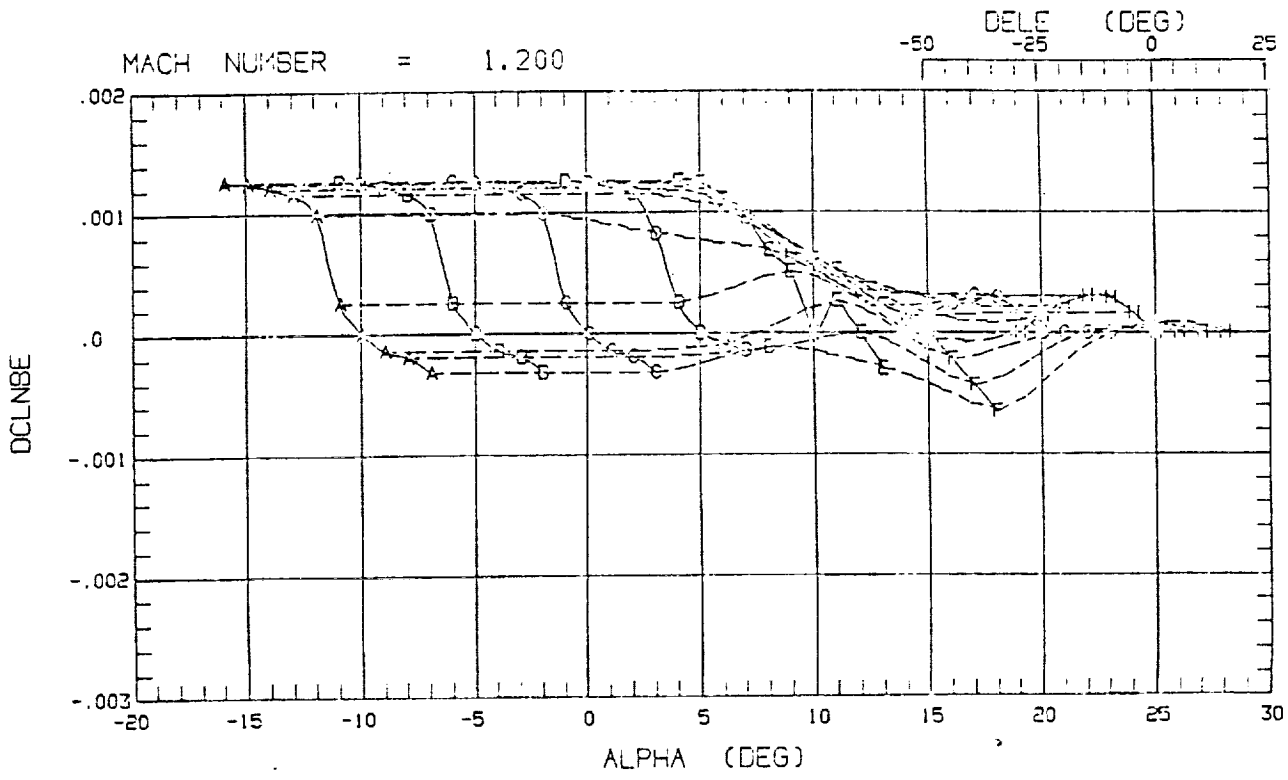
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT DERIVATIVE							
-30.000	-0.00130	-0.00130	-0.00130	-0.00130	-0.00130	0.00085	0.0	0.0
-25.000	-0.00115	-0.00115	-0.00115	-0.00115	-0.00115	0.00057	0.00014	0.00014
-20.000	-0.00075	-0.00075	-0.00075	-0.00075	-0.00075	0.00050	0.00024	0.00024
-15.000	0.0	0.0	0.0	0.0	0.0	0.00040	0.00026	0.00026
-10.000	0.00155	0.00155	0.00155	0.00130	0.00138	0.00030	0.00020	0.00020
-5.000	0.00050	0.00050	0.00050	0.00050	0.00072	0.00019	0.00008	0.00008
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00031	-0.00031	-0.00031	-0.00014	0.00008	-0.00021	0.0	0.0
10.000	-0.00025	-0.00025	-0.00025	-0.00028	-0.00020	-0.00030	0.00009	0.00009
15.000	-0.00058	-0.00058	-0.00058	-0.00033	-0.00082	-0.00033	0.00017	0.00017

ENGINEER HP
DATE 10/21/82

FIGURE 4.2.1.2-38
EFFECT OF ELEVON



CONFIGURATION

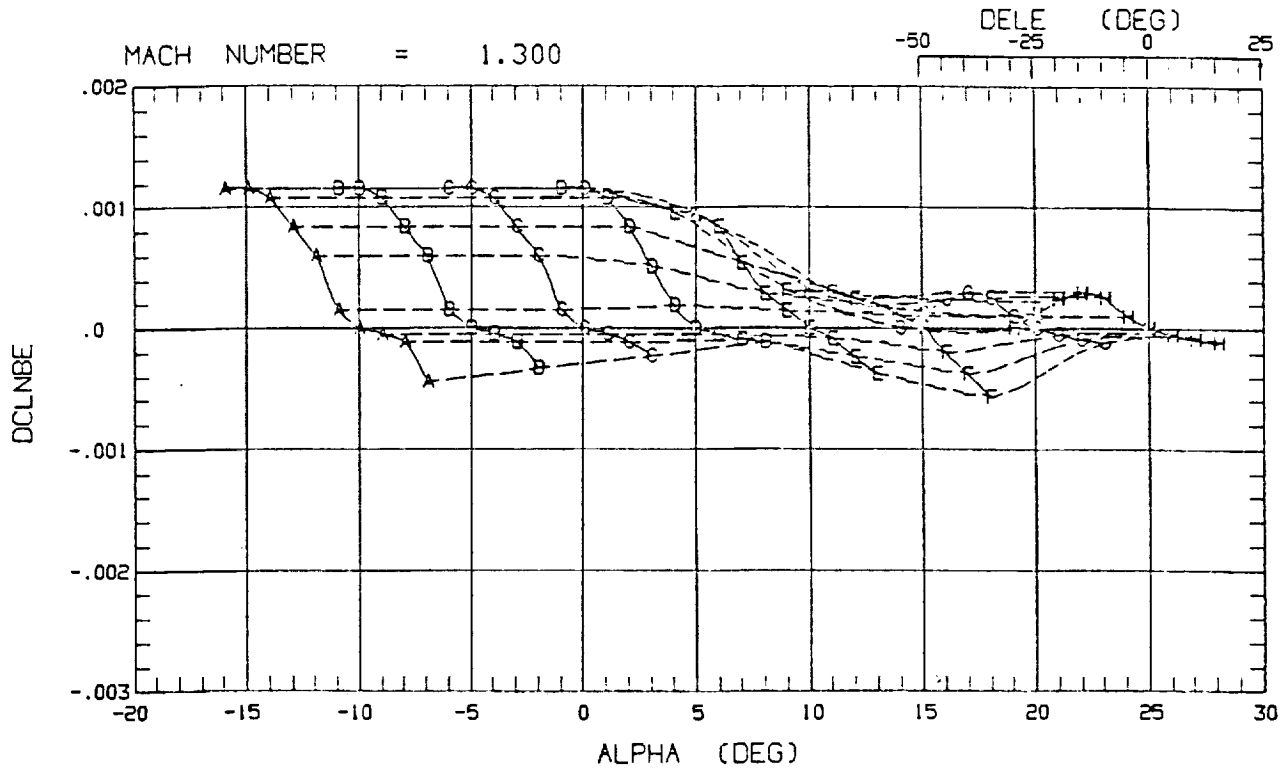
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.580 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT DERIVATIVE							
-30.000	0.00125	0.00125	0.00125	0.00125	0.00125	0.00066	0.0	0.0
-25.000	0.00124	0.00124	0.00124	0.00124	0.00124	0.00061	0.00014	0.00014
-20.000	0.00120	0.00120	0.00120	0.00120	0.00110	0.00051	0.00024	0.00024
-15.000	0.00115	0.00115	0.00115	0.00115	0.00095	0.00035	0.00030	0.00030
-10.000	0.00099	0.00099	0.00099	0.00092	0.00068	0.00022	0.00029	0.00029
-5.000	0.00025	0.00025	0.00025	0.00025	0.00050	0.00013	0.00016	0.00016
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00015	-0.00015	-0.00015	-0.00003	0.00026	-0.00022	0.0	0.0
10.000	-0.00020	-0.00020	-0.00020	-0.00015	0.0	-0.00044	0.0	0.0
15.000	-0.00032	-0.00032	-0.00032	-0.00012	-0.00030	-0.00065	0.0	0.0

ENGINEER HP
DATE 10/27/78

FIGURE 4.2.1.2-39
EFFECT OF ELEVON

SL 77-SH-0000 IM



CONFIGURATION

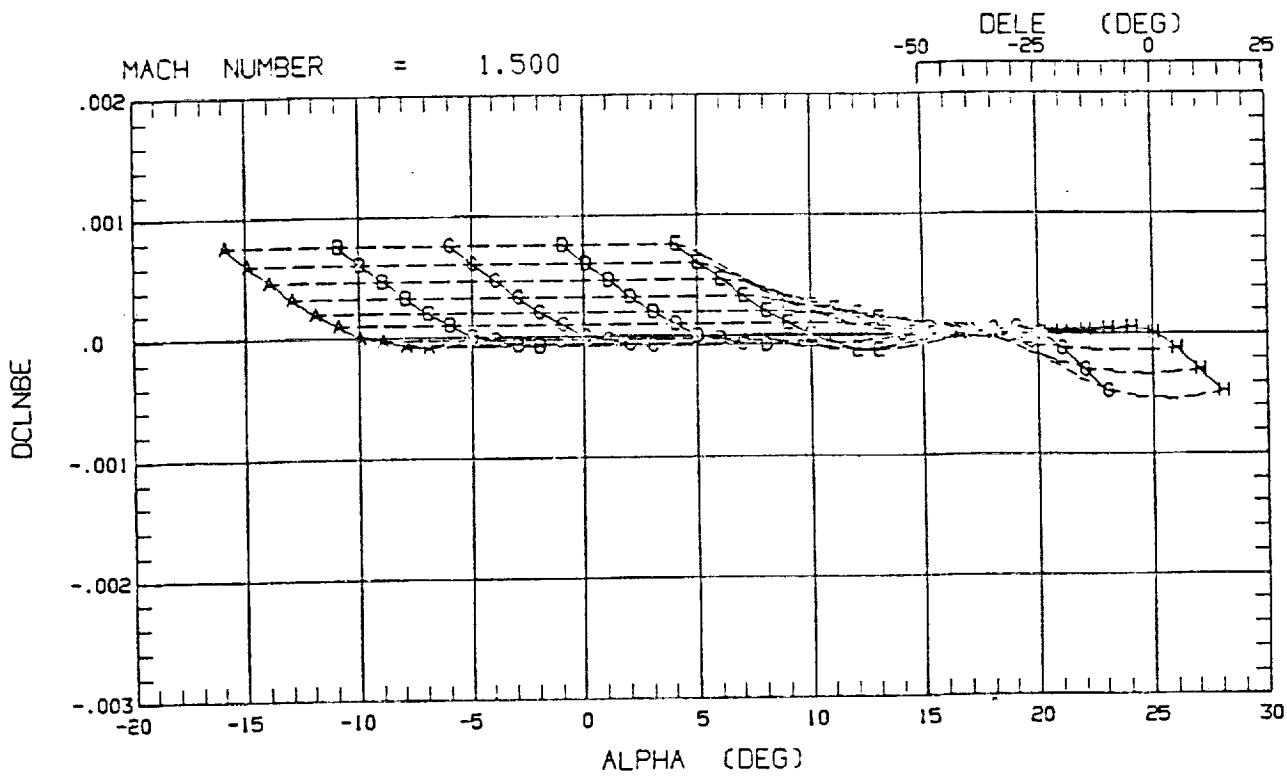
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	0.00115	0.00115	0.00115	0.00115	0.00095	0.00030	0.0	0.0
-25.000	0.00115	0.00115	0.00115	0.00115	0.00094	0.00030	0.00012	0.00012
-20.000	0.00107	0.00107	0.00107	0.00107	0.00083	0.00029	0.00023	0.00023
-15.000	0.00083	0.00083	0.00083	0.00083	0.00053	0.00024	0.00029	0.00029
-10.000	0.00059	0.00059	0.00059	0.00050	0.00028	0.00019	0.00025	0.00025
-5.000	0.00015	0.00015	0.00015	0.00018	0.00014	0.00010	0.00010	0.00010
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00005	-0.00006	-0.00009	-0.00021	-0.00006	-0.00006
10.000	-0.00012	-0.00012	-0.00012	-0.00010	-0.00025	-0.00039	-0.00010	-0.00010
15.000	-0.00045	-0.00034	-0.00023	-0.00012	-0.00039	-0.00058	-0.00012	-0.00012

ENGINEER HP
DATE 10/27/78

FIGURE 4.2.1.2-40
EFFECT OF ELEVON

SLV-...-0000 IM



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

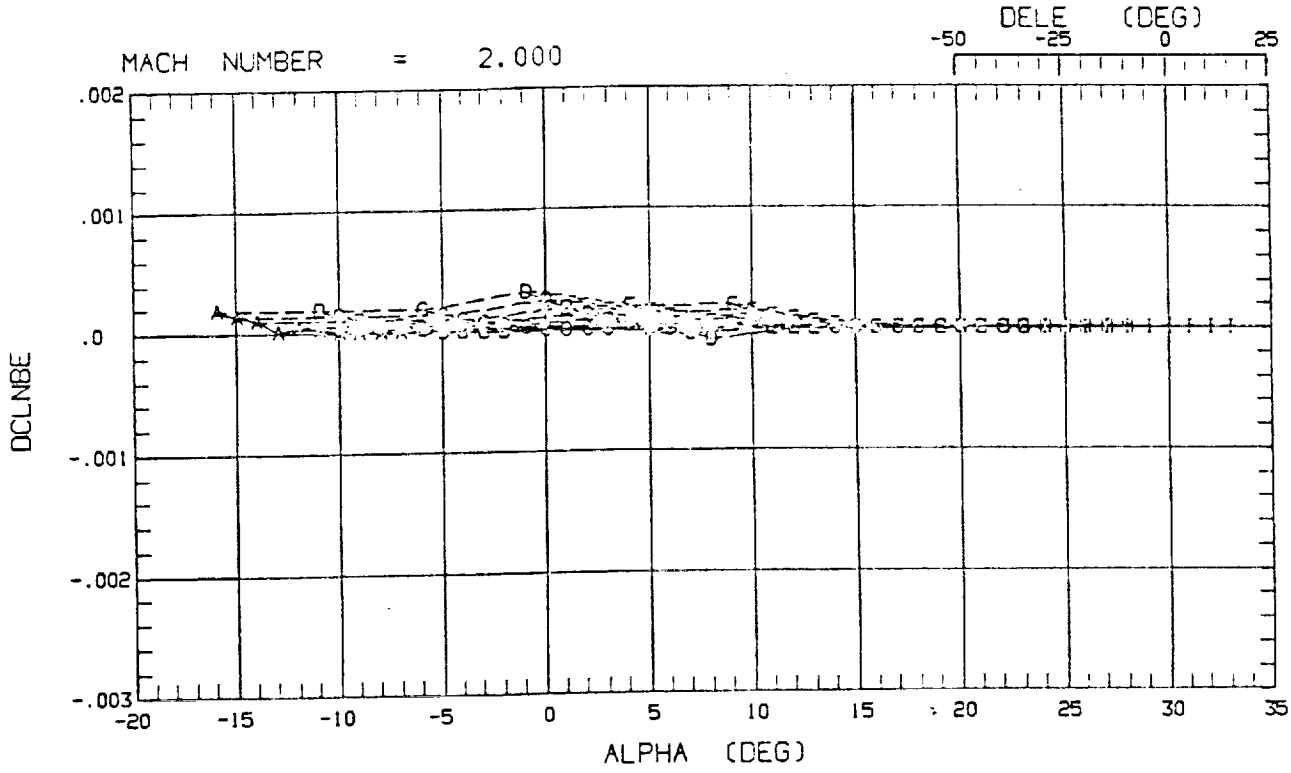
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	0.00076	0.00076	0.00076	0.00076	0.00076	0.00026	0.0	0.0
-25.000	0.00060	0.00060	0.00060	0.00060	0.00060	0.00024	0.0	0.0
-20.000	0.00047	0.00047	0.00047	0.00047	0.00047	0.00021	0.00001	0.00001
-15.000	0.00032	0.00032	0.00032	0.00032	0.00032	0.00017	0.00002	0.00002
-10.000	0.00020	0.00020	0.00020	0.00020	0.00020	0.00013	0.00003	0.00003
-5.000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00006	0.00004	0.00004
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00003	-0.00003	-0.00003	-0.00003	-0.00007	0.0	-0.00013	-0.00013
10.000	-0.00007	-0.00007	-0.00007	-0.00007	-0.00013	0.0	-0.00031	-0.00031
15.000	-0.00009	-0.00008	-0.00009	-0.00008	-0.00013	0.0	-0.00049	-0.00049

ENGINEER [illegible]
DATE 10/3/79

FIGURE 4.2.1.2-41
EFFECT OF ELEVON



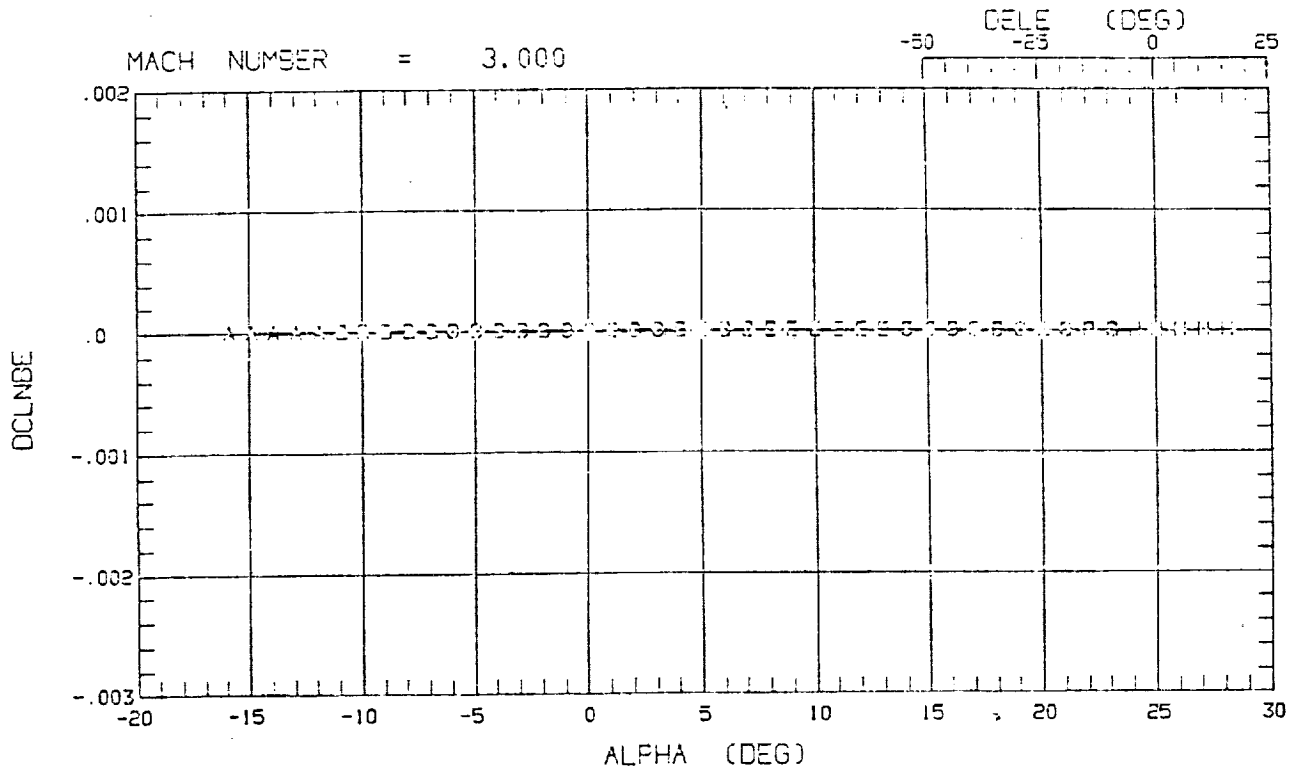
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT								
-30.000	0.00019	0.00019	0.00019	0.00031	0.00019	0.00019	0.0	0.0	0.0
-25.000	0.00014	0.00014	0.00014	0.00024	0.00014	0.00014	0.0	0.0	0.0
-20.000	0.00010	0.00010	0.00010	0.00017	0.00010	0.00010	0.0	0.0	0.0
-15.000	0.00001	0.00007	0.00007	0.00012	0.00007	0.00007	0.0	0.0	0.0
-10.000	0.00004	0.00004	0.00004	0.00007	0.00004	0.00004	0.0	0.0	0.0
-5.000	0.00002	0.00002	0.00002	0.00003	0.00002	0.00002	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.0	0.0	0.0	-0.00004	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	-0.00009	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/27/78

FIGURE 4.2.1.2-42
EFFECT OF ELEVON



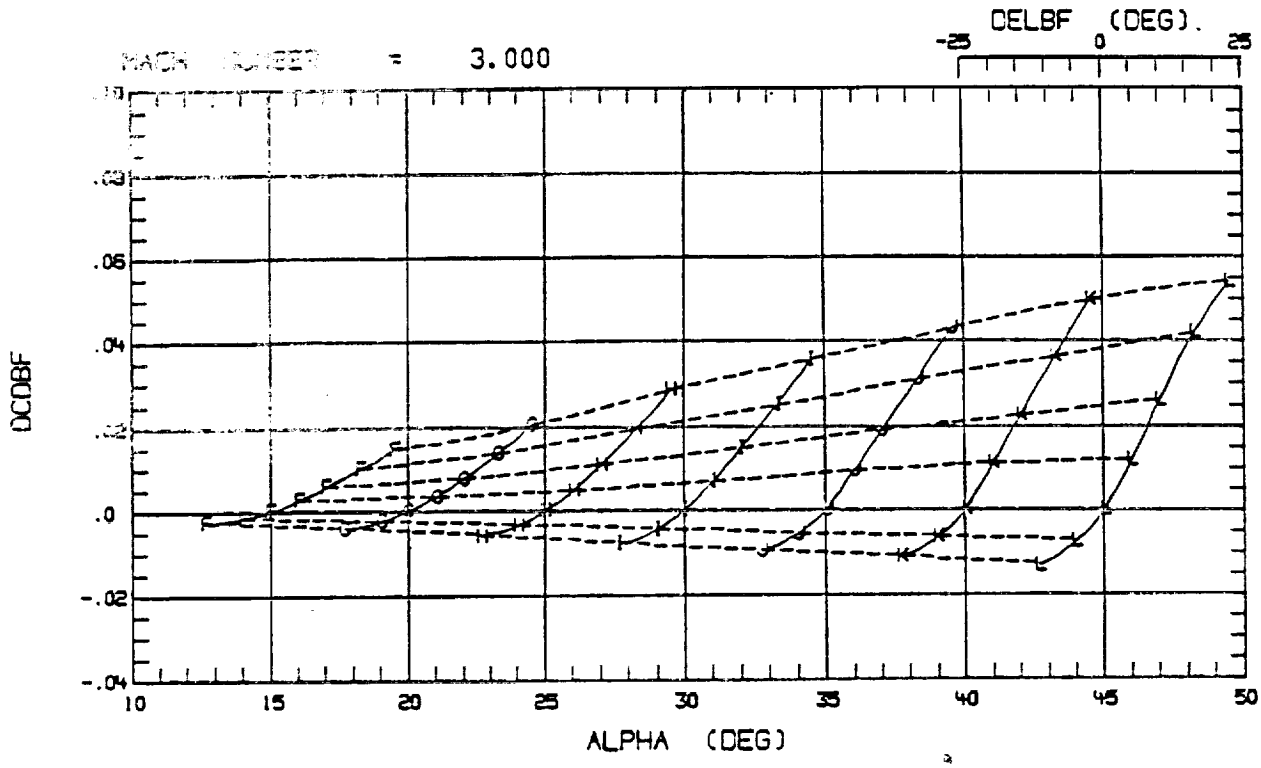
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-20.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER _____
DATE 10/2/78

FIGURE 4.2.1.2-43
EFFECT OF ELEVON

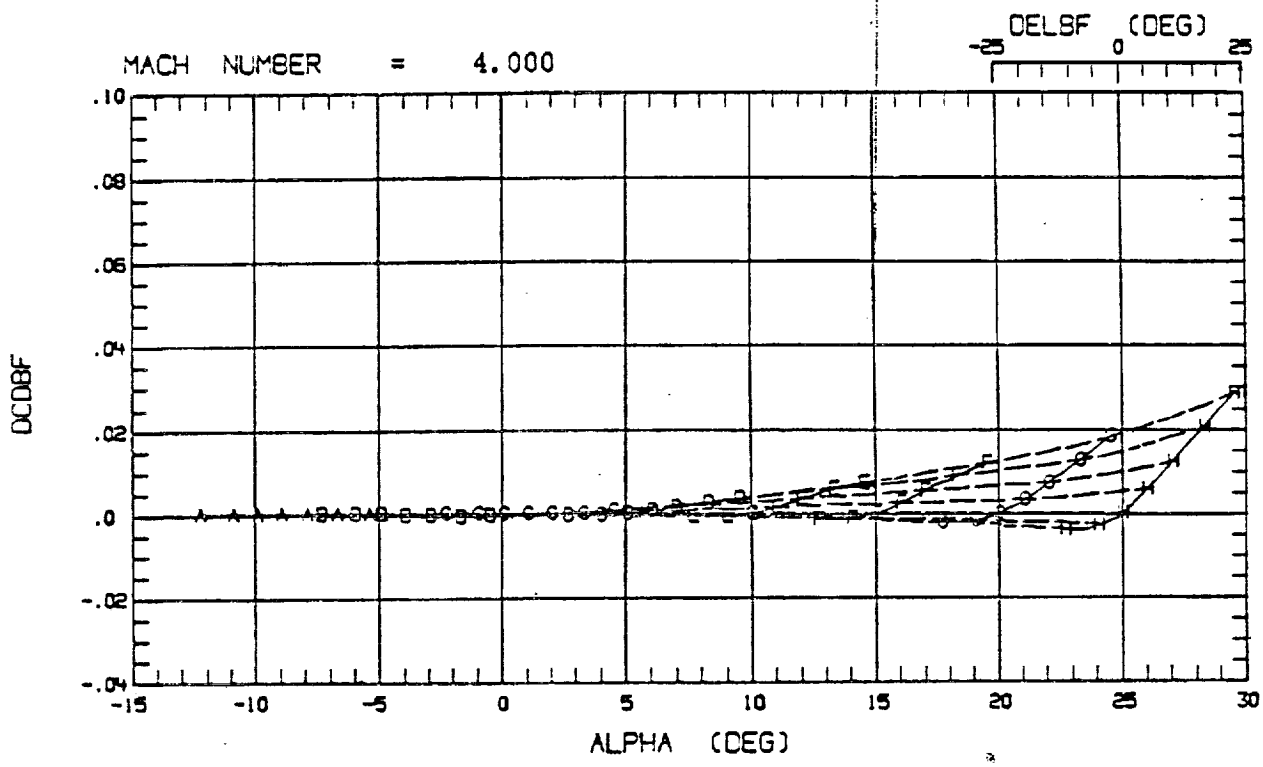


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT						
-11.700	-0.00295	-0.00425	-0.00575	-0.00780	-0.00950	-0.01100	-0.01300
-5.000	-0.00167	-0.00240	-0.00328	-0.00437	-0.00536	-0.00625	-0.00731
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00256	0.00347	0.00481	0.00678	0.00926	0.01102	0.01197
10.000	0.00574	0.00776	0.01081	0.01467	0.01887	0.02245	0.02626
16.300	0.01011	0.01381	0.01926	0.02500	0.03100	0.03650	0.04200
22.500	0.01476	0.02035	0.02841	0.03555	0.04300	0.05000	0.05400

ENGINEER [illegible]
DATE [illegible]-79

FIGURE 4.1.2.2-50
EFFECT OF BODY FLAP



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

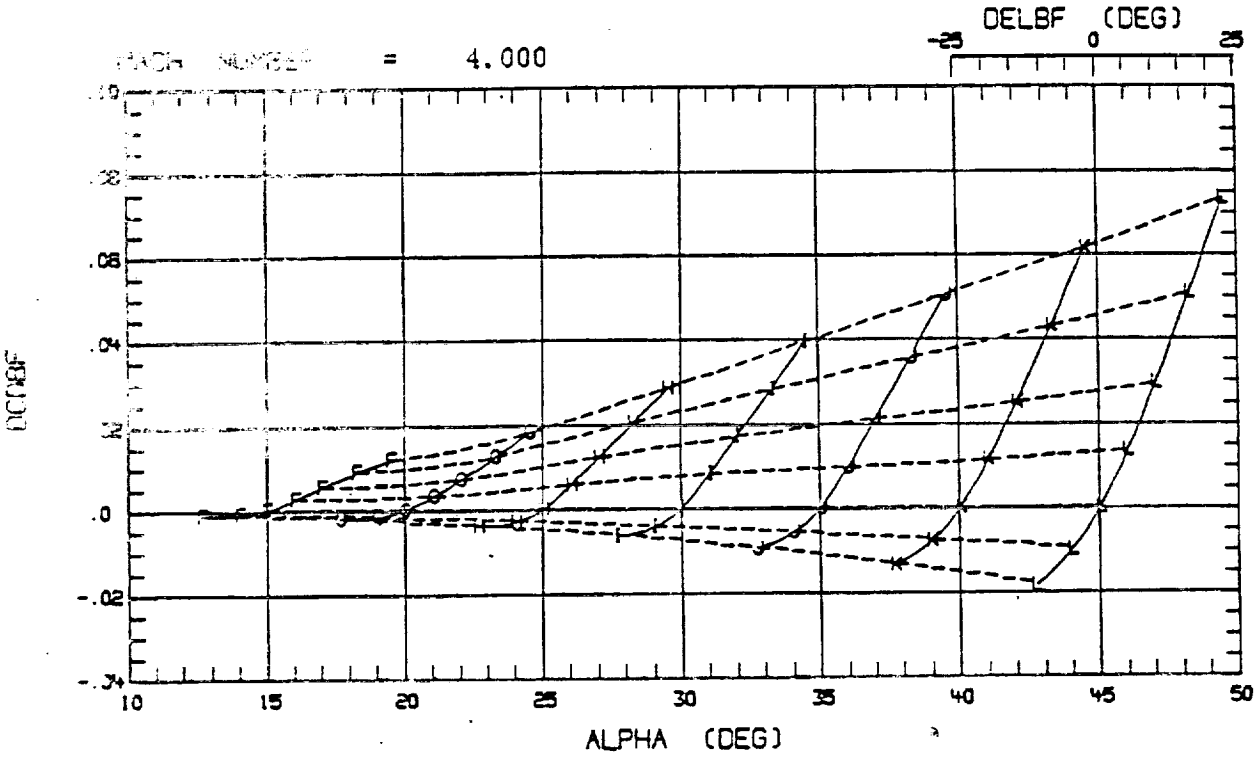
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.0	0.00007	0.0	-0.00021	-0.00060	-0.00118	-0.00210	-0.00386
-5.000	0.0	0.00006	-0.00002	-0.00027	-0.00062	-0.00104	-0.00161	-0.00276
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00013	0.00004	0.00077	0.00162	0.00262	0.00326	0.00587
10.000	0.0	-0.00033	0.00010	0.00175	0.00364	0.00552	0.00728	0.01229
16.300	0.0	-0.00050	0.00030	0.00279	0.00580	0.00892	0.01260	0.02045
22.500	0.0	-0.00025	0.00090	0.00355	0.00740	0.01200	0.01810	0.02959

ENGINEER Wm Z
DATE 9-26-78

FIGURE 4.1.2.2-51
EFFECT OF BODY FLAP

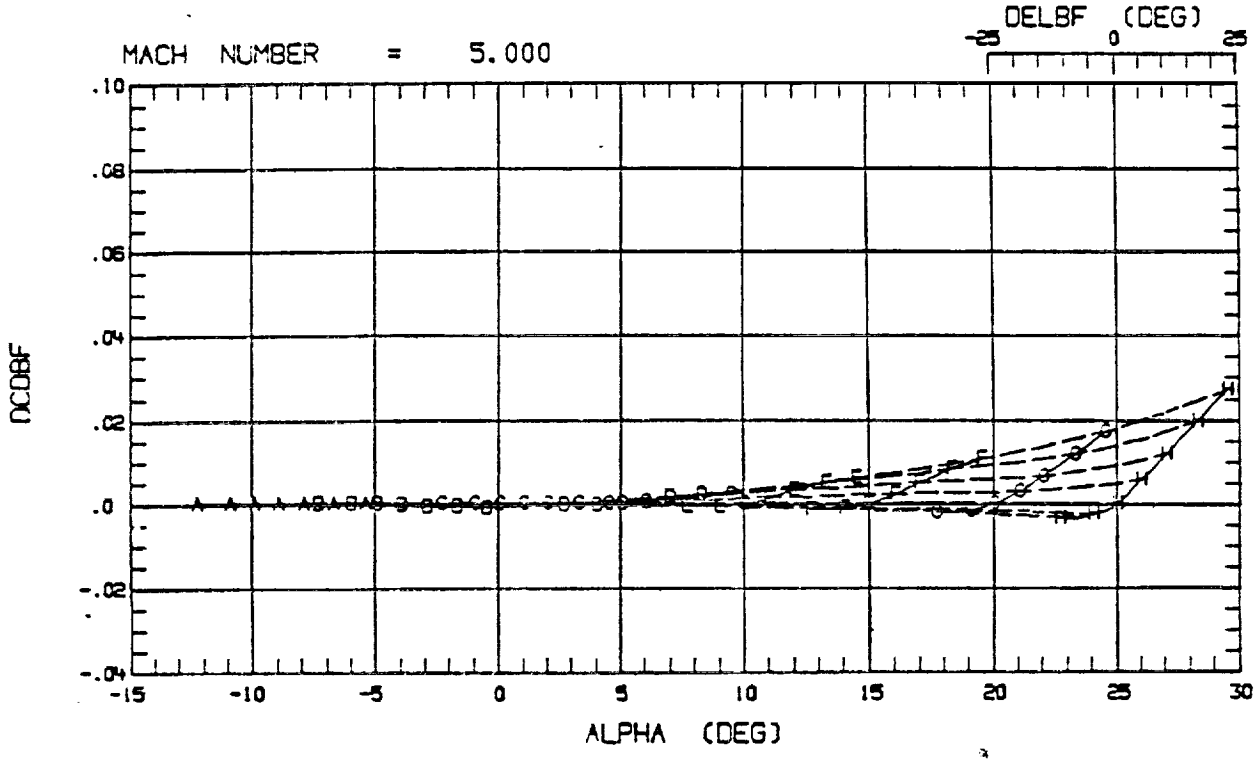


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT						
-11.700	-0.00118	-0.00210	-0.00386	-0.00630	-0.00940	-0.01330	-0.01822
-5.000	-0.00104	-0.00161	-0.00276	-0.00413	-0.00568	-0.00749	-0.00966
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00262	0.00326	0.00587	0.00819	0.00977	0.01142	0.01354
10.000	0.00552	0.00728	0.01229	0.01706	0.02107	0.02502	0.02952
16.300	0.00892	0.01260	0.02045	0.02830	0.03570	0.04310	0.05095
22.300	0.01200	0.01810	0.02859	0.03950	0.05054	0.06180	0.07325

ENGINEER WMZ
DATE 9-14-78

FIGURE 4.1.2.2-52
EFFECT OF BODY FLAP



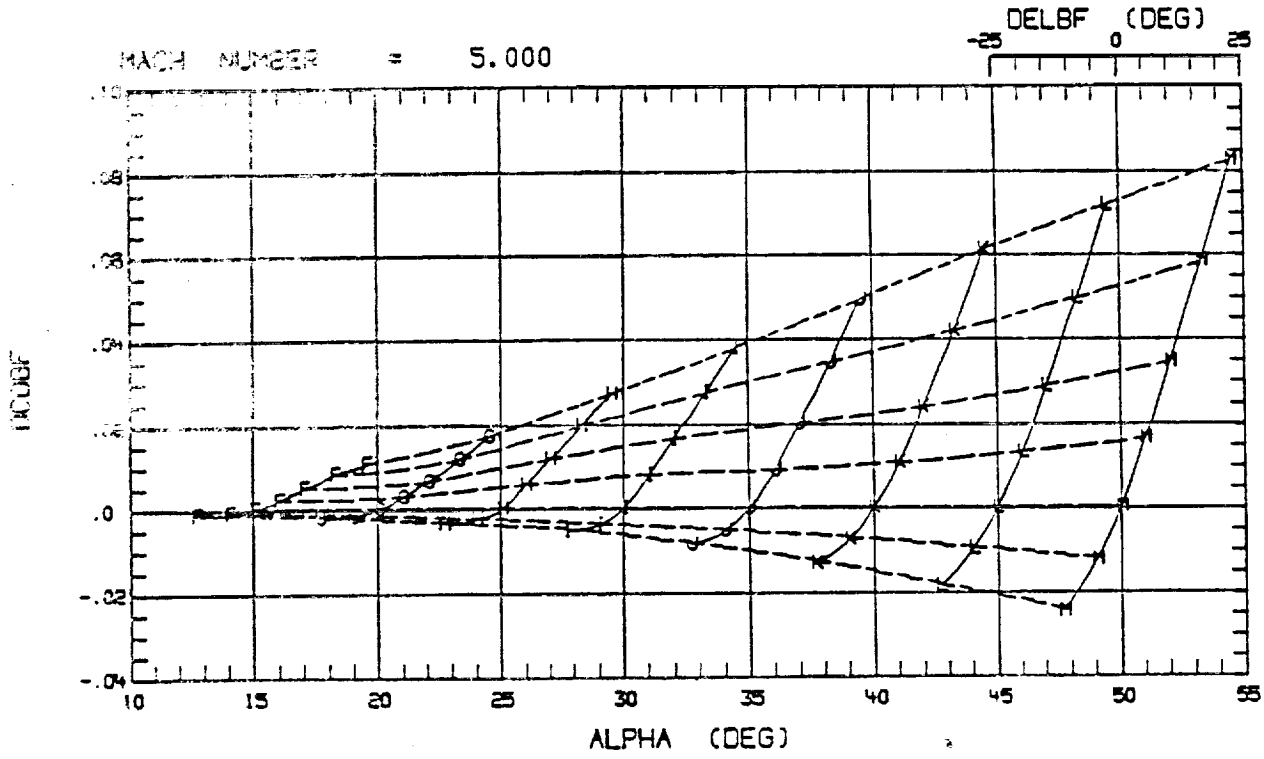
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.0	0.00007	0.0	-0.00021	-0.00060	-0.00116	-0.00200	-0.00324
-5.000	0.0	0.00007	0.0	-0.00024	-0.00058	-0.00098	-0.00152	-0.00249
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00017	0.0	0.00061	0.00140	0.00235	0.00293	0.00574
10.000	0.0	-0.00041	0.0	0.00150	0.00331	0.00510	0.00668	0.01186
16.300	0.0	-0.00065	0.0	0.00232	0.00520	0.00820	0.01180	0.01960
22.500	0.0	-0.00076	0.0	0.00235	0.00610	0.01082	0.01720	0.02728

ENGINEER WMT
DATE 9-20-78

FIGURE 4.1.2.2-53
EFFECT OF BODY FLAP

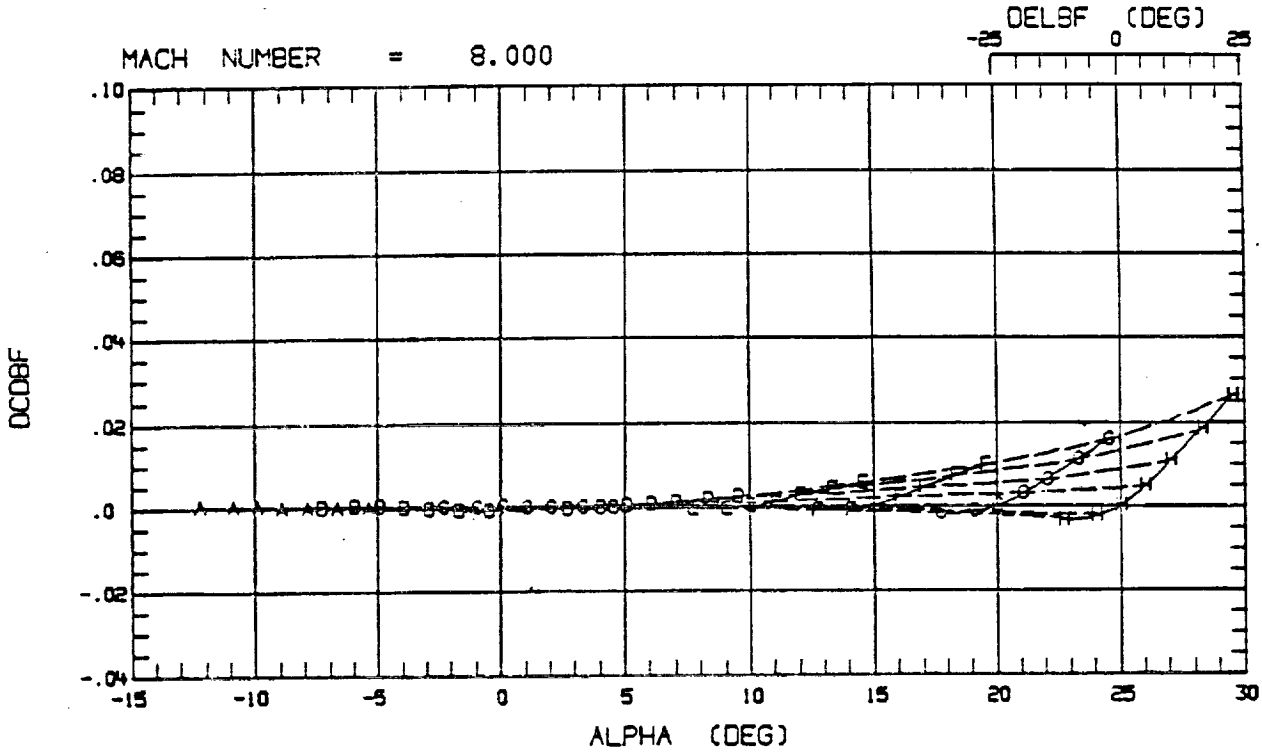


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	-0.00116	-0.00200	-0.00324	-0.00510	-0.00849	-0.01290	-0.01815	-0.02430
-5.000	-0.00098	-0.00152	-0.00249	-0.00367	-0.00531	-0.00728	-0.00957	-0.01219
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00235	0.00293	0.00574	0.00797	0.00914	0.01075	0.01324	0.01643
10.000	0.00510	0.00668	0.01186	0.01654	0.02015	0.02391	0.02990	0.03477
16.300	0.00820	0.01180	0.01960	0.02740	0.03470	0.04200	0.05001	0.05850
22.500	0.01082	0.01720	0.02728	0.03820	0.04970	0.06120	0.07206	0.08250

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.2 -54
EFFECT OF BODY FLAP



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1078.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

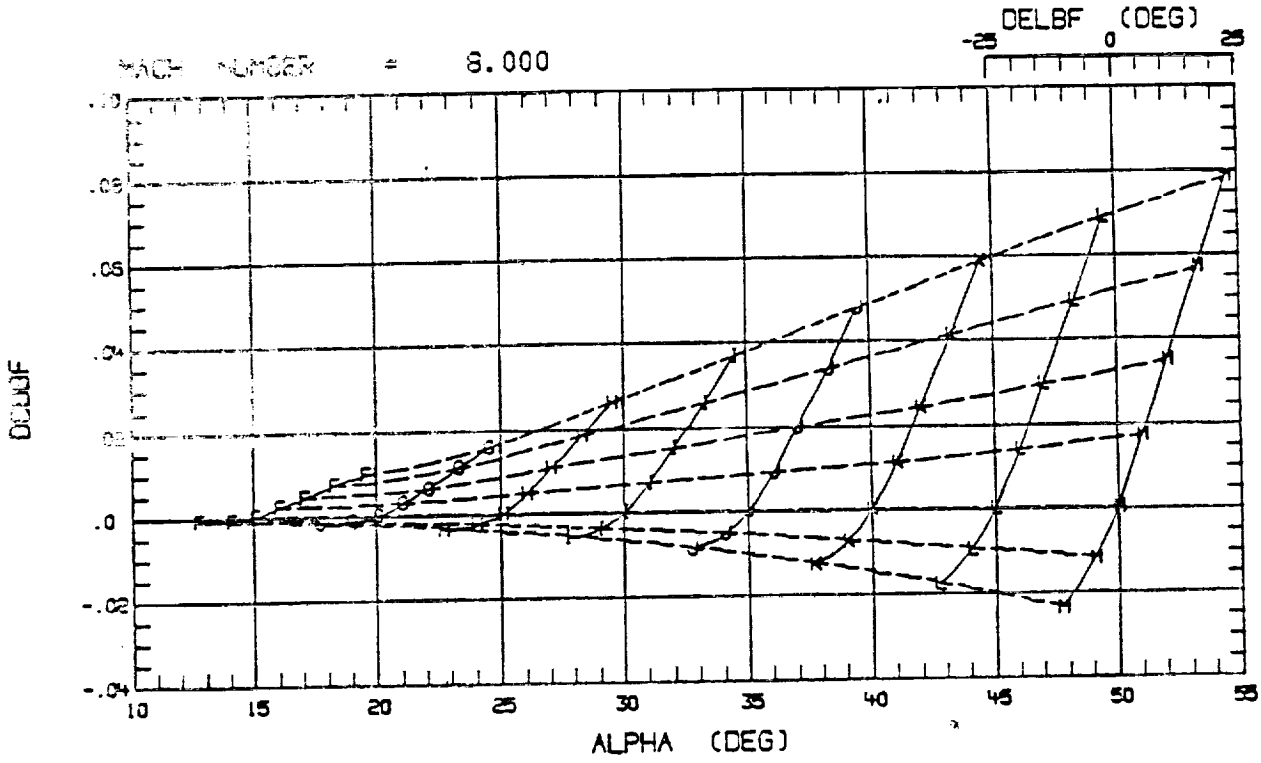
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5 000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.0	-0.00016	-0.00030	-0.00040	-0.00050	-0.00096	-0.00180	-0.00330
-5.000	0.00001	0.0	-0.00008	-0.00025	-0.00047	-0.00084	-0.00139	-0.00242
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00019	-0.00003	0.00046	0.00122	0.00213	0.00284	0.00481
10.000	-0.00013	-0.00049	-0.00014	0.00100	0.00261	0.00435	0.00635	0.01064
16.300	-0.00020	-0.00075	-0.00020	0.00161	0.00420	0.00714	0.01100	0.01829
22.500	-0.00010	-0.00081	-0.00010	0.00212	0.00560	0.00990	0.01580	0.02614

ENGINEER [illegible]
DATE 9-20-78

FIGURE 4.1.2.2-55
EFFECT OF BODY FLAP



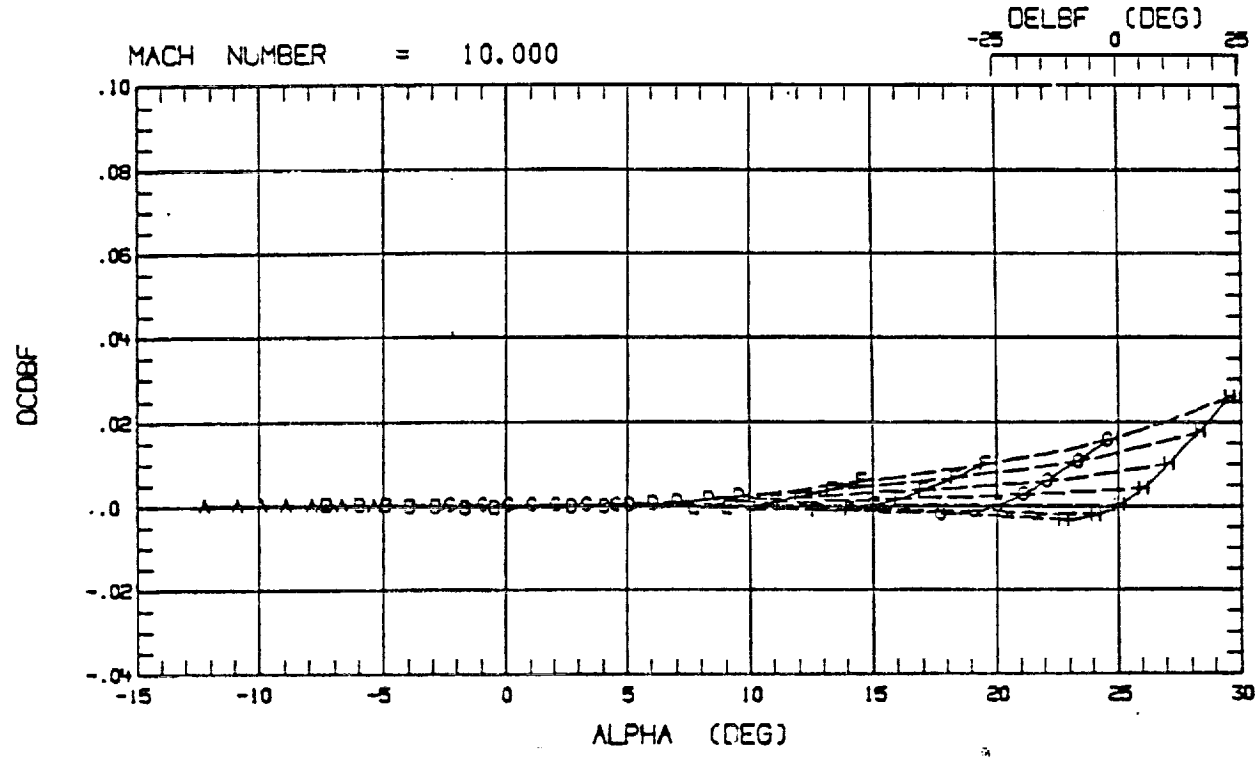
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	-0.00096	-0.00180	-0.00330	-0.00550	-0.00859	-0.01260	-0.01788	-0.02370
-5.000	-0.00084	-0.00139	-0.00242	-0.00369	-0.00527	-0.00714	-0.00935	-0.01188
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00213	0.00294	0.00481	0.00691	0.00910	0.01131	0.01407	0.01738
10.000	0.00435	0.00635	0.01064	0.01514	0.01978	0.02442	0.02951	0.03493
16.300	0.00714	0.01100	0.01829	0.02590	0.03370	0.04150	0.04922	0.05690
22.500	0.00990	0.01580	0.02614	0.03690	0.04790	0.05890	0.06896	0.07840

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.2.2-56
EFFECT OF BODY FLAP

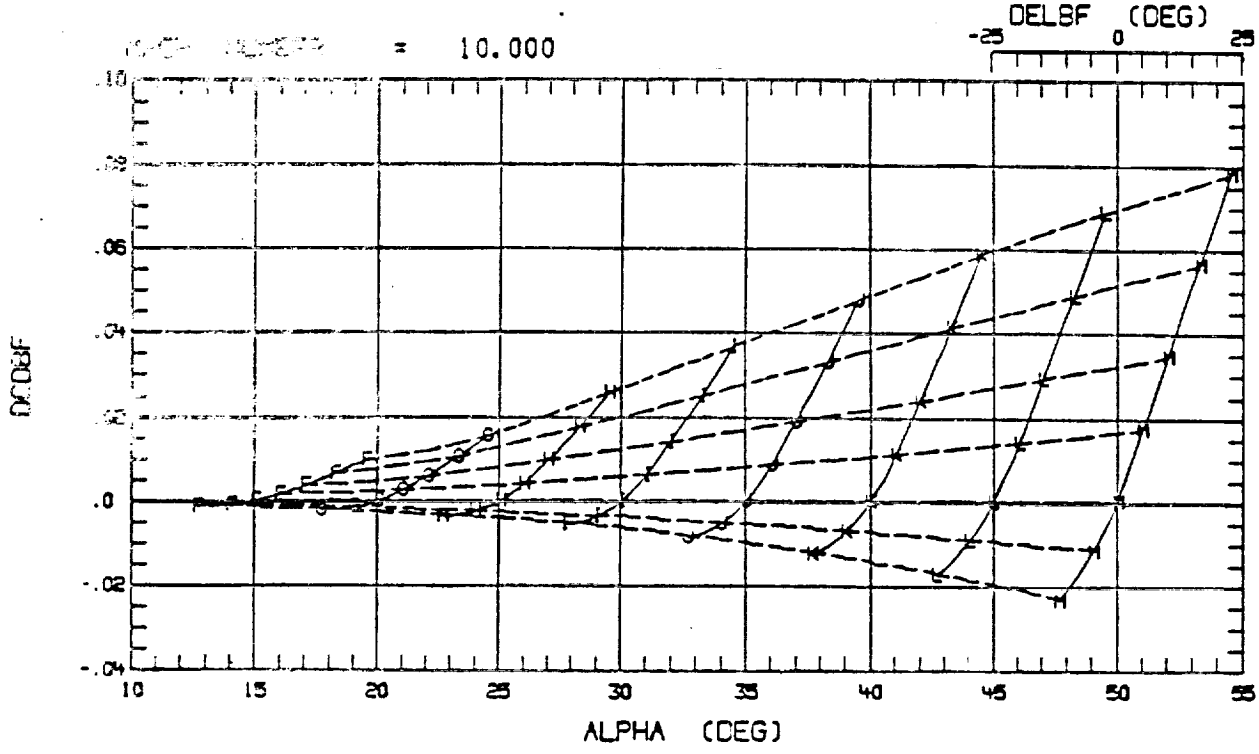


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.0	0.00007	0.0	-0.00021	-0.00060	-0.00116	-0.00200	-0.00334
-5.000	0.0	0.00006	0.0	-0.00018	-0.00047	-0.00086	-0.00142	-0.00237
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00011	0.0	0.00034	0.00088	0.00159	0.00258	0.00421
10.000	0.0	-0.00025	0.0	0.00080	0.00208	0.00367	0.00590	0.00972
16.300	0.0	-0.00047	0.0	0.00149	0.00380	0.00662	0.01050	0.01748
22.500	0.0	-0.00071	0.0	0.00225	0.00570	0.00981	0.01540	0.02588

ENGINEER WMZ
DATE 9-20-79

FIGURE 4.1.2.2-57
EFFECT OF BODY FLAP

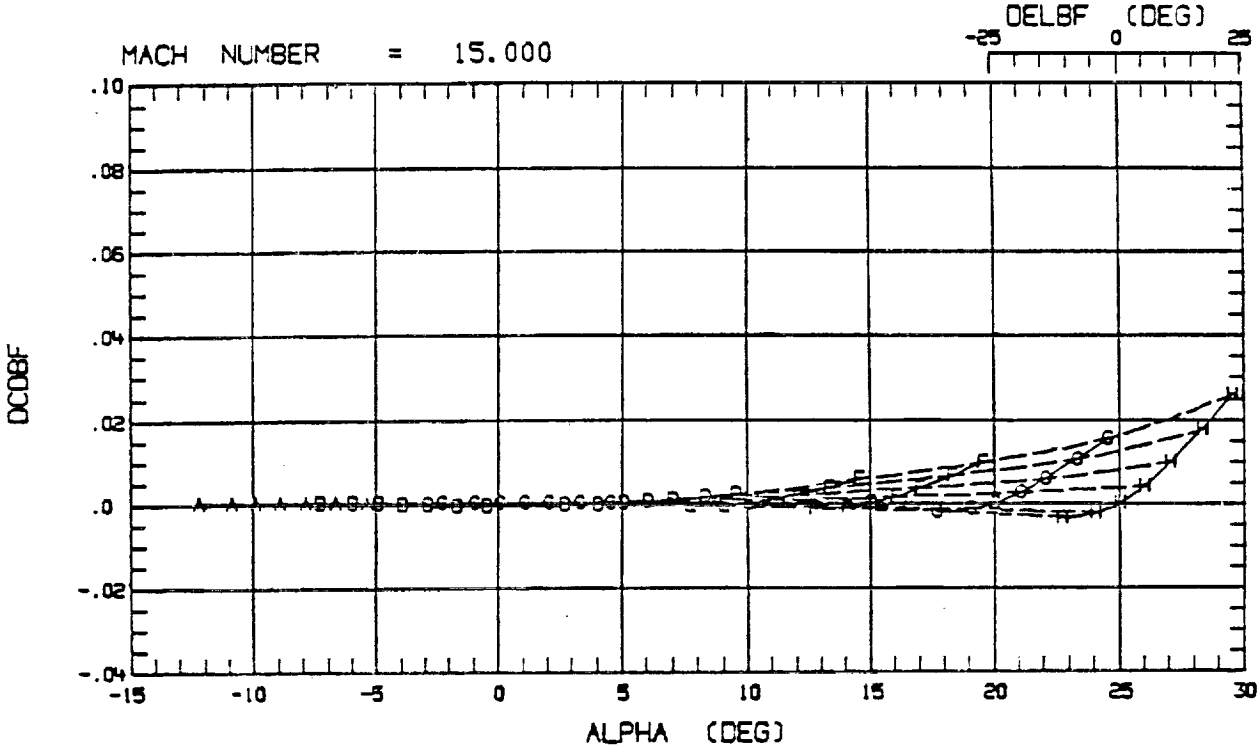


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	-0.00116	-0.00200	-0.00334	-0.00530	-0.00833	-0.01230	-0.01726	-0.02320
-5.000	-0.00086	-0.00142	-0.00237	-0.00357	-0.00514	-0.00702	-0.00920	-0.01168
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00159	0.00258	0.00421	0.00624	0.00863	0.01109	0.01391	0.01727
10.000	0.00367	0.00590	0.00972	0.01418	0.01913	0.02411	0.02927	0.03461
16.300	0.00662	0.01050	0.01748	0.02510	0.03315	0.04120	0.04891	0.05640
22.500	0.00981	0.01540	0.02588	0.03670	0.04770	0.05870	0.06861	0.07780

ENGINEER WMC
DATE 5-30-78

FIGURE 4.1.2.2-58
EFFECT OF BODY FLAP



CONFIGURATION

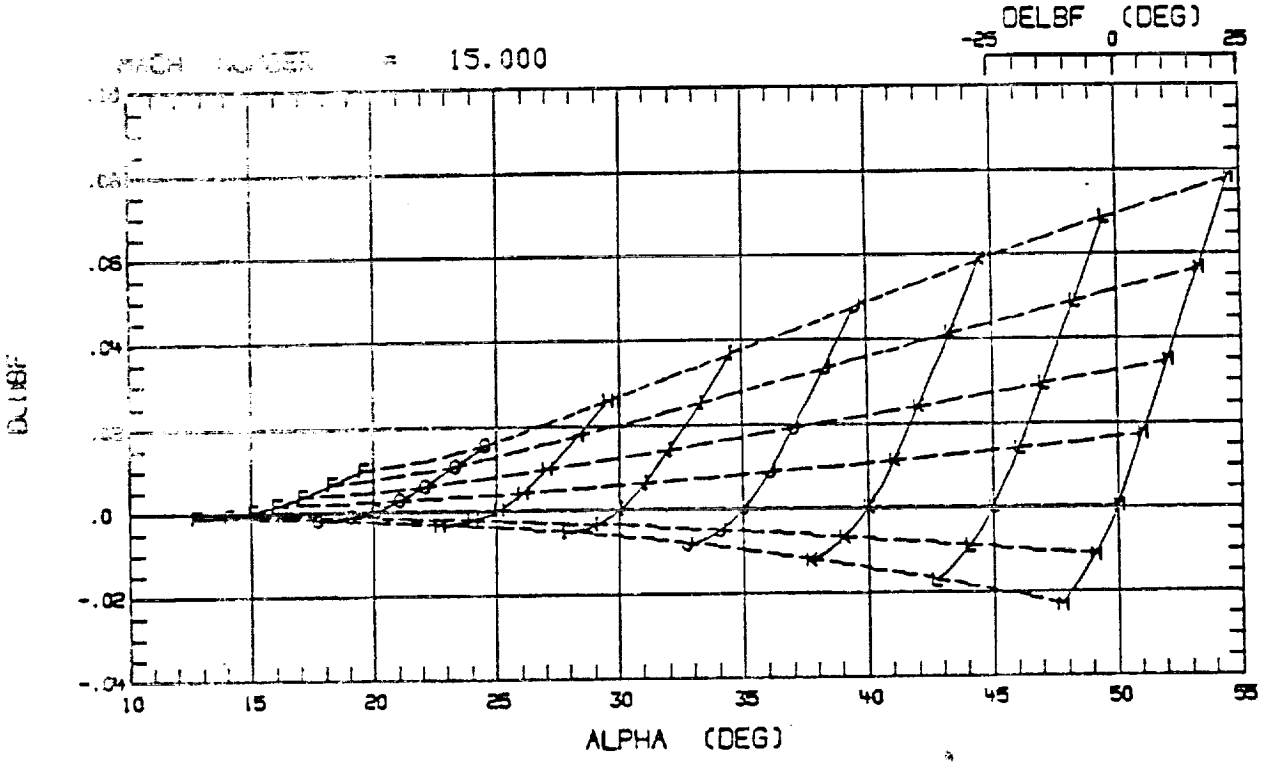
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.0	0.00007	0.0	-0.00021	-0.00060	-0.00116	-0.00200	-0.00334
-5.000	0.0	0.00006	0.0	-0.00018	-0.00047	-0.00086	-0.00142	-0.00237
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00011	0.0	0.00034	0.00088	0.00159	0.00258	0.00421
10.000	0.0	-0.00025	0.0	0.00080	0.00208	0.00367	0.00590	0.00972
16.300	0.0	-0.00047	0.0	0.00149	0.00380	0.00662	0.01050	0.01748
22.500	0.0	-0.00071	0.0	0.00225	0.00570	0.00981	0.01540	0.02588

ENGINEER LMZ
DATE 9-20-78

FIGURE 4.1.2.2-59
EFFECT OF BODY FLAP



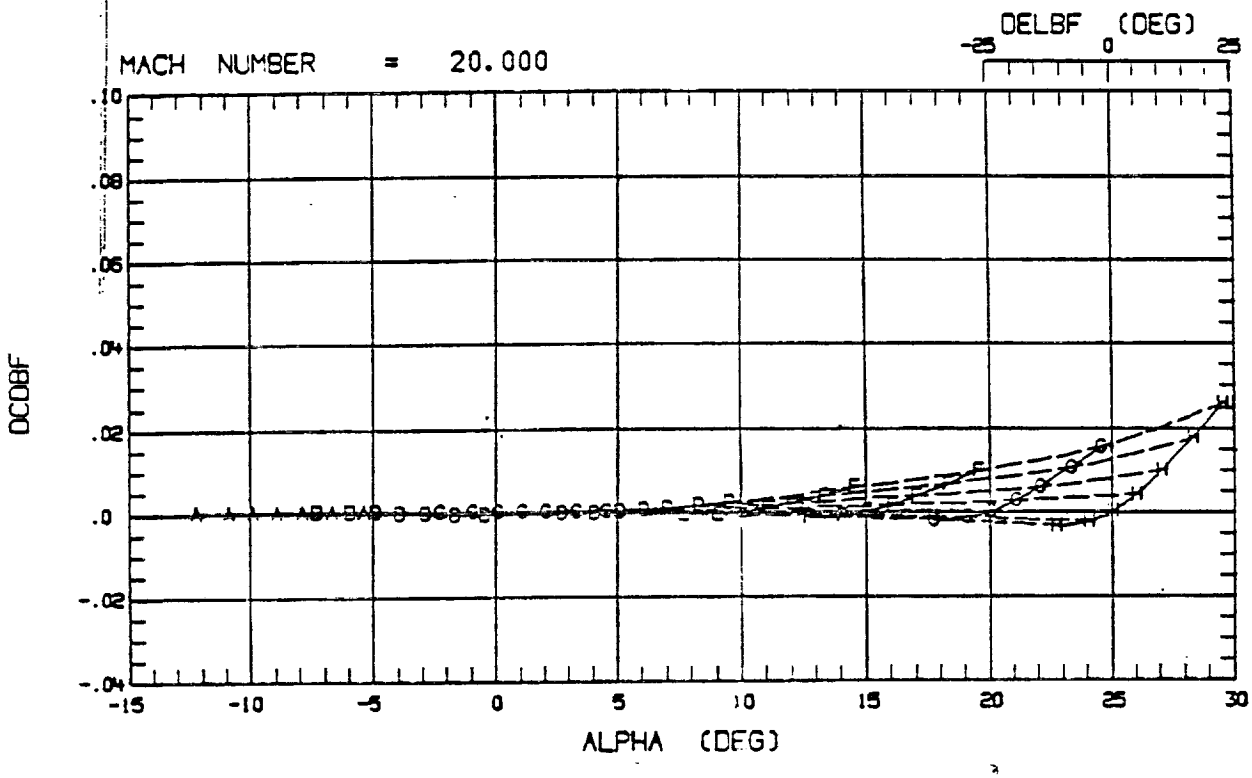
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	-0.00116	-0.00200	-0.00334	-0.00530	-0.00833	-0.01230	-0.01726	-0.02320
-5.000	-0.00086	-0.00142	-0.00237	-0.00357	-0.00514	-0.00702	-0.00920	-0.01168
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00159	0.00258	0.00421	0.00624	0.00863	0.01109	0.01391	0.01727
10.000	0.00367	0.00550	0.00972	0.01418	0.01913	0.02411	0.02927	0.03461
16.300	0.00662	0.01050	0.01748	0.02510	0.03315	0.04120	0.04891	0.05640
22.500	0.00981	0.01540	0.02588	0.03670	0.04770	0.05870	0.06861	0.07780

ENGINEER W.M.Z.
DATE 9-20-78

FIGURE 4.1.2.2-60
EFFECT OF BODY FLAP



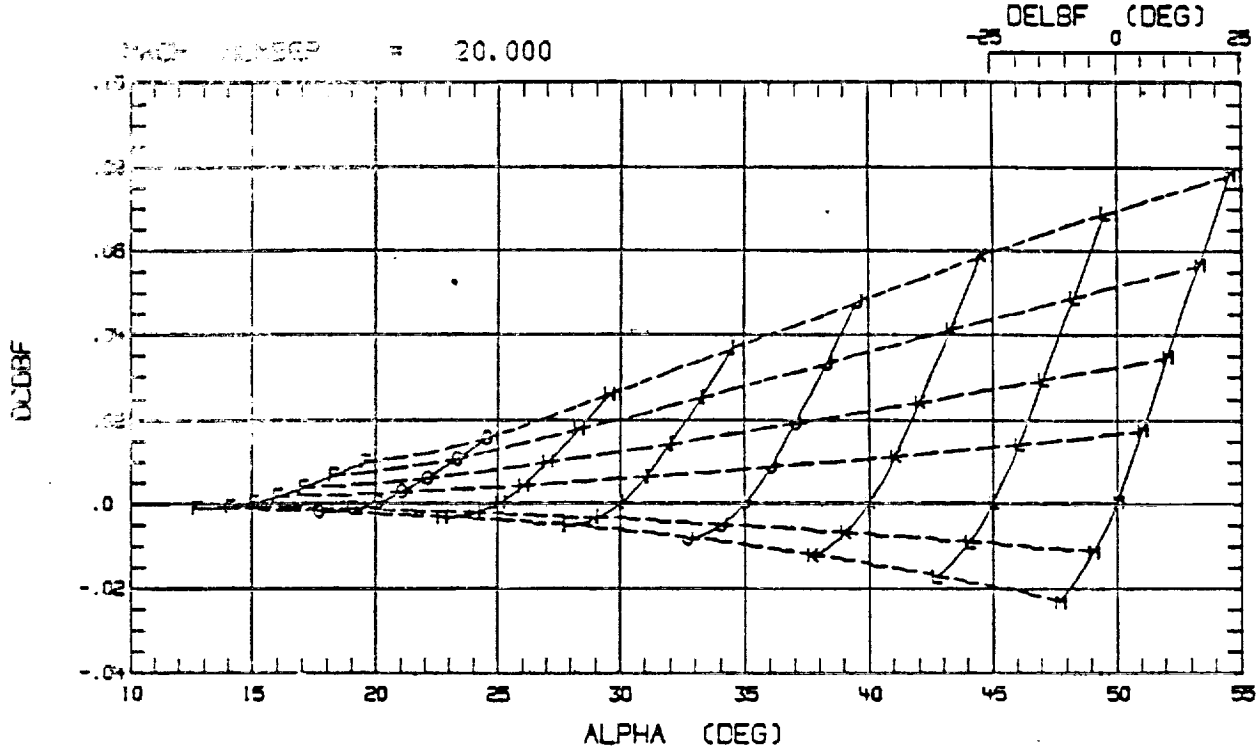
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	0.0	0.00007	0.0	-0.00021	-0.00060	-0.00116	-0.00200	-0.00334
-5.000	0.0	0.00006	0.0	-0.00018	-0.00047	-0.00086	-0.00142	-0.00237
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00011	0.0	0.00034	0.00088	0.00159	0.00258	0.00421
10.000	0.0	-0.00025	0.0	0.00080	0.00208	0.00367	0.00590	0.00972
16.300	0.0	-0.00047	0.0	0.00149	0.00380	0.00662	0.01050	0.01748
22.500	0.0	-0.00071	0.0	0.00226	0.00570	0.00981	0.01540	0.02588

ENGINEER WMZ
DATE 4-30-79

FIGURE 4.1.2.2-61
EFFECT OF BODY FLAP



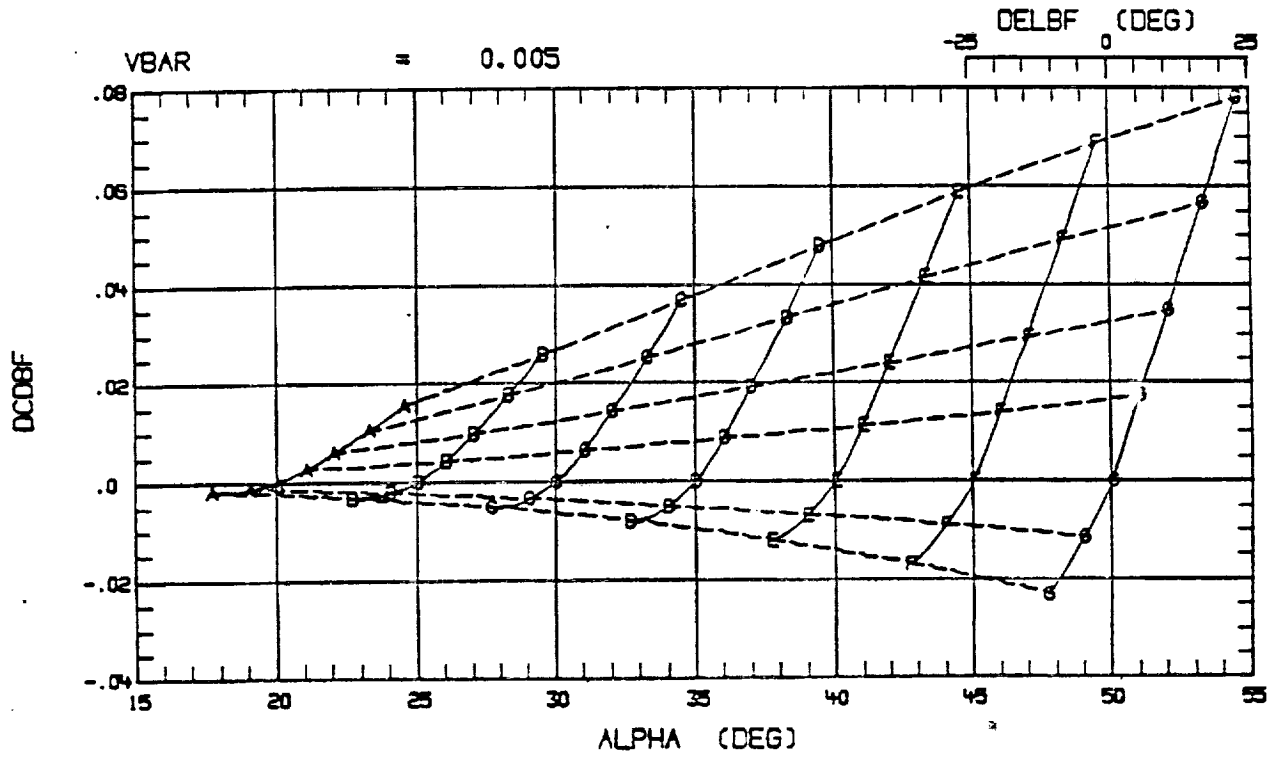
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP DRAG FORCE INCREMENT							
-11.700	-0.00116	-0.00200	-0.00334	-0.00530	-0.00833	-0.01230	-0.01726	-0.02320
-5.000	-0.00088	-0.00142	-0.00237	-0.00357	-0.00514	-0.00702	-0.00920	-0.01168
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00159	0.00258	0.00421	0.00624	0.00863	0.01109	0.01391	0.01727
10.000	0.00367	0.00590	0.00972	0.01418	0.01913	0.02411	0.02927	0.03461
16.300	0.00662	0.01050	0.01748	0.02510	0.03315	0.04120	0.04891	0.05640
22.500	0.00981	0.01540	0.02588	0.03670	0.04770	0.05870	0.06861	0.07780

ENGINEER WMT
DATE 4-20-78

FIGURE 4.1.2.2-62
EFFECT OF BODY FLAP



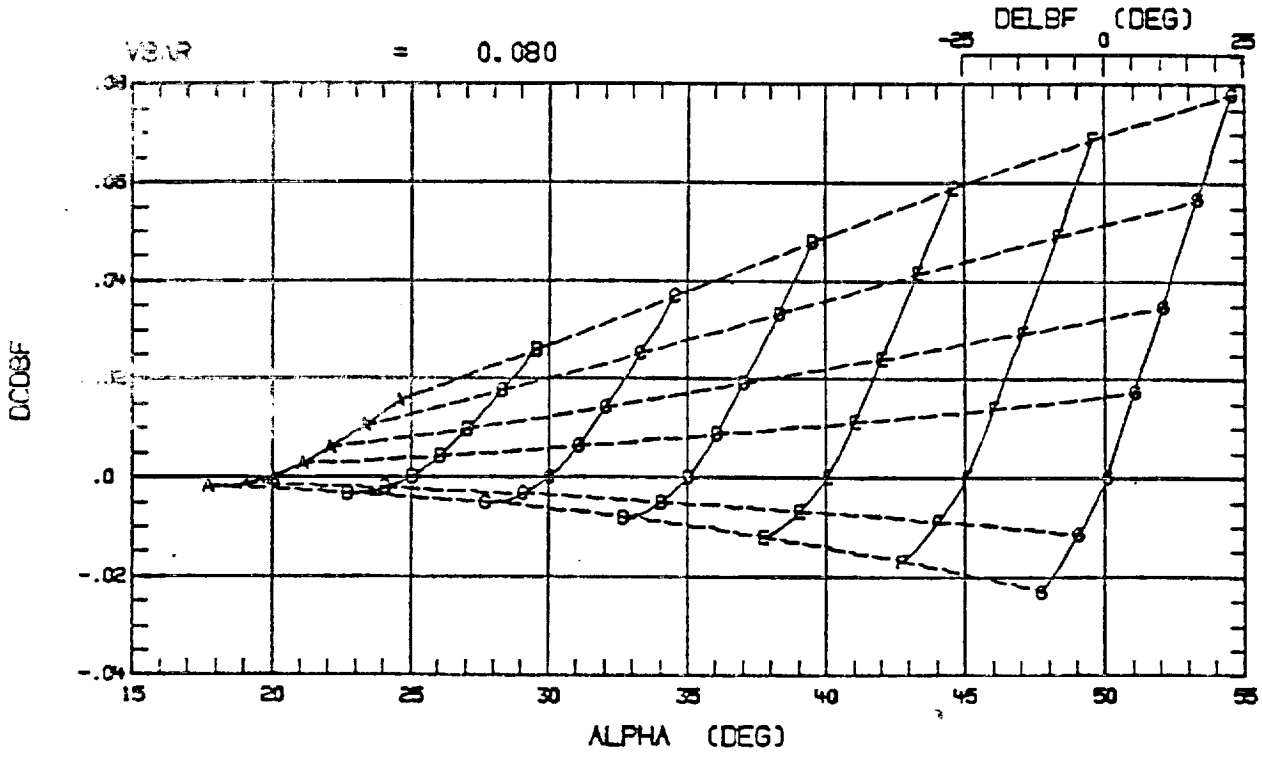
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODYFLAP DRAG INCREMENT						
-11.700	-0.00200	-0.00334	-0.00530	-0.00833	-0.01230	-0.01726	-0.02320
-5.000	-0.00142	-0.00237	-0.00357	-0.00514	-0.00702	-0.00920	-0.01168
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00258	0.00421	0.00624	0.00863	0.01109	0.01391	0.01727
10.000	0.00590	0.00972	0.01418	0.01913	0.02411	0.02927	0.03461
16.300	0.01050	0.01748	0.02510	0.03315	0.04120	0.04891	0.05640
22.500	0.01540	0.02588	0.03670	0.04770	0.05870	0.06861	0.07780

ENGINEER NASA
DATE

FIGURE 4.1.2.2-63
EFFECT OF BODYFLAP

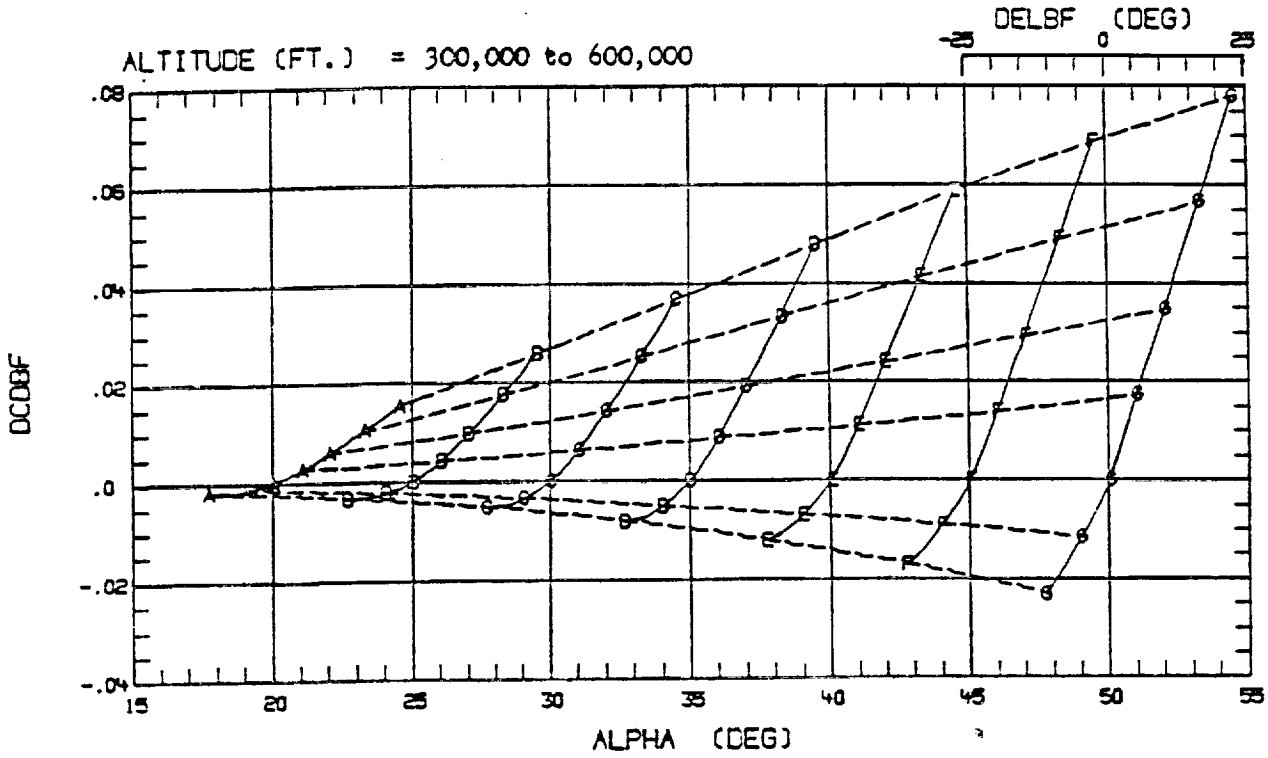


CONFIGURATION				
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELBF (DEG)	BODYFLAP DRAG INCREMENT						
-11.700	-0.00200	-0.00334	-0.00530	-0.00833	-0.01230	-0.01726	-0.02320
-5.000	-0.00142	-0.00237	-0.00357	-0.00514	-0.00702	-0.00920	-0.01168
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00258	0.00421	0.00624	0.00863	0.01109	0.01391	0.01727
10.000	0.00550	0.00972	0.01418	0.01913	0.02411	0.02927	0.03461
16.300	0.01050	0.01748	0.02510	0.03315	0.04120	0.04891	0.05640
22.500	0.01540	0.02588	0.03670	0.04770	0.05870	0.06861	0.07780

ENGINEER NASA
DATE

FIGURE 4.1.2.2-64
EFFECT OF BODYFLAP

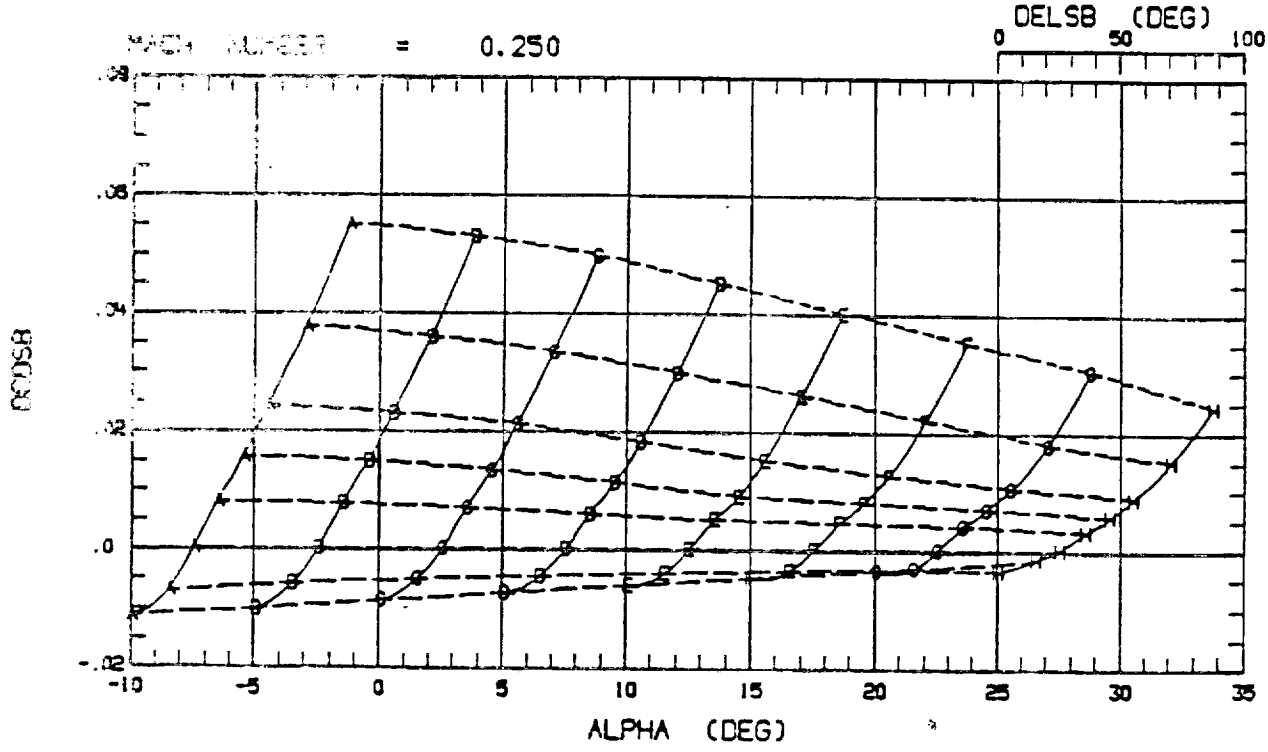


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODYFLAP DRAG INCREMENT						
-11.700	-0.00200	-0.00334	-0.00530	-0.00833	-0.01230	-0.01726	-0.02320
-5.000	-0.00142	-0.00237	-0.00357	-0.00514	-0.00702	-0.00920	-0.01168
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00258	0.00421	0.00624	0.00863	0.01109	0.01391	0.01727
10.000	0.00590	0.00972	0.01418	0.01913	0.02411	0.02927	0.03461
16.300	0.01050	0.01748	0.02510	0.03315	0.04120	0.04891	0.05640
22.500	0.01540	0.02568	0.03670	0.04770	0.05870	0.06861	0.07780

ENGINEER NASA
DATE

FIGURE 4.1.2.2-65
EFFECT OF BODYFLAP



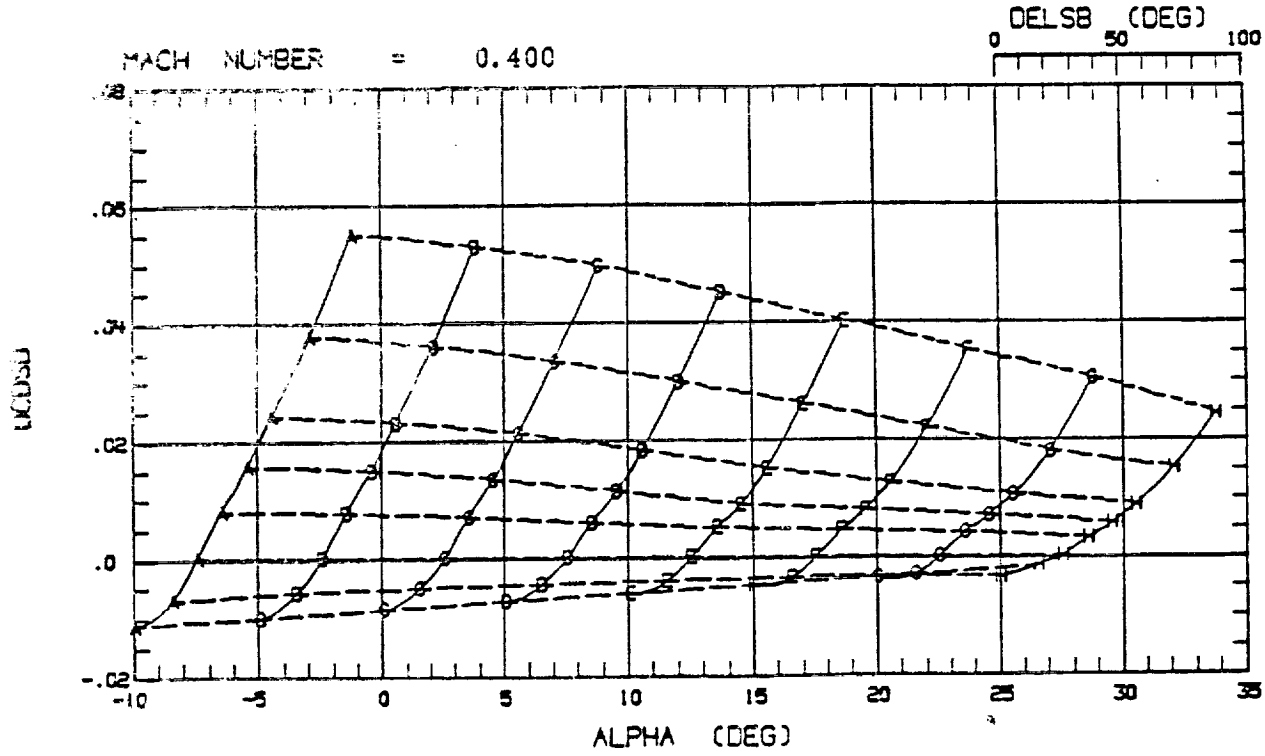
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.01130	-0.01001	-0.00870	-0.00735	-0.00600	-0.00468	-0.00340	-0.00350
15.000	-0.00700	-0.00587	-0.00500	-0.00450	-0.00400	-0.00350	-0.00300	-0.00140
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00800	0.00762	0.00700	0.00600	0.00500	0.00450	0.00400	0.00300
45.000	0.01560	0.01471	0.01330	0.01110	0.00890	0.00795	0.00700	0.00560
55.000	0.02420	0.02296	0.02100	0.01795	0.01490	0.01251	0.01050	0.00880
70.000	0.03760	0.03591	0.03340	0.02976	0.02590	0.02190	0.01790	0.01500
87.200	0.05500	0.05292	0.04960	0.04485	0.04000	0.03515	0.03020	0.02410

ENGINEER DSD
DATE 9-12-78

FIGURE 4.1.2.2-66
EFFECT OF SPEEDBRAKE

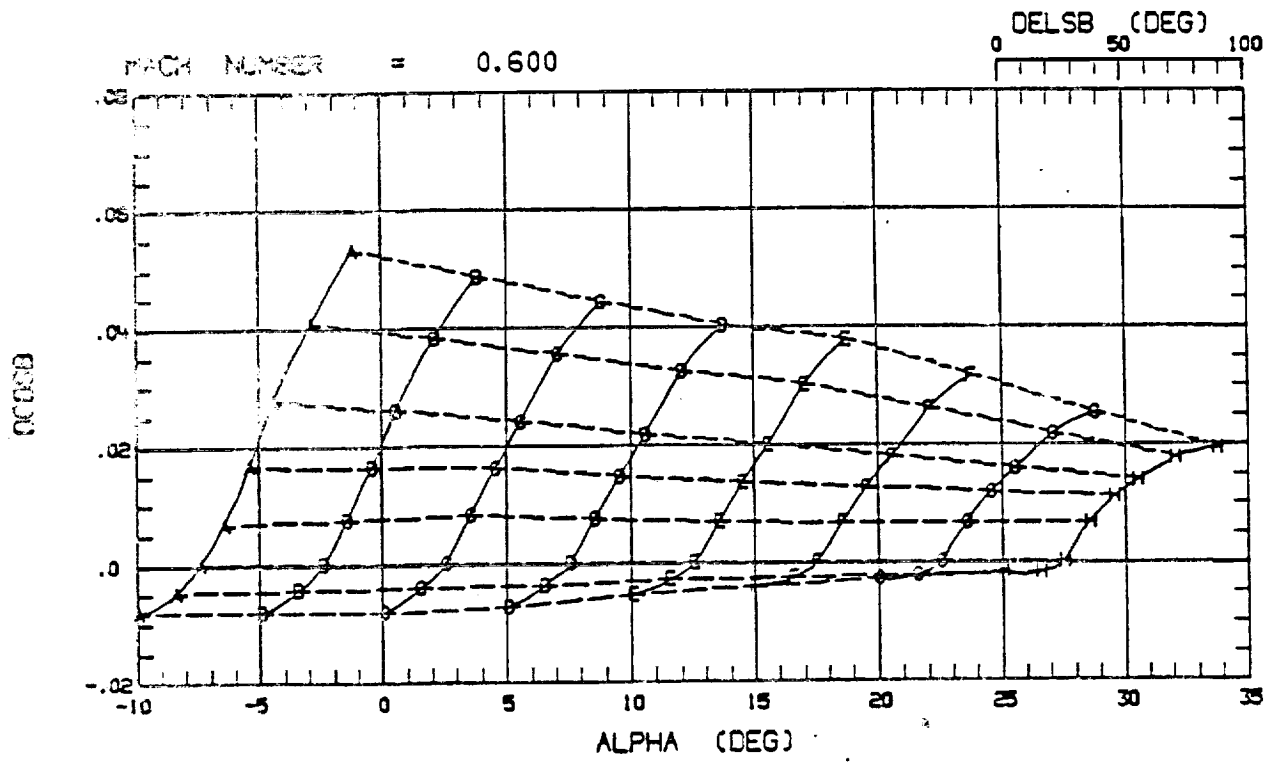


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.01130	-0.01001	-0.00870	-0.00735	-0.00600	-0.00468	-0.00340	-0.00350
15.000	-0.00700	-0.00587	-0.00500	-0.00450	-0.00400	-0.00350	-0.00300	-0.00140
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00800	0.00762	0.00700	0.00600	0.00500	0.00450	0.00400	0.00300
45.000	0.01560	0.01471	0.01330	0.01110	0.00890	0.00795	0.00700	0.00560
55.000	0.02420	0.02296	0.02100	0.01795	0.01490	0.01251	0.01050	0.00880
70.000	0.03760	0.03591	0.03340	0.02976	0.02590	0.02190	0.01790	0.01500
87.200	0.05500	0.05292	0.04960	0.04485	0.04000	0.03515	0.03020	0.02410

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-67
EFFECT OF SPEEDBRAKE

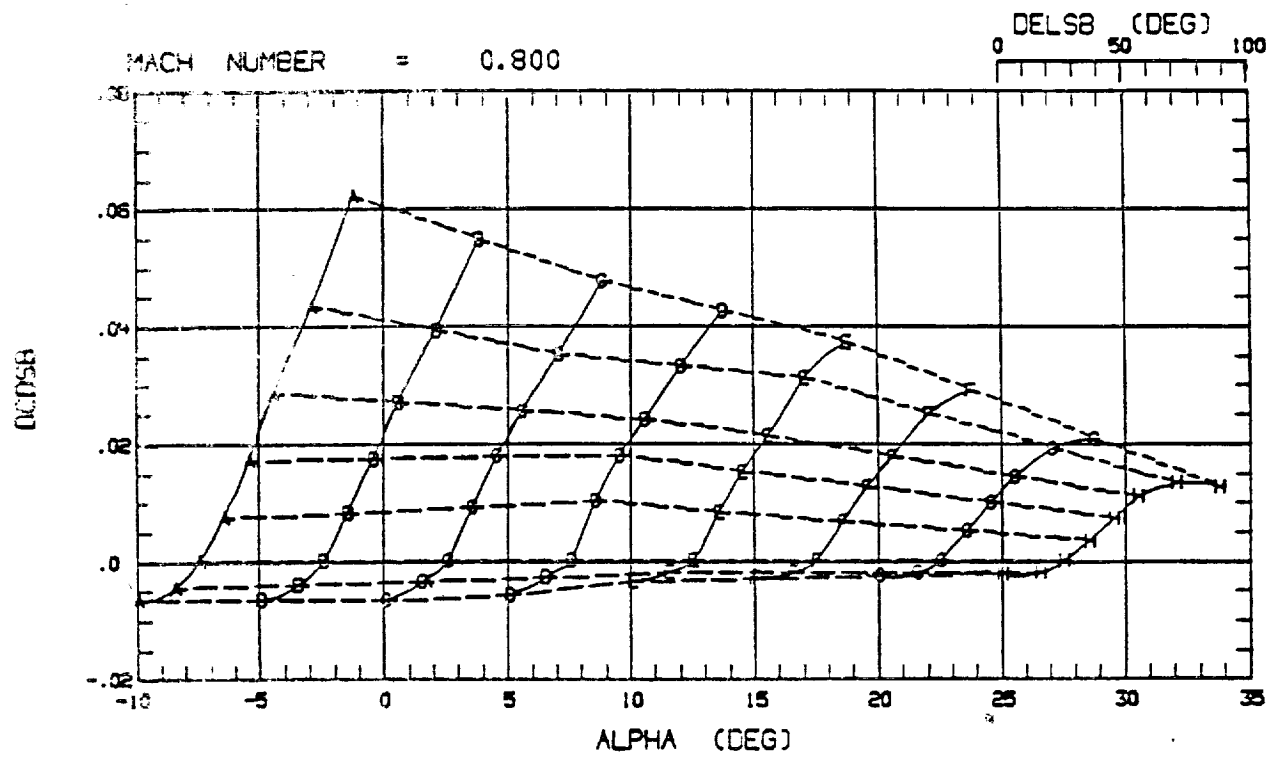


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00818	-0.00812	-0.00806	-0.00735	-0.00522	-0.00400	-0.00278	-0.00156
15.000	-0.00471	-0.00437	-0.00403	-0.00366	-0.00294	-0.00250	-0.00218	-0.00182
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00672	0.00741	0.00811	0.00742	0.00680	0.00674	0.00669	0.00663
45.000	0.01646	0.01630	0.01614	0.01463	0.01340	0.01259	0.01179	0.01098
55.000	0.02768	0.02585	0.02402	0.02169	0.01982	0.01778	0.01574	0.01370
70.000	0.04072	0.03800	0.03528	0.03235	0.03007	0.02590	0.02173	0.01756
87.200	0.05311	0.04864	0.04417	0.04012	0.03765	0.03145	0.02525	0.01905

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-68
EFFECT OF SPEEDBRAKE

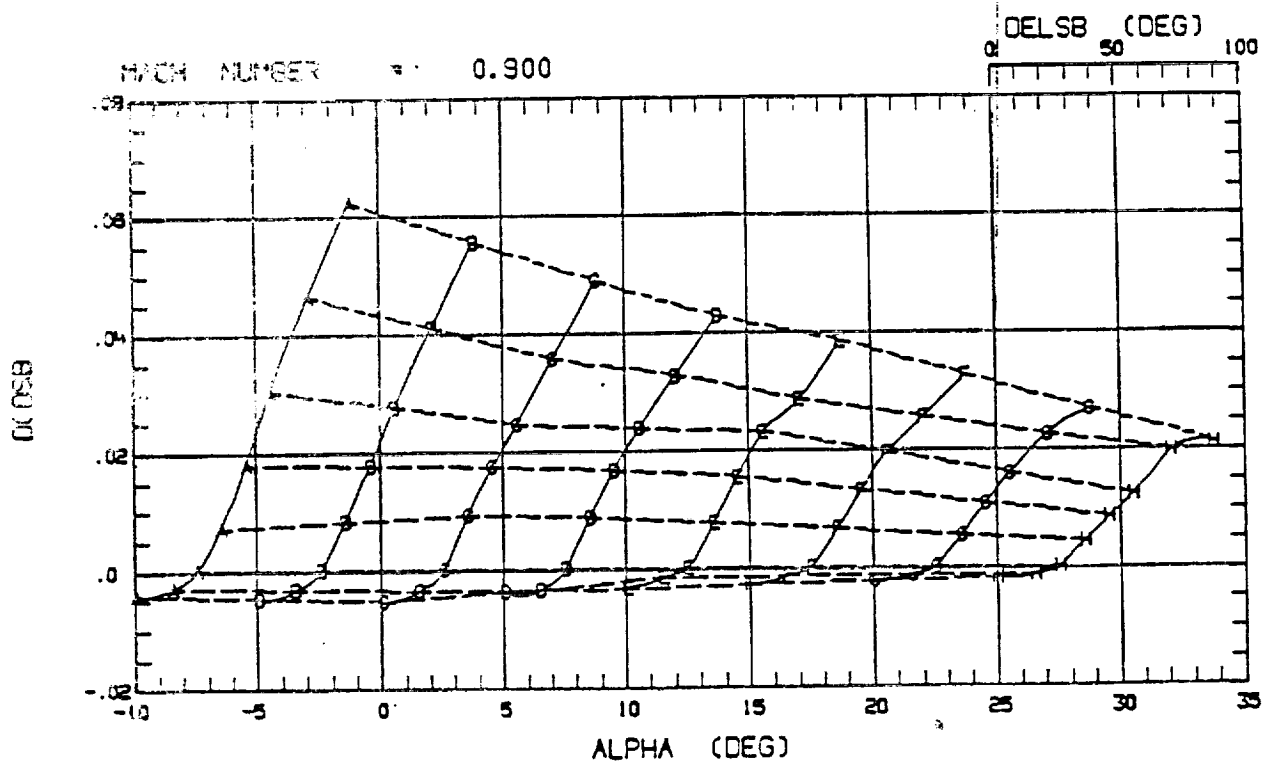


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00661	-0.00662	-0.00663	-0.00571	-0.00350	-0.00305	-0.00260	-0.00215
15.000	-0.00445	-0.00394	-0.00343	-0.00291	-0.00200	-0.00200	-0.00200	-0.00200
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00734	0.00822	0.00911	0.01014	0.00821	0.00661	0.00500	0.00339
45.000	0.01709	0.01740	0.01772	0.01784	0.01514	0.01252	0.00990	0.00727
55.000	0.02852	0.02701	0.02550	0.02381	0.02103	0.01766	0.01429	0.01092
70.000	0.04312	0.03914	0.03516	0.03311	0.03093	0.02500	0.01907	0.01314
87.200	0.06198	0.05472	0.04746	0.04232	0.03723	0.02898	0.02073	0.01248

ENGINEER DGD
DATE 9-13-78

FIGURE 4.1.2.2-69
EFFECT OF SPEEDBRAKE



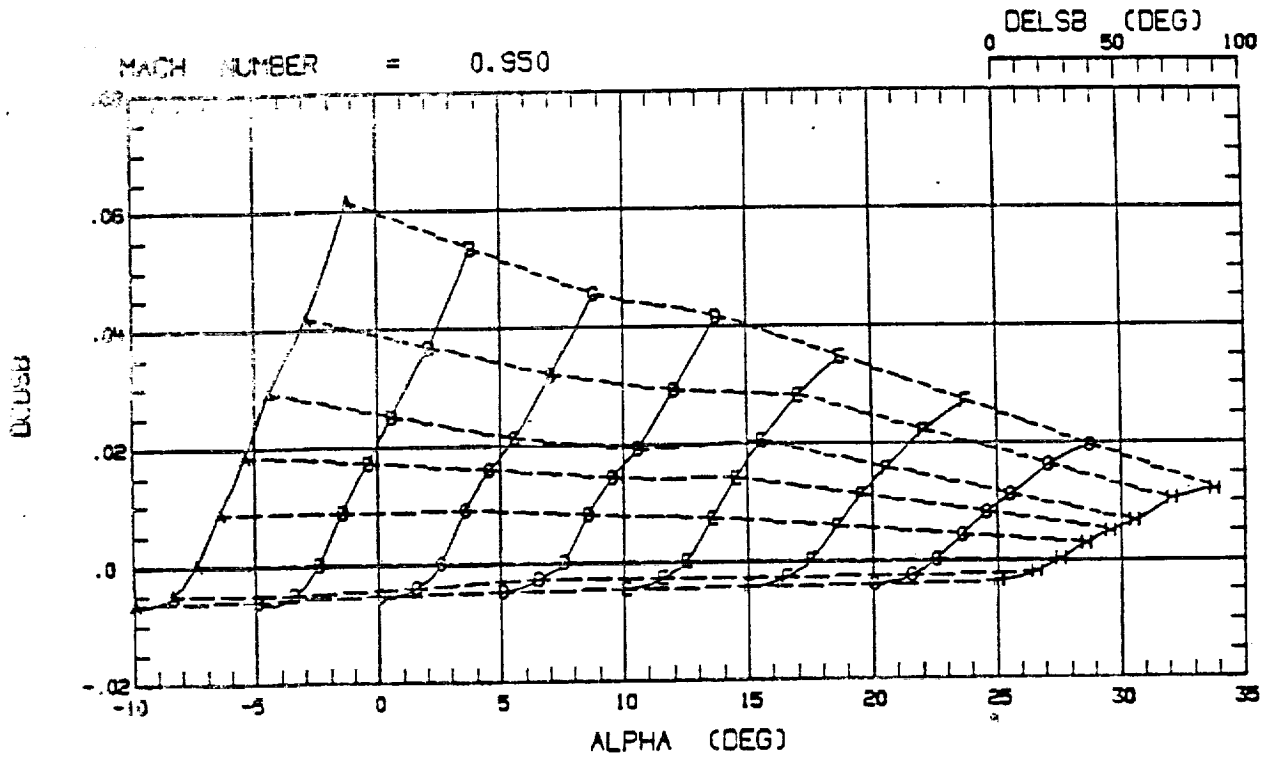
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00419	-0.00468	-0.00517	-0.00373	-0.00330	-0.00274	-0.00218	-0.00162
15.000	-0.00298	-0.00323	-0.00351	-0.00338	-0.00140	-0.00134	-0.00128	-0.00122
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00721	0.00823	0.00926	0.00863	0.00767	0.00654	0.00542	0.00430
45.000	0.01796	0.01759	0.01731	0.01663	0.01533	0.01303	0.01073	0.00843
55.000	0.03025	0.02739	0.02453	0.02385	0.02300	0.01939	0.01578	0.01217
70.000	0.04617	0.04083	0.03549	0.03265	0.02850	0.02550	0.02250	0.01950
87.200	0.06214	0.05541	0.04868	0.04266	0.03828	0.03250	0.02672	0.02094

ENGINEER
DATE 9-12-75

FIGURE 4.1.2.2-70
EFFECT OF SPEEDBRAKE



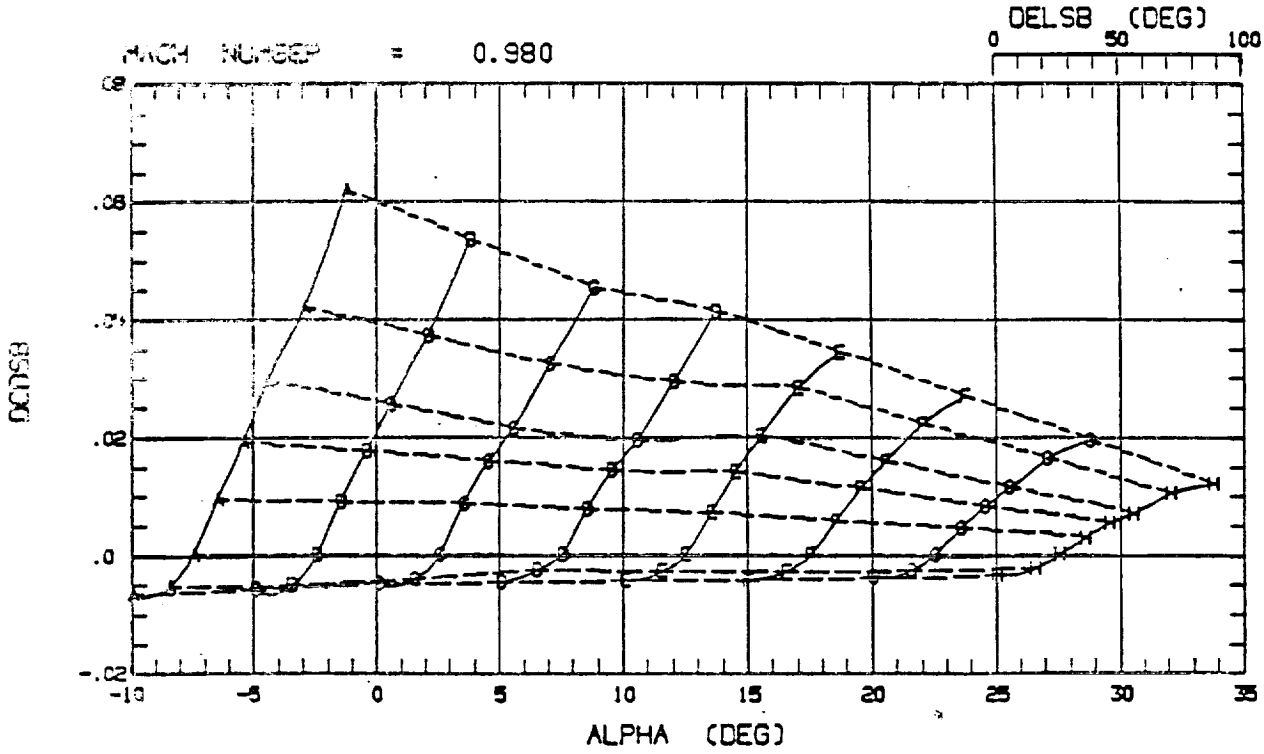
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00650	-0.00600	-0.00530	-0.00488	-0.00450	-0.00431	-0.00400	-0.00350
15.000	-0.00500	-0.00500	-0.00400	-0.00271	-0.00270	-0.00267	-0.00250	-0.00200
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00863	0.00874	0.00884	0.00788	0.00720	0.00567	0.00415	0.00262
45.000	0.01836	0.01706	0.01576	0.01421	0.01404	0.01094	0.00784	0.00474
55.000	0.02895	0.02498	0.02101	0.01917	0.02026	0.01562	0.01098	0.00634
70.000	0.04164	0.03670	0.03176	0.02903	0.02785	0.02194	0.01603	0.01012
87.200	0.06137	0.05337	0.04537	0.04147	0.03448	0.02691	0.01934	0.01177

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-71
EFFECT OF SPEEDBRAKE

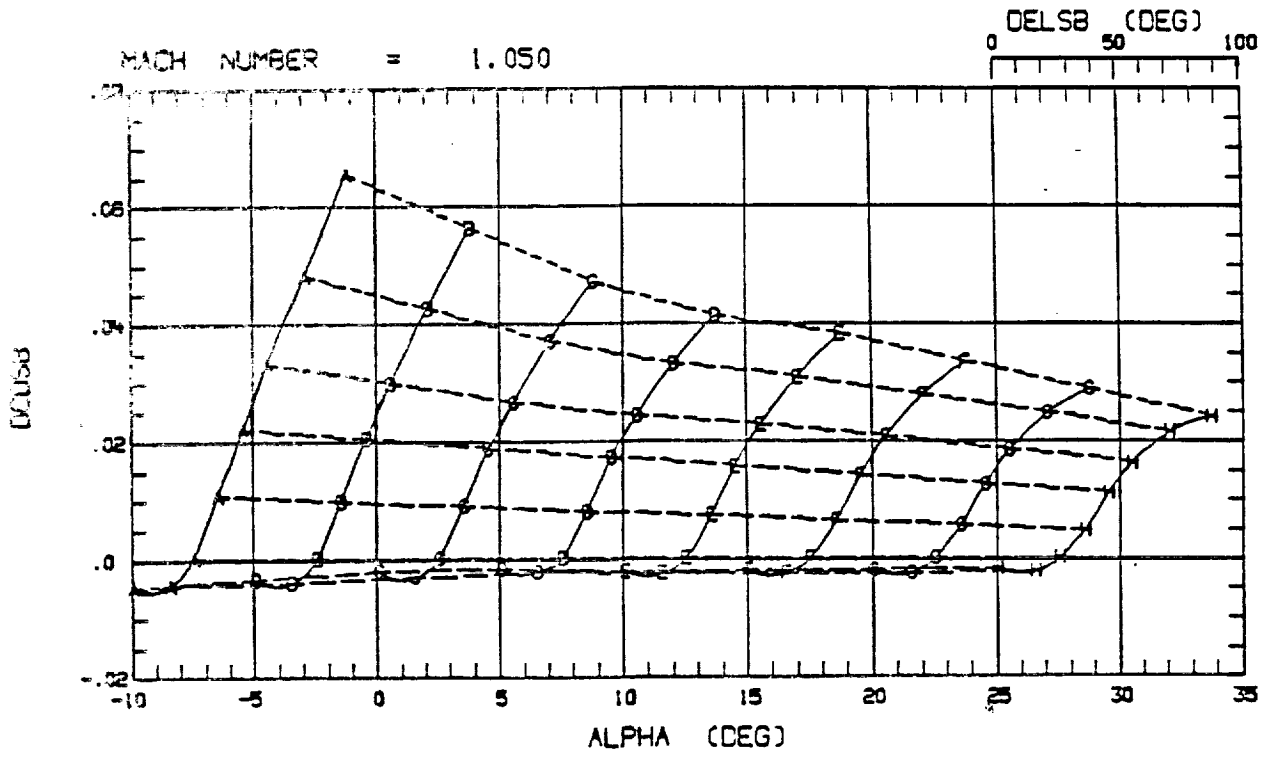


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00662	-0.00584	-0.00480	-0.00462	-0.00437	-0.00420	-0.00388	-0.00334
15.000	-0.00525	-0.00510	-0.00394	-0.00245	-0.00285	-0.00271	-0.00260	-0.00224
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00935	0.00903	0.00873	0.00773	0.00709	0.00570	0.00453	0.00289
45.000	0.01905	0.01746	0.01591	0.01420	0.01400	0.01110	0.00824	0.00541
55.000	0.02936	0.02537	0.02143	0.01931	0.02016	0.01578	0.01140	0.00702
70.000	0.04198	0.03709	0.03221	0.02918	0.02820	0.02222	0.01627	0.01033
87.200	0.06181	0.05345	0.04533	0.04116	0.03434	0.02690	0.01946	0.01202

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-72
EFFECT OF SPEEDBRAKE

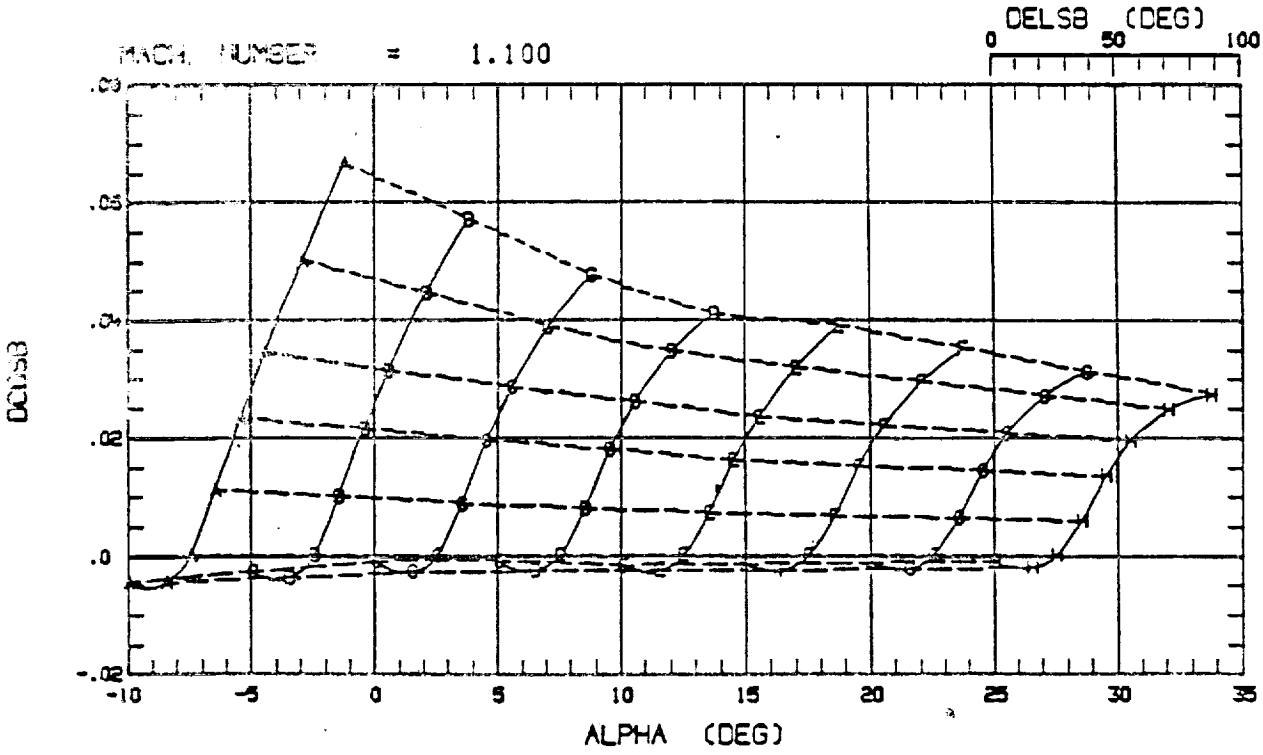


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XB = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YB = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZB = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00483	-0.00342	-0.00201	-0.00181	-0.00229	-0.00209	-0.00188	-0.00162
15.000	-0.00443	-0.00390	-0.00311	-0.00228	-0.00257	-0.00247	-0.00239	-0.00227
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01072	0.00967	0.00890	0.00804	0.00733	0.00648	0.00560	0.00455
45.000	0.02189	0.02027	0.01860	0.01705	0.01565	0.01413	0.01258	0.01102
55.000	0.03314	0.02983	0.02648	0.02428	0.02275	0.02054	0.01834	0.01613
70.000	0.04793	0.04240	0.03686	0.03314	0.03085	0.02773	0.02459	0.02144
97.200	0.06529	0.05621	0.04701	0.04112	0.03805	0.03334	0.02963	0.02392

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-73
EFFECT OF SPEEDBRAKE



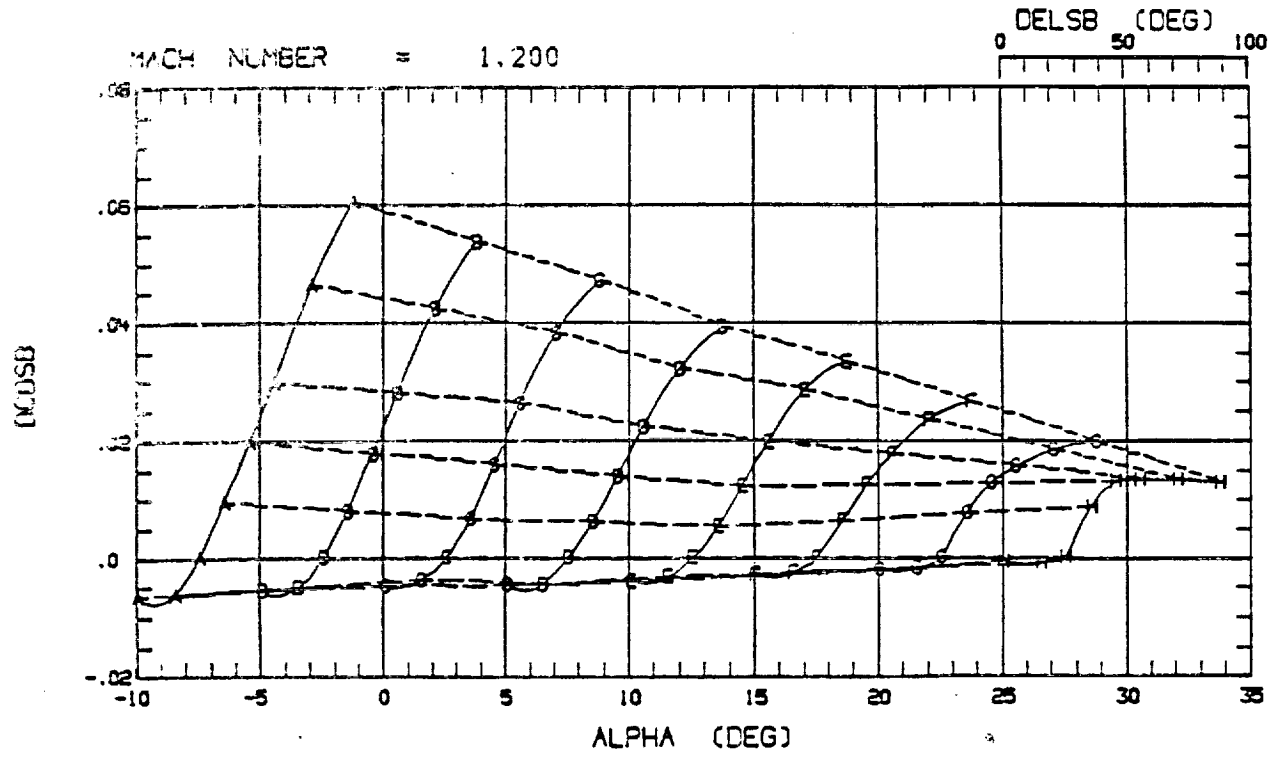
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00443	-0.00267	-0.00091	-0.00090	-0.00185	-0.00140	-0.00115	-0.00090
15.000	-0.00442	-0.00363	-0.00294	-0.00261	-0.00260	-0.00241	-0.00221	-0.00202
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.01105	0.00992	0.00878	0.00793	0.00723	0.00676	0.00630	0.00583
45.000	0.02319	0.02129	0.01939	0.01776	0.01598	0.01510	0.01424	0.01339
55.000	0.03442	0.03139	0.02836	0.02595	0.02334	0.02200	0.02066	0.01932
70.000	0.04997	0.04436	0.03875	0.03447	0.03180	0.02942	0.02704	0.02466
87.200	0.06844	0.05700	0.04755	0.04081	0.03888	0.03500	0.03112	0.02724

ENGINEER DGD
DATE 9-13-78

FIGURE 4.1.2.2-74
EFFECT OF SPEEDBRAKE



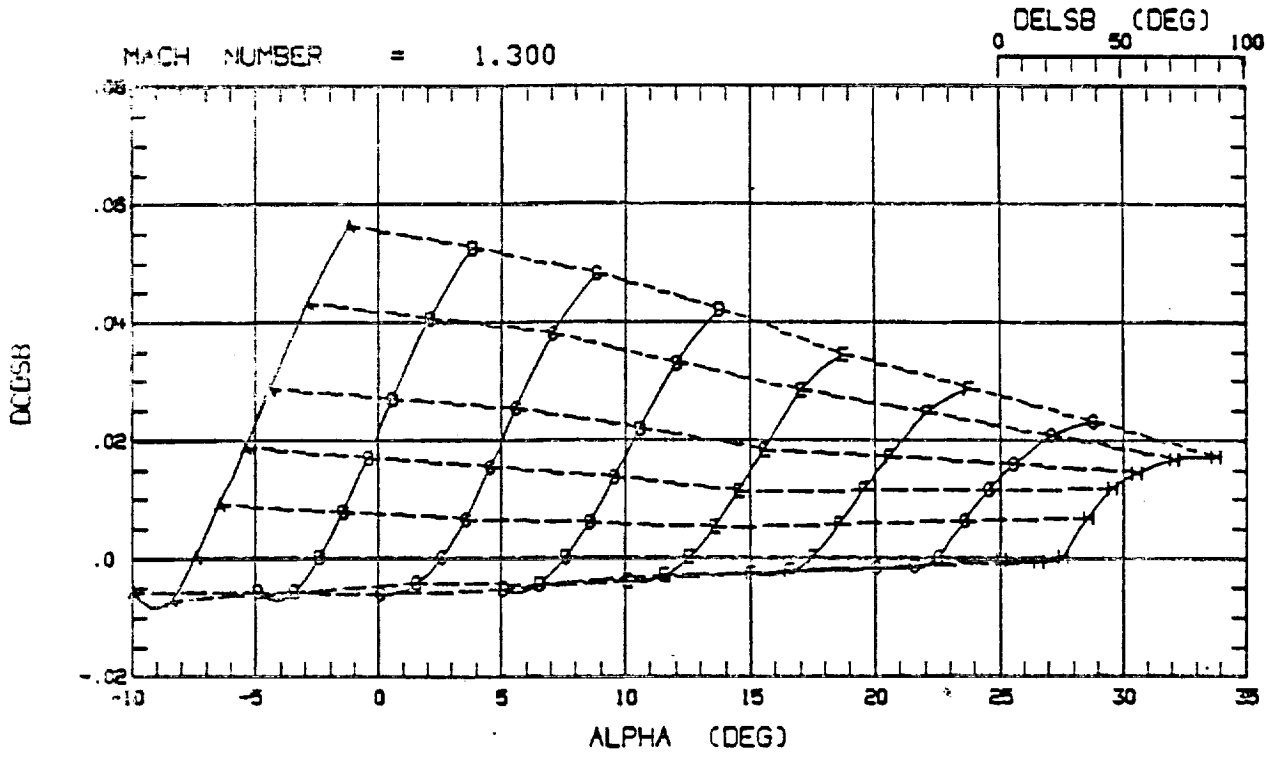
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00659	-0.00563	-0.00467	-0.00463	-0.00411	-0.00301	-0.00191	-0.00081
15.000	-0.00628	-0.00498	-0.00368	-0.00449	-0.00327	-0.00250	-0.00173	-0.00096
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00937	0.00800	0.00663	0.00613	0.00535	0.00547	0.00760	0.00872
45.000	0.01950	0.01785	0.01580	0.01377	0.01217	0.01245	0.01273	0.01301
55.000	0.02975	0.02800	0.02625	0.02220	0.01972	0.01759	0.01546	0.01333
70.000	0.04624	0.04223	0.03822	0.03215	0.02960	0.02350	0.01840	0.01330
87.200	0.06037	0.05371	0.04705	0.03919	0.03335	0.02650	0.01965	0.01280

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-75
EFFECT OF SPEEDBRAKE

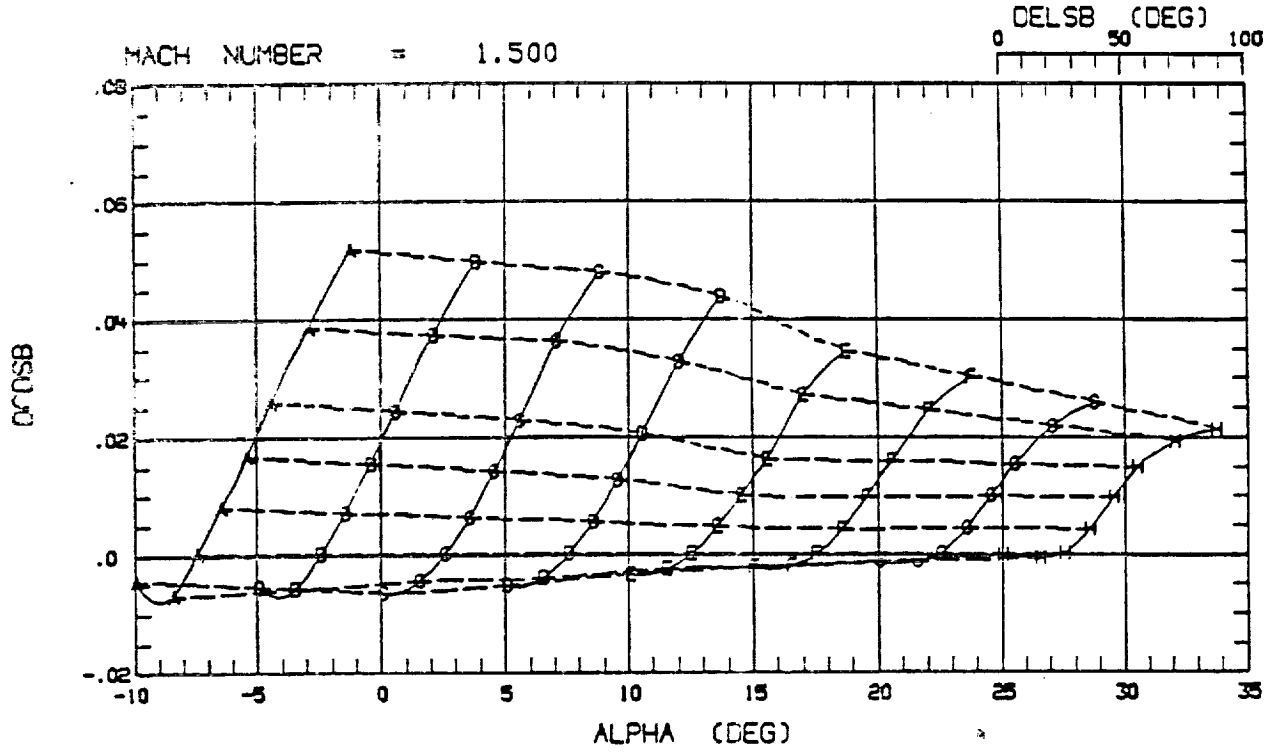


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN..	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00572	-0.00582	-0.00601	-0.00519	-0.00390	-0.00275	-0.00163	-0.00050
15.000	-0.00709	-0.00570	-0.00429	-0.00444	-0.00299	-0.00225	-0.00146	-0.00069
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00884	0.00768	0.00652	0.00592	0.00508	0.00563	0.00618	0.00672
45.000	0.01849	0.01688	0.01528	0.01341	0.01127	0.01137	0.01148	0.01159
55.000	0.02945	0.02677	0.02509	0.02170	0.01819	0.01702	0.01571	0.01439
70.000	0.04295	0.04045	0.03779	0.03284	0.02925	0.02438	0.02051	0.01664
87.200	0.05619	0.05226	0.04791	0.04185	0.03432	0.02855	0.02278	0.01700

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-76
EFFECT OF SPEEDBRAKE



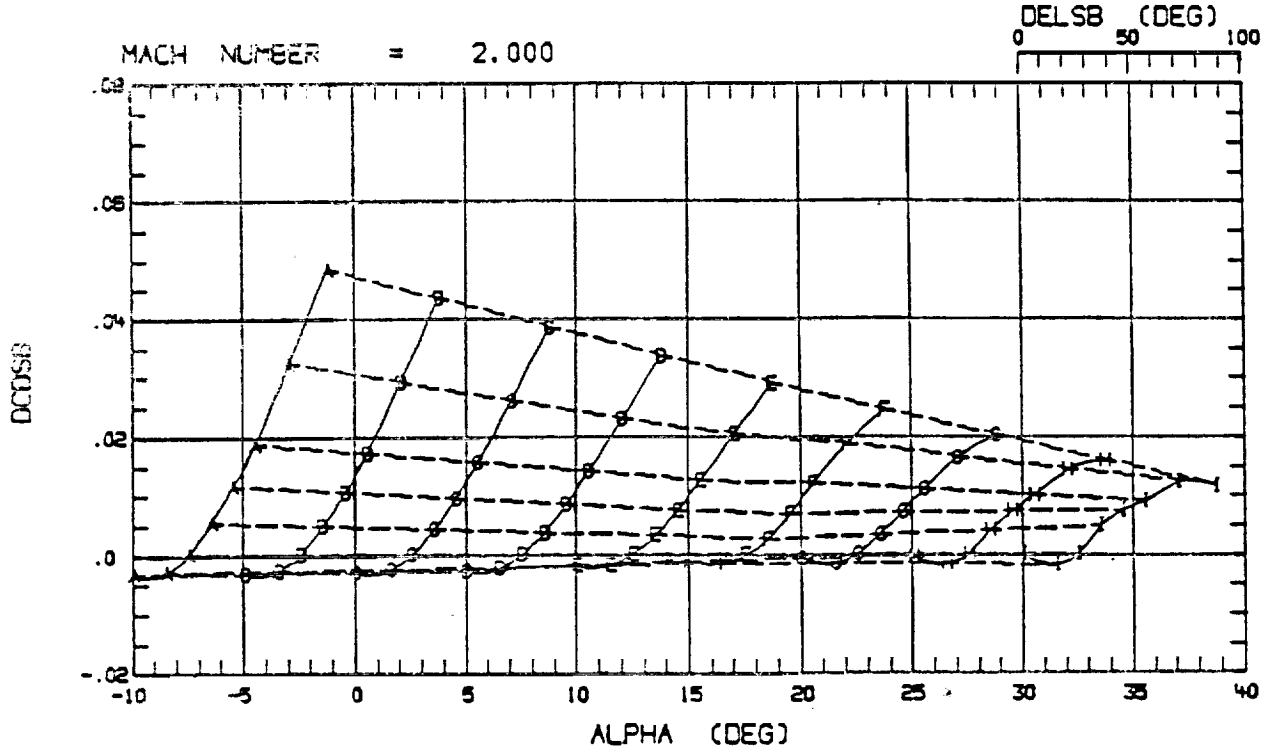
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00443	-0.00550	-0.00650	-0.00519	-0.00338	-0.00225	-0.00124	-0.00014
15.000	-0.00710	-0.00581	-0.00452	-0.00403	-0.00250	-0.00187	-0.00123	-0.00060
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00782	0.00699	0.00614	0.00543	0.00456	0.00422	0.00437	0.00413
45.000	0.01647	0.01528	0.01403	0.01245	0.00993	0.00972	0.00983	0.00959
55.000	0.02577	0.02420	0.02264	0.02027	0.01602	0.01579	0.01524	0.01477
70.000	0.03847	0.03704	0.03599	0.03248	0.02589	0.02431	0.02167	0.01908
87.200	0.05163	0.04957	0.04767	0.04364	0.03437	0.02998	0.02561	0.02119

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-77
EFFECT OF SPEEDBRAKE



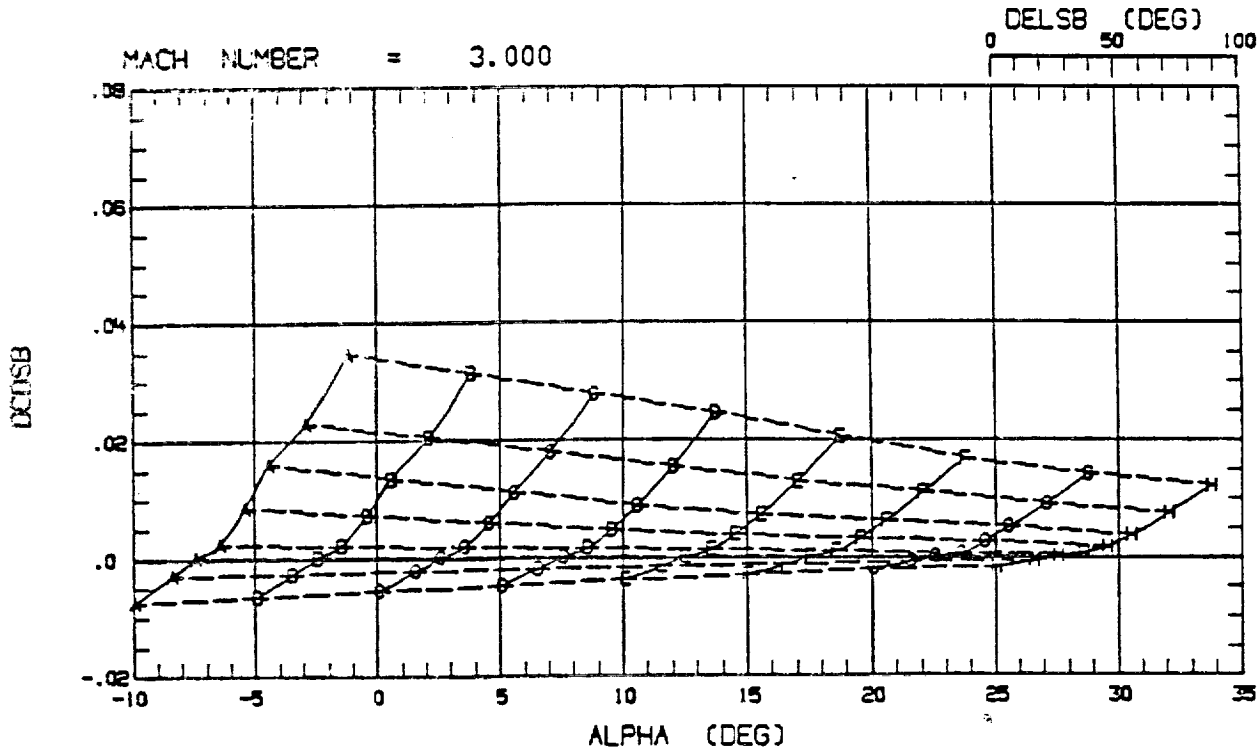
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT								
0.0	-0.00333	-0.00314	-0.00295	-0.00276	-0.00185	-0.00111	-0.00074	-0.00037	0.0
15.000	-0.00294	-0.00268	-0.00243	-0.00218	-0.00177	-0.00139	-0.00148	-0.00157	-0.00166
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00536	0.00482	0.00427	0.00373	0.00324	0.00265	0.00337	0.00410	0.00482
45.000	0.01145	0.01046	0.00948	0.00849	0.00749	0.00691	0.00712	0.00732	0.00753
55.000	0.01847	0.01697	0.01547	0.01397	0.01243	0.01200	0.01101	0.01002	0.00903
70.000	0.03230	0.02913	0.02596	0.02279	0.02036	0.01850	0.01642	0.01434	0.01225
87.200	0.04823	0.04336	0.03849	0.03362	0.02998	0.02438	0.02006	0.01574	0.01142

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-78
EFFECT OF SPEEDBRAKE



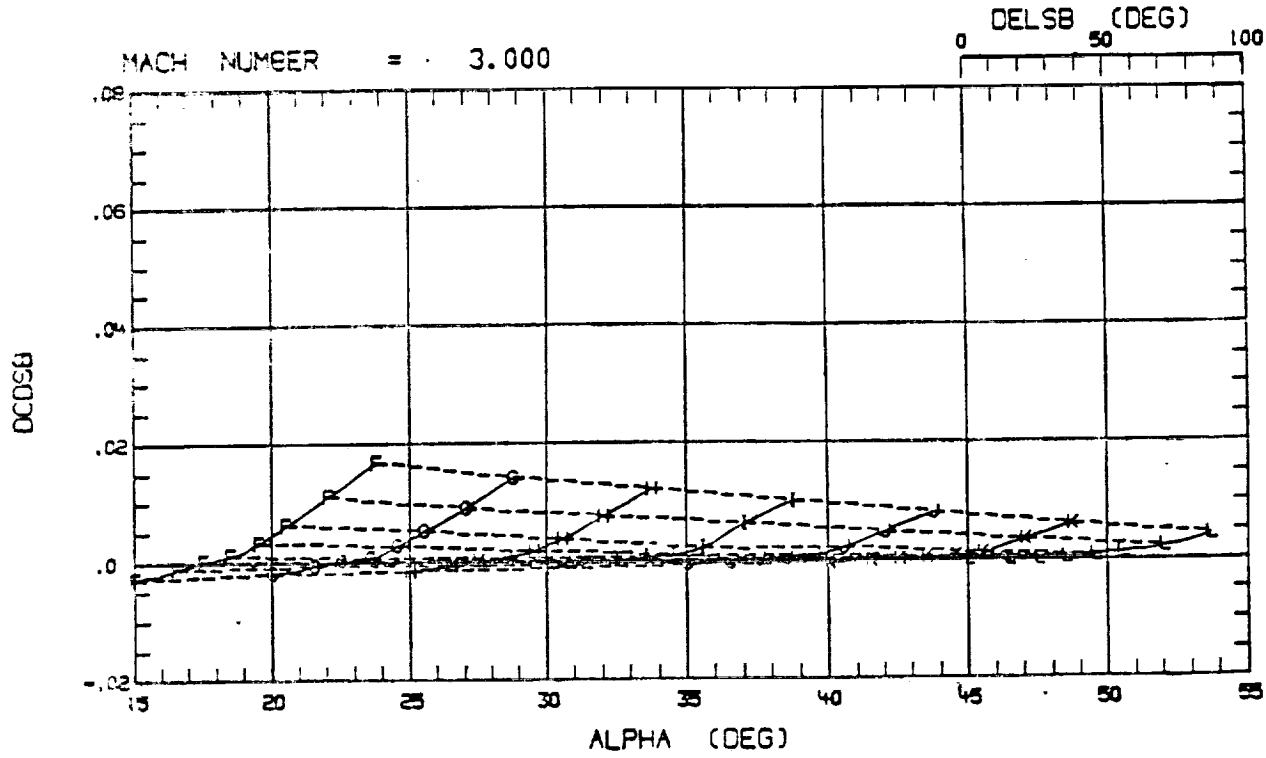
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00762	-0.00663	-0.00565	-0.00467	-0.00387	-0.00307	-0.00208	-0.00167
15.000	-0.00305	-0.00265	-0.00226	-0.00187	-0.00155	-0.00123	-0.00083	-0.00067
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00232	0.00205	0.00179	0.00152	0.00127	0.00096	0.00055	0.00050
45.000	0.00836	0.00711	0.00587	0.00462	0.00377	0.00314	0.00248	0.00167
55.000	0.01570	0.01337	0.01104	0.00871	0.00717	0.00611	0.00502	0.00350
70.000	0.02272	0.02023	0.01774	0.01525	0.01284	0.01089	0.00888	0.00750
87.200	0.03459	0.03116	0.02773	0.02430	0.02037	0.01684	0.01400	0.01200

ENGINEER LSD
DATE 10-3-78

FIGURE 4.1.2.2-79
EFFECT OF SPEEDBRAKE



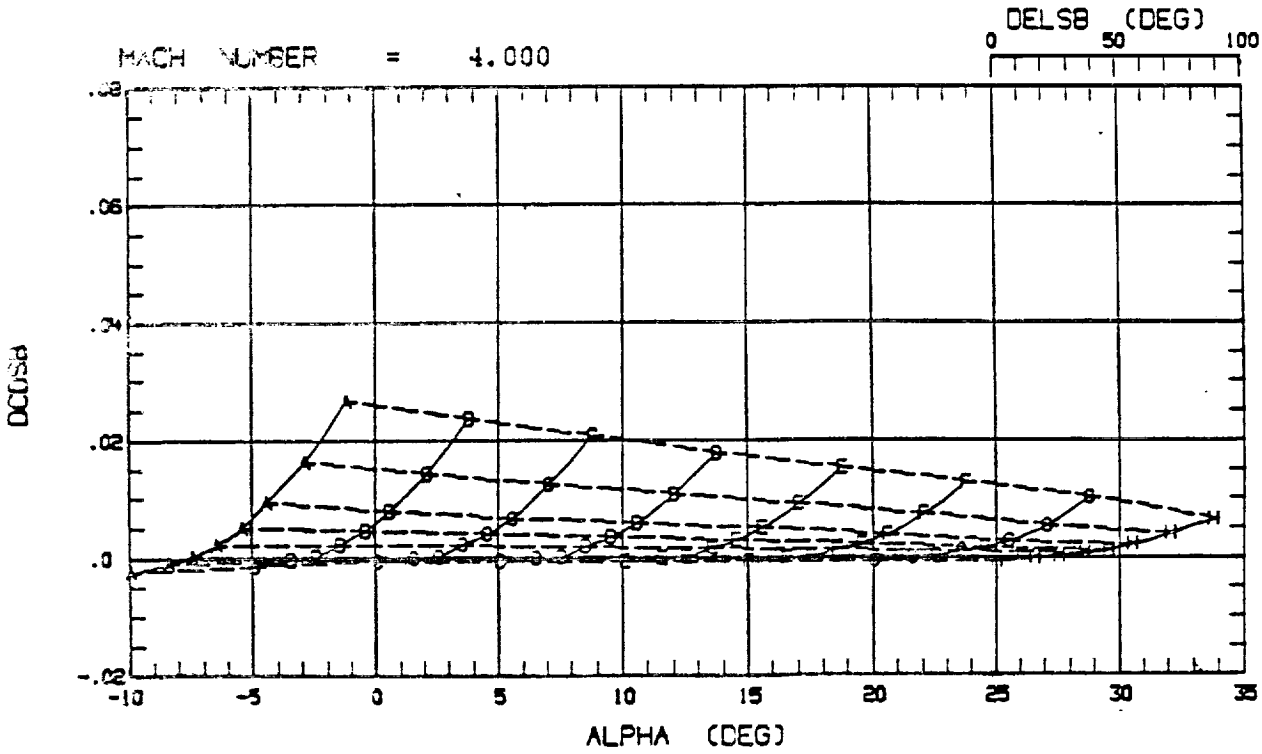
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT						
0.0	-0.00307	-0.00208	-0.00167	-0.00125	-0.00083	-0.00042	0.0
15.000	-0.00123	-0.00083	-0.00067	-0.00050	-0.00033	-0.00017	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00096	0.00065	0.00050	0.00045	0.00039	0.00034	0.00029
45.000	0.00314	0.00248	0.00167	0.00085	0.00080	0.00050	0.00060
55.000	0.00611	0.00502	0.00350	0.00198	0.00200	0.00106	0.00100
70.000	0.01089	0.00888	0.00750	0.00612	0.00474	0.00336	0.00198
87.200	0.01664	0.01400	0.01200	0.01000	0.00800	0.00600	0.00400

ENGINEER DGD
DATE 9-12-75

FIGURE 4.1.2.2-80
EFFECT OF SPEEDBRAKE

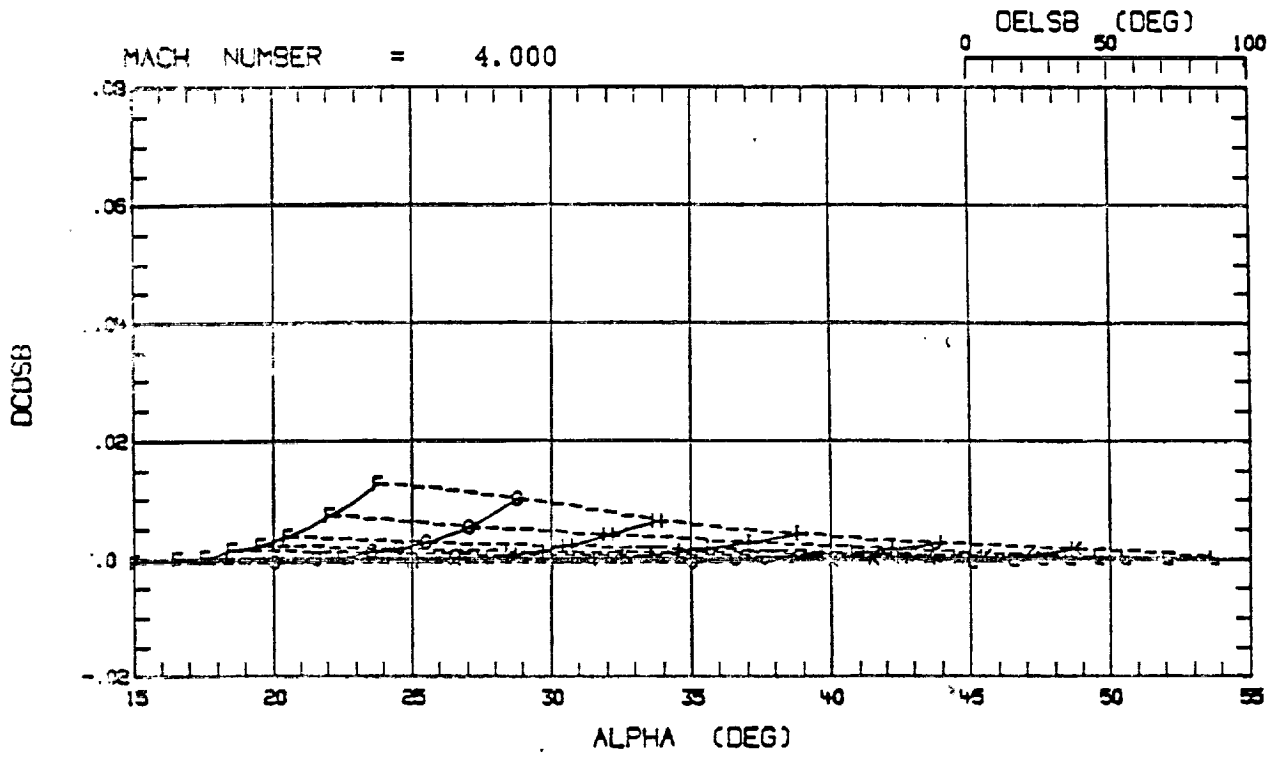


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00250	-0.00137	-0.00070	-0.00070	-0.00070	-0.00070	-0.00070	-0.00070
15.000	-0.00100	-0.00056	-0.00030	-0.00030	-0.00030	-0.00030	-0.00030	-0.00030
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00220	0.00214	0.00200	0.00175	0.00150	0.00125	0.00100	0.00050
45.000	0.00490	0.00441	0.00390	0.00337	0.00280	0.00215	0.00150	0.00110
55.000	0.00910	0.00769	0.00650	0.00565	0.00480	0.00370	0.00260	0.00200
70.000	0.01600	0.01404	0.01220	0.01055	0.00890	0.00705	0.00520	0.00390
87.200	0.02650	0.02344	0.02050	0.01769	0.01500	0.01250	0.01000	0.00620

ENGINEER DSD
DATE 9-12-78

FIGURE 4.1.2.2- 81
EFFECT OF SPEEDBRAKE

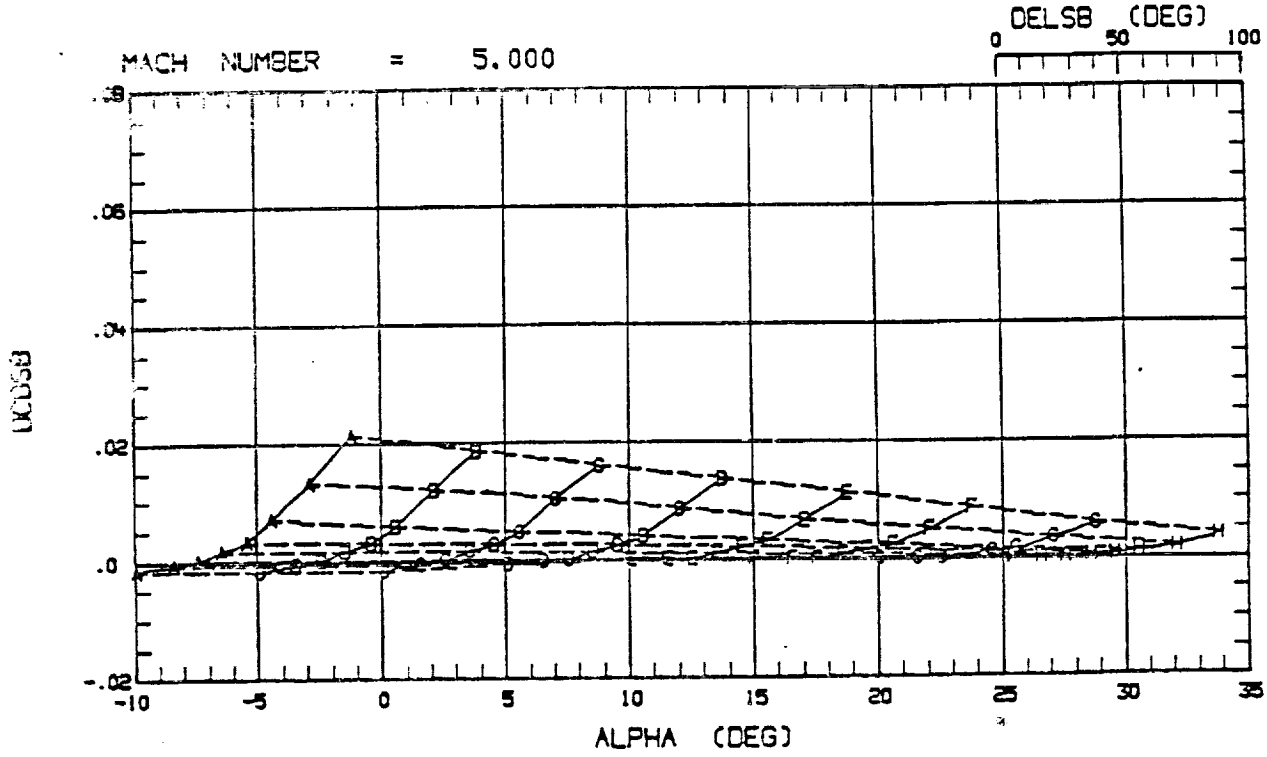


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT						
0.0	-0.00070	-0.00070	-0.00070	-0.00070	-0.00063	-0.00050	-0.00040
15.000	-0.00030	-0.00030	-0.00030	-0.00030	-0.00030	-0.00030	-0.00030
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00125	0.00100	0.00050	0.00050	0.00033	0.0	0.0
45.000	0.00215	0.00150	0.00110	0.00110	0.00073	0.0	0.0
55.000	0.00370	0.00260	0.00200	0.00150	0.00093	0.00030	0.0
70.000	0.00705	0.00520	0.00390	0.00260	0.00147	0.00050	0.0
87.200	0.01250	0.01000	0.00620	0.00400	0.00250	0.00170	0.0

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-82
EFFECT OF SPEEDBRAKE



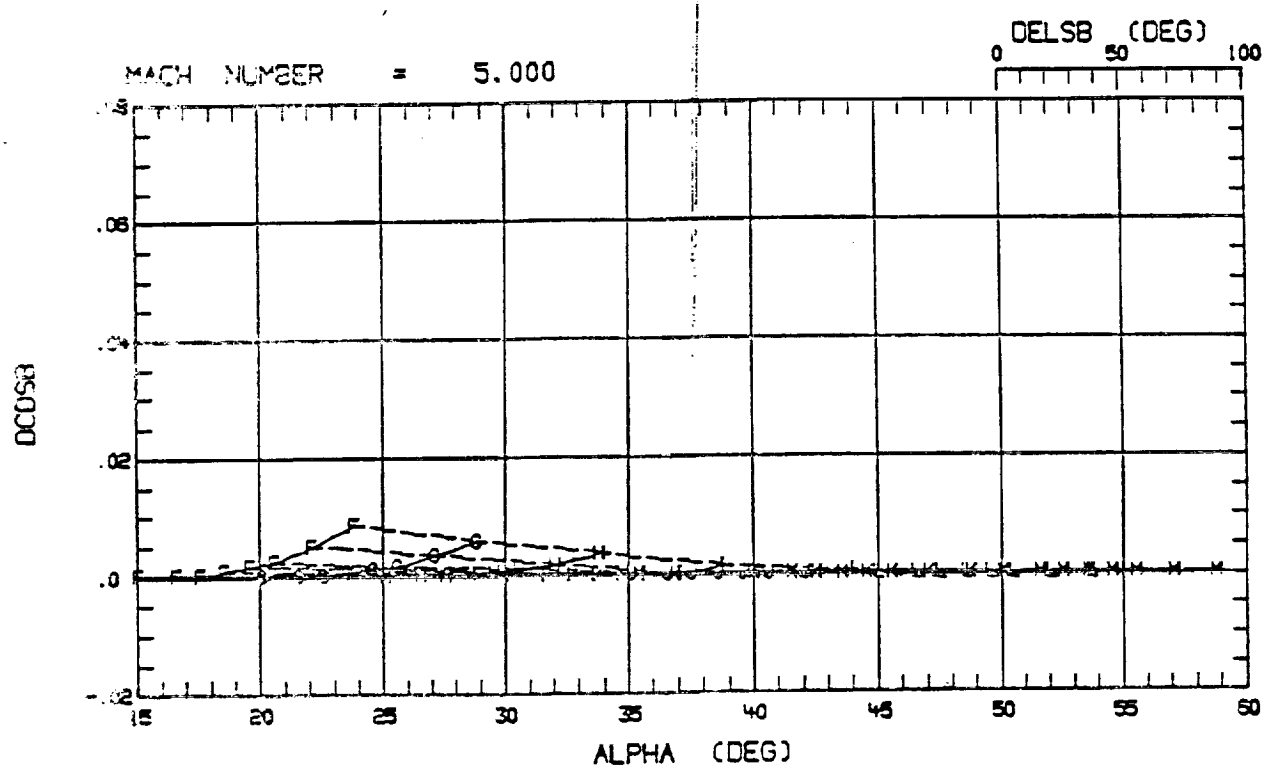
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00160	-0.00180	-0.00160	-0.00080	0.0	0.0	0.0	0.0
15.000	-0.00060	-0.00067	-0.00060	-0.00030	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00160	0.00160	0.00150	0.00125	0.00100	0.00075	0.00050	0.00030
45.000	0.00320	0.00296	0.00270	0.00242	0.00210	0.00184	0.00110	0.00050
55.000	0.00680	0.00569	0.00470	0.00390	0.00310	0.00230	0.00150	0.00100
70.000	0.01310	0.01182	0.01030	0.00840	0.00650	0.00490	0.00330	0.00170
87.200	0.02110	0.01839	0.01580	0.01340	0.01100	0.00835	0.00570	0.00350

ENGINEER DGD
DATE 9-12-88

FIGURE 4.1.2.2-83
EFFECT OF SPEEDBRAKE



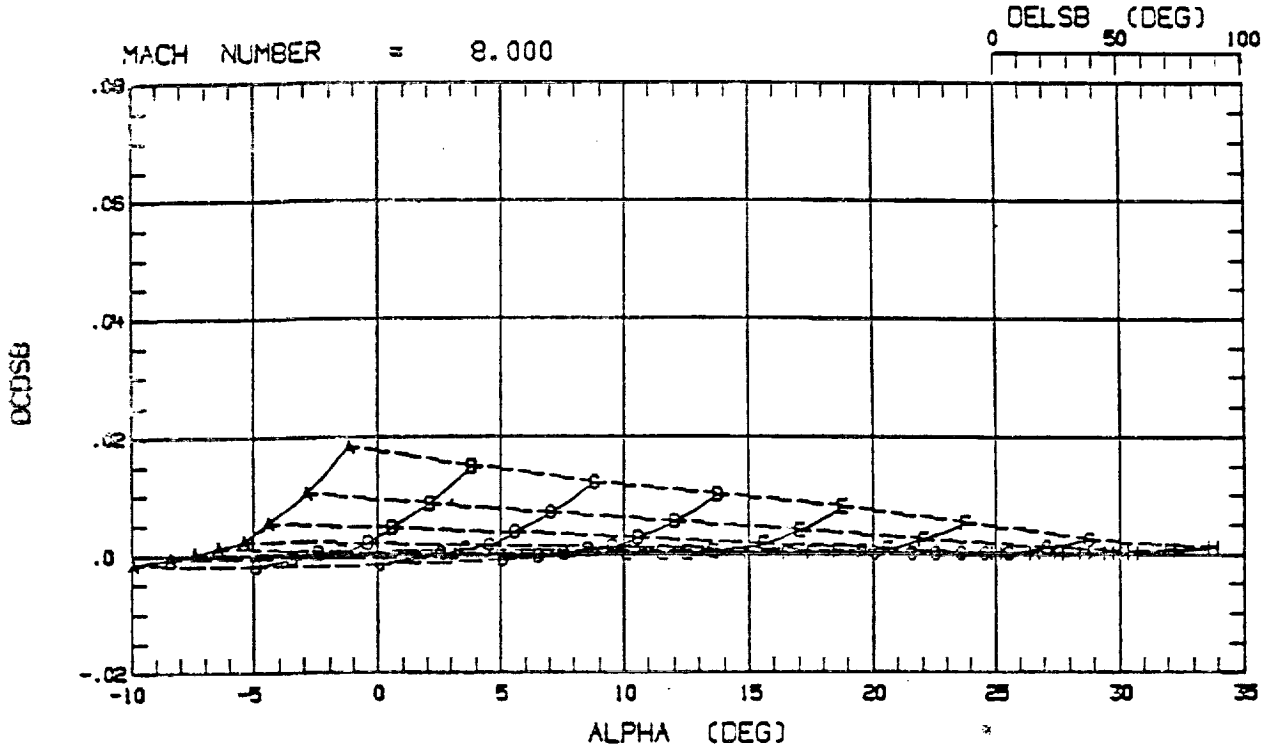
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00075	0.00050	0.00030	0.0	0.0	0.0	0.0	0.0
45.000	0.00164	0.00110	0.00050	0.0	0.0	0.0	0.0	0.0
55.000	0.00230	0.00150	0.00100	0.0	0.0	0.0	0.0	0.0
70.000	0.00490	0.00330	0.00170	0.0	0.0	0.0	0.0	0.0
87.200	0.00935	0.00570	0.00350	0.00140	0.00045	0.0	0.0	0.0

ENGINEER DGD
DATE 9-12-82

FIGURE 4.1.2.2-84
EFFECT OF SPEEDBRAKE



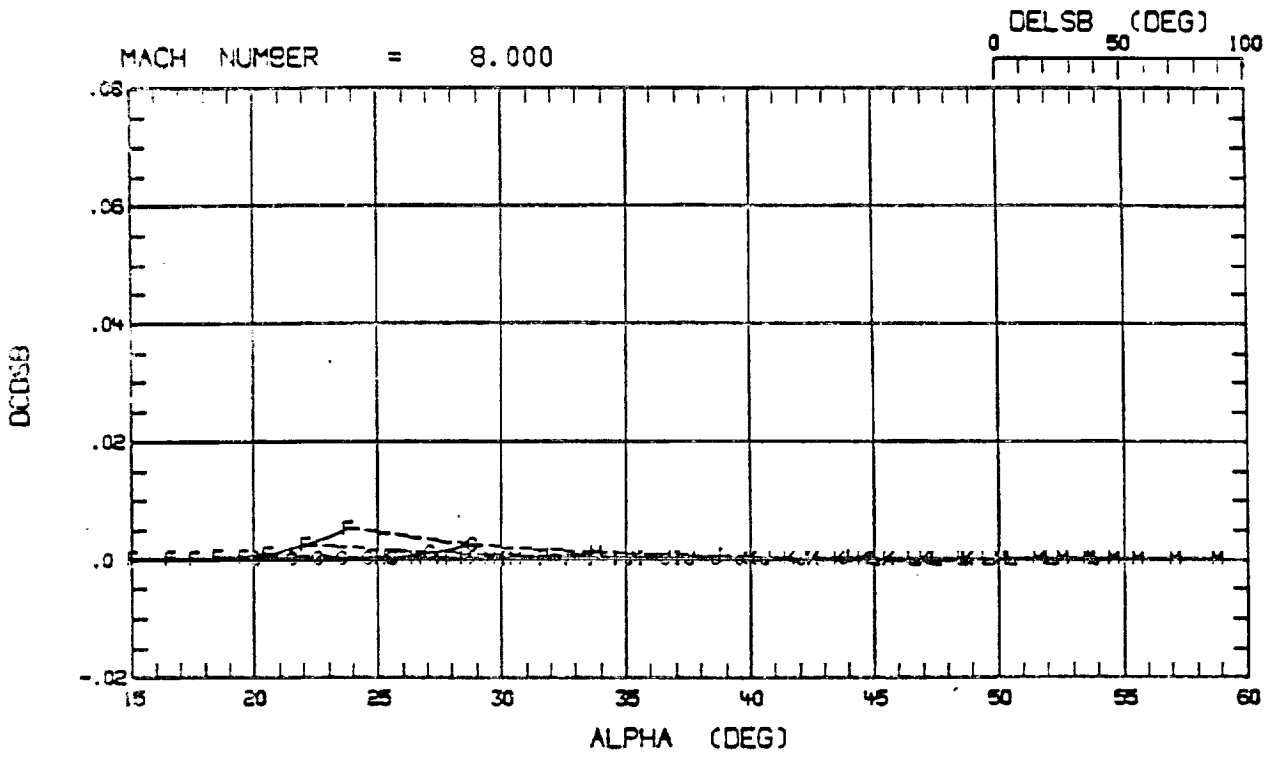
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00180	-0.00202	-0.00180	-0.00090	0.0	0.0	0.0	0.0
15.000	-0.00070	-0.00079	-0.00070	-0.00035	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00100	0.00037	0.00070	0.00055	0.00040	0.00020	0.0	0.0
45.000	0.00220	0.00177	0.00140	0.00110	0.00080	0.00040	0.0	0.0
55.000	0.00510	0.00432	0.00350	0.00260	0.00170	0.00083	0.0	0.0
70.000	0.01020	0.00844	0.00680	0.00535	0.00350	0.00245	0.00100	0.00050
87.200	0.01810	0.01489	0.01210	0.00995	0.00780	0.00510	0.00240	0.00100

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-85
EFFECT OF SPEEDBRAKE



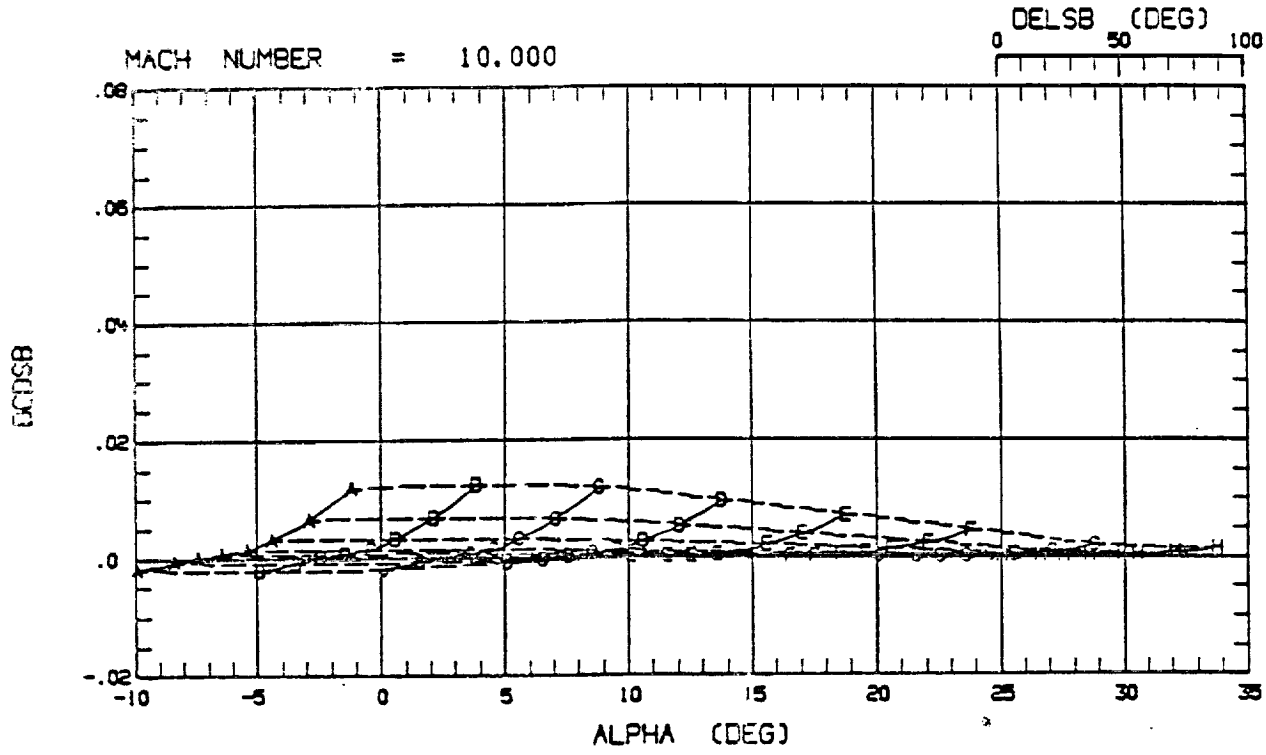
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00020	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00040	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00083	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00245	0.00100	0.00050	0.0	0.0	0.0	0.0	0.0
97.200	0.00510	0.00240	0.00100	0.00050	0.00018	0.0	0.0	0.0

ENGINEER
DATE 9-12-78

FIGURE 4.1.2.2-86
EFFECT OF SPEEDBRAKE



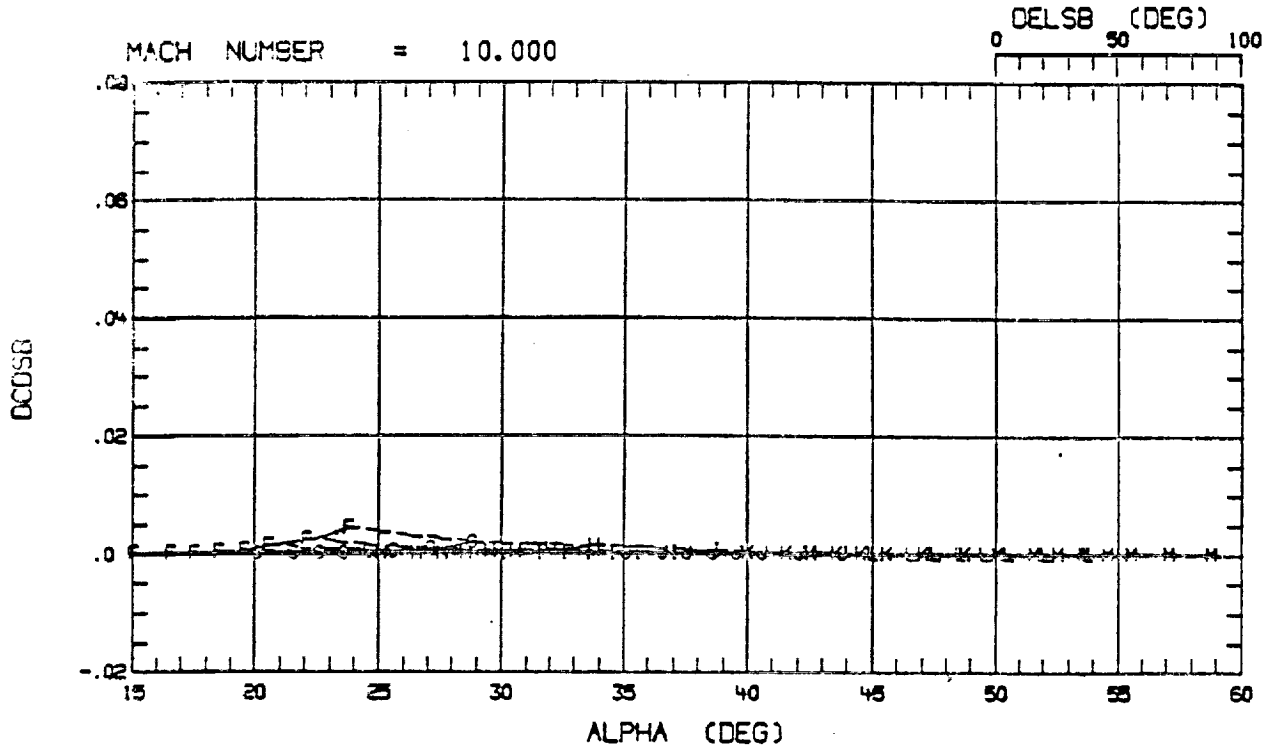
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00210	-0.00236	-0.00210	-0.00105	0.0	0.0	0.0	0.0
15.000	-0.00080	-0.00090	-0.00080	-0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00065	0.00068	0.00068	0.00050	0.00035	0.00023	0.00015	0.00010
45.000	0.00130	0.00137	0.00130	0.00100	0.00070	0.00047	0.00030	0.00020
55.000	0.00300	0.00312	0.00300	0.00259	0.00200	0.00120	0.00040	0.00030
70.000	0.00640	0.00672	0.00640	0.00520	0.00380	0.00225	0.00070	0.00050
87.200	0.01170	0.01229	0.01170	0.00946	0.00700	0.00440	0.00180	0.00130

ENGINEER DGD
DATE 9-12-78

FIGURE 4.1.2.2-87
EFFECT OF SPEEDBRAKE



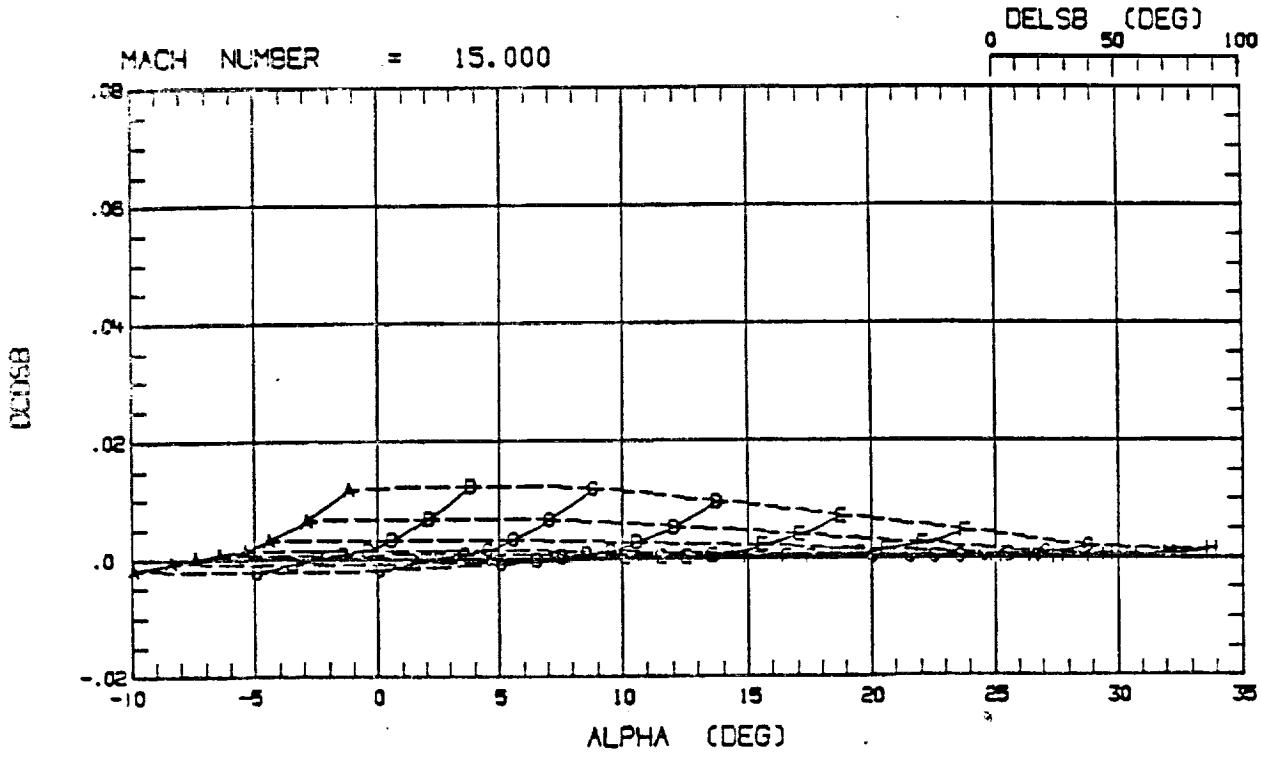
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00023	0.00015	0.00010	0.0	0.0	0.0	0.0	0.0
45.000	0.00047	0.00030	0.00020	0.0	0.0	0.0	0.0	0.0
55.000	0.00120	0.00040	0.00030	0.0	0.0	0.0	0.0	0.0
70.000	0.00225	0.00070	0.00050	0.0	0.0	0.0	0.0	0.0
87.200	0.00440	0.00180	0.00130	0.00050	0.00016	0.0	0.0	0.0

ENGINEER DGD
DATE 9-13-85

FIGURE 4.1.2.2-88
EFFECT OF SPEEDBRAKE



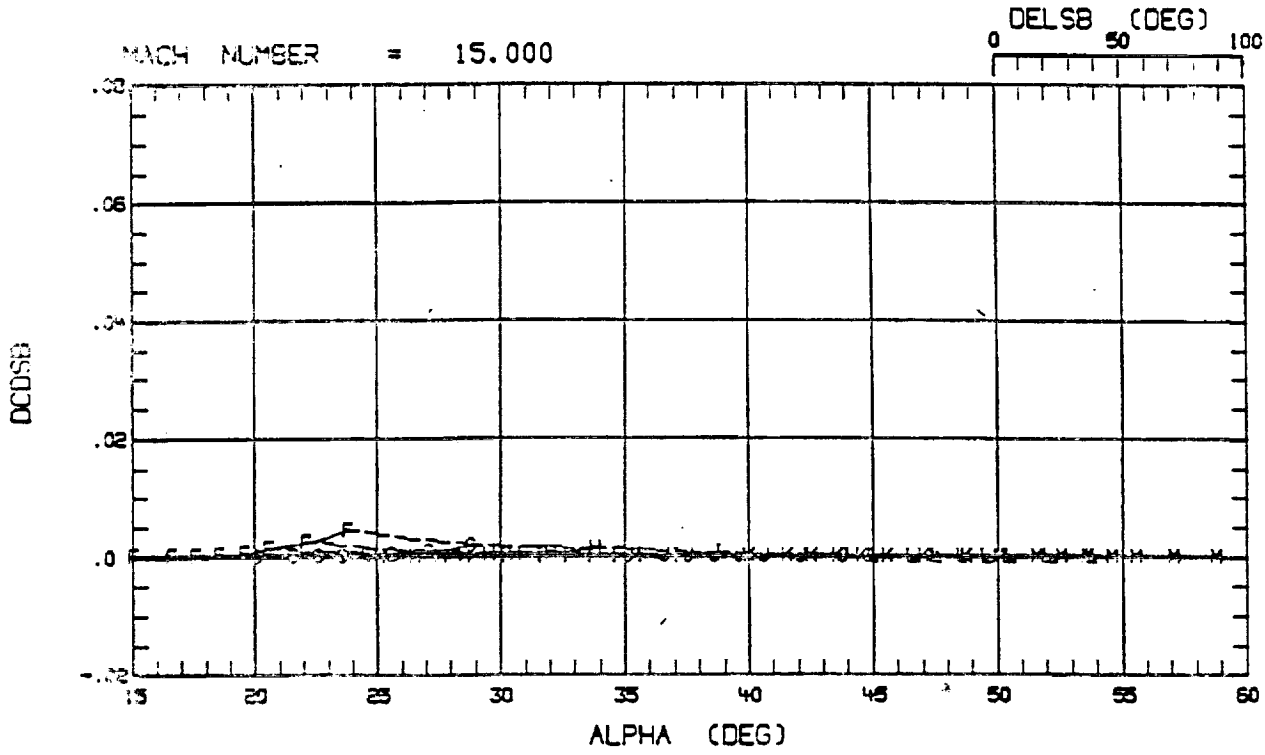
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00210	-0.00236	-0.00210	-0.00105	0.0	0.0	0.0	0.0
15.000	-0.00080	-0.00090	-0.00080	-0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00065	0.00068	0.00068	0.00050	0.00035	0.00023	0.00015	0.00010
45.000	0.00130	0.00137	0.00130	0.00100	0.00070	0.00047	0.00030	0.00020
55.000	0.00300	0.00312	0.00300	0.00259	0.00200	0.00120	0.00040	0.00030
70.000	0.00640	0.00672	0.00640	0.00520	0.00380	0.00225	0.00070	0.00050
87.200	0.01170	0.01229	0.01170	0.00946	0.00700	0.00440	0.00180	0.00130

ENGINEER DSD
DATE 9-12-78

FIGURE 4.1.2.2-89
EFFECT OF SPEEDBRAKE

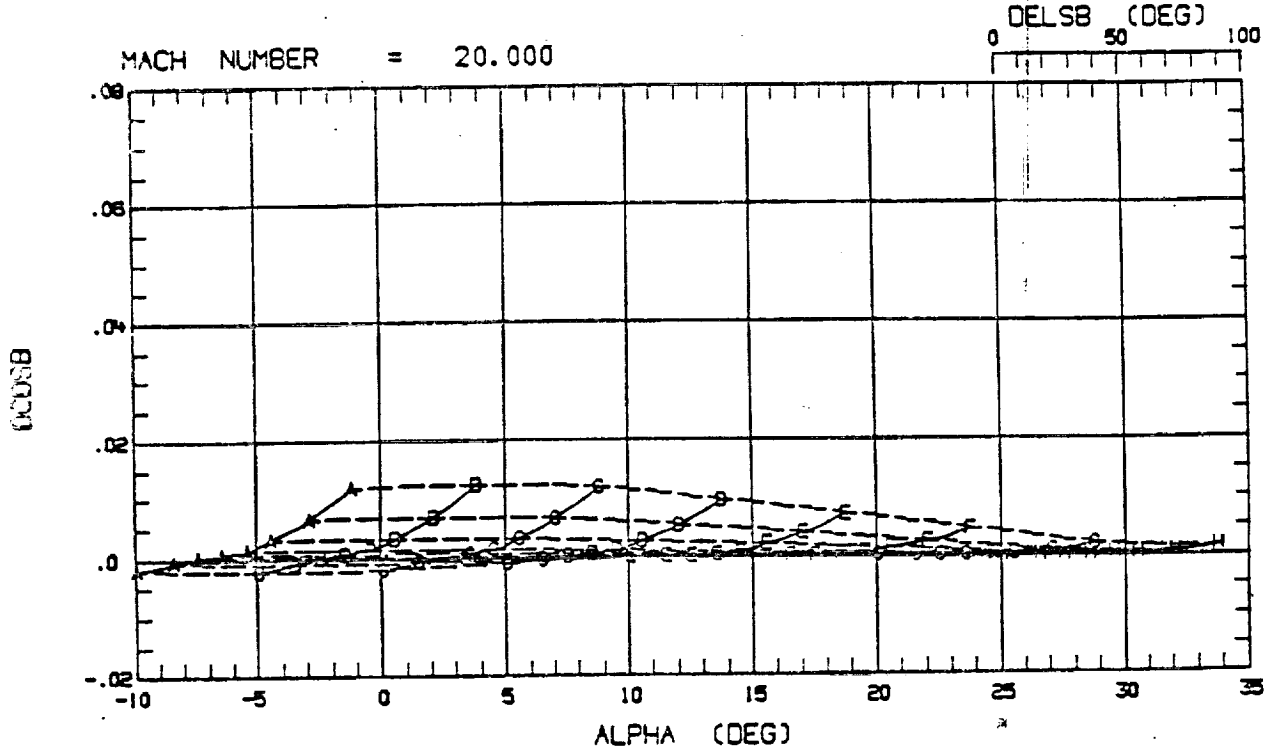


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00023	0.00015	0.00010	0.0	0.0	0.0	0.0	0.0
45.000	0.00047	0.00030	0.00020	0.0	0.0	0.0	0.0	0.0
55.000	0.00120	0.00040	0.00030	0.0	0.0	0.0	0.0	0.0
70.000	0.00225	0.00070	0.00050	0.0	0.0	0.0	0.0	0.0
87.200	0.00440	0.00180	0.00130	0.00050	0.00015	0.0	0.0	0.0

ENGINEER DGD
DATE 9-15-78

FIGURE 4.1.2.2-90
EFFECT OF SPEEDBRAKE



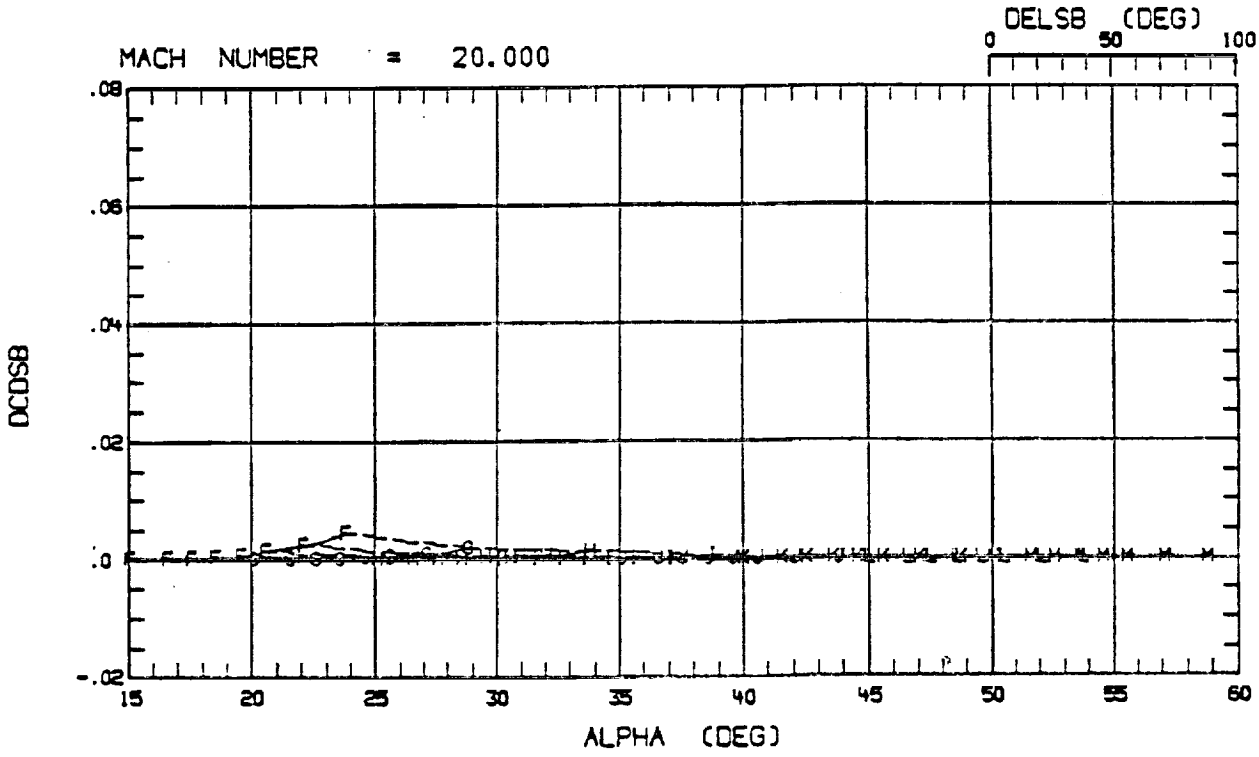
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	-0.00210	-0.00235	-0.00210	-0.00105	0.0	0.0	0.0	0.0
15.000	-0.00080	-0.00090	-0.00080	-0.00040	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00065	0.00068	0.00068	0.00050	0.00035	0.00023	0.00015	0.00010
45.000	0.00130	0.00137	0.00130	0.00100	0.00070	0.00047	0.00030	0.00020
55.000	0.00300	0.00312	0.00300	0.00259	0.00200	0.00120	0.00040	0.00030
70.000	0.00640	0.00672	0.00640	0.00520	0.00380	0.00225	0.00070	0.00050
87.200	0.01170	0.01229	0.01170	0.00946	0.00700	0.00440	0.00180	0.00130

ENGINEER DGD
DATE 9-13-78

FIGURE 4.1.2.2-91
EFFECT OF SPEEDBRAKE

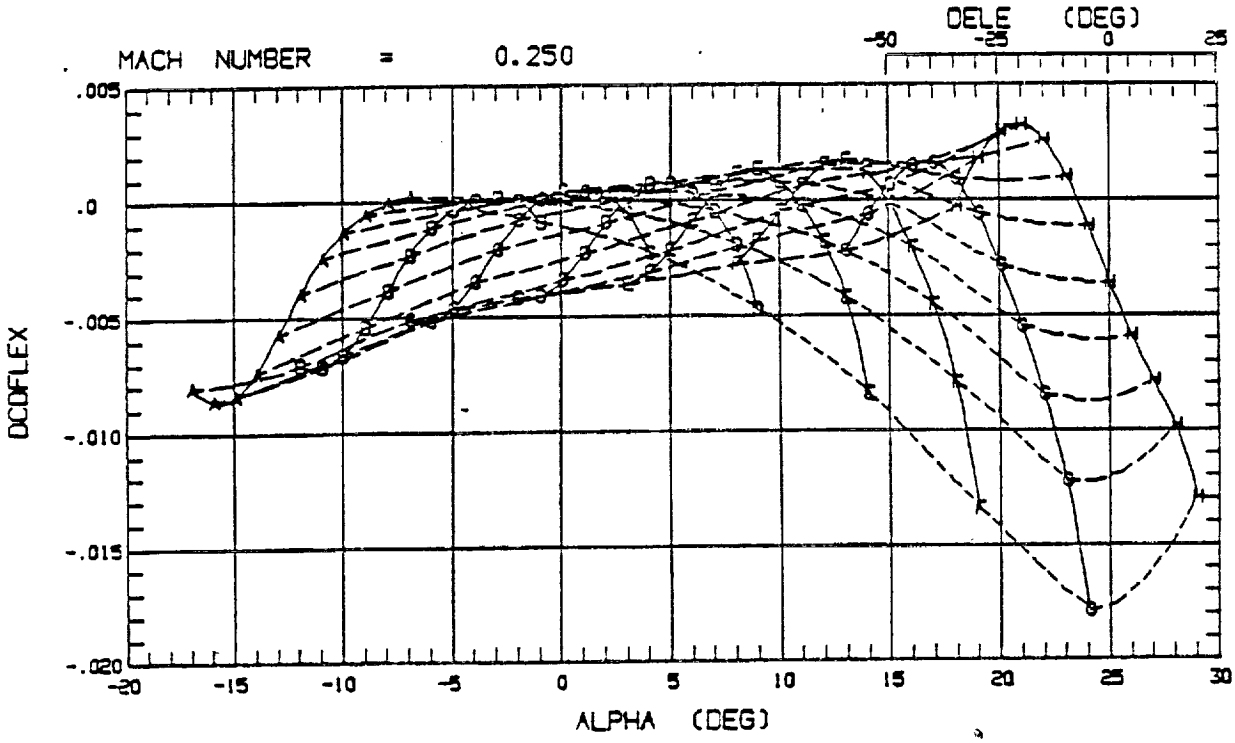


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE DRAG FORCE INCREMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00023	0.00015	0.00010	0.0	0.0	0.0	0.0	0.0
45.000	0.00047	0.00030	0.00020	0.0	0.0	0.0	0.0	0.0
55.000	0.00120	0.00040	0.00030	0.0	0.0	0.0	0.0	0.0
70.000	0.00225	0.00070	0.00050	0.0	0.0	0.0	0.0	0.0
87.200	0.00440	0.00180	0.00130	0.00050	0.00016	0.0	0.0	0.0

ENGINEER DSD
DATE 9-15-78

FIGURE 4.1.2.2-92
EFFECT OF SPEEDBRAKE



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

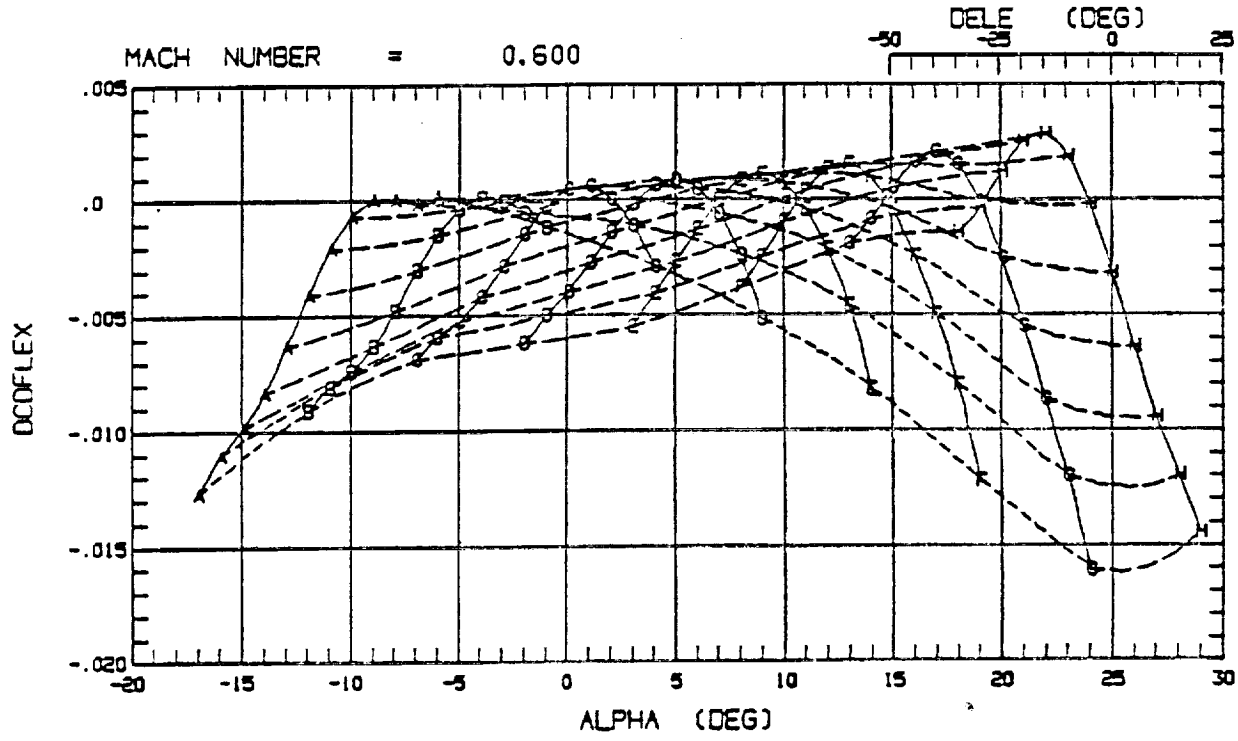
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00809	-0.00714	-0.00513	-0.00422	-0.00361	-0.00293	-0.00223	-0.00032
-30.000	-0.00866	-0.00720	-0.00519	-0.00415	-0.00311	-0.00176	-0.00062	0.00179
-25.000	-0.00847	-0.00656	-0.00465	-0.00347	-0.00215	-0.00055	0.00084	0.00295
-20.000	-0.00741	-0.00544	-0.00351	-0.00229	-0.00087	0.00065	0.00145	0.00322
-15.000	-0.00577	-0.00386	-0.00211	-0.00097	0.00034	0.00150	0.00159	0.00257
-10.000	-0.00401	-0.00233	-0.00084	0.00011	0.00113	0.00171	0.00089	0.00103
-5.000	-0.00247	-0.00114	0.00002	0.00068	0.00129	0.00113	-0.00066	-0.00115
0.0	-0.00133	-0.00040	0.00040	0.00071	0.00078	-0.00019	-0.00297	-0.00351
5.000	-0.00057	-0.00003	0.00039	0.00027	-0.00023	-0.00211	-0.00553	-0.00592
10.000	-0.00007	0.00010	0.00010	-0.00055	-0.00186	-0.00459	-0 00852	-0.00789
15.000	0.00019	-0.00003	-0.00056	-0.00196	-0.00425	-0.00798	-0.01224	-0.00982
20.000	-0.00022	-0.00094	-0.00237	-0.00478	-0.00845	-0.01344	-0.01792	-0.01399

ENGINEER [illegible]
DATE 4-1-77

FIGURE 4.1.2.2-93
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.0=300)



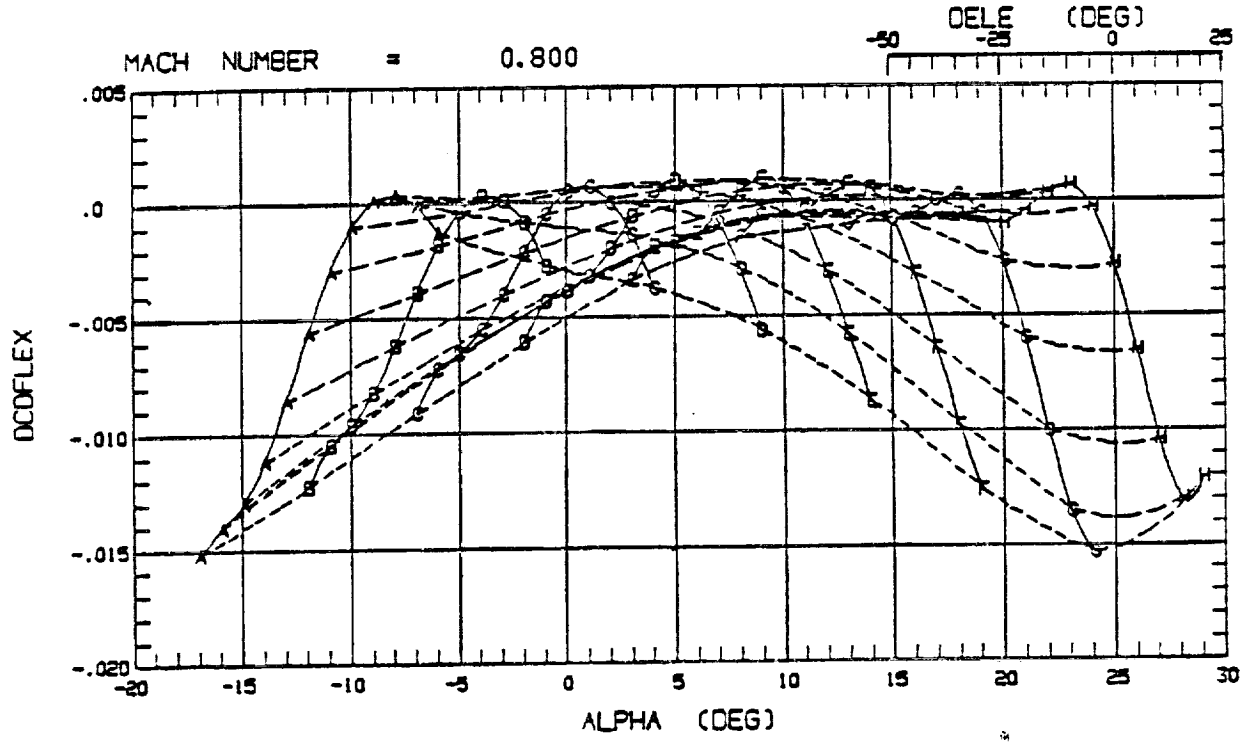
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01278	-0.00917	-0.00694	-0.00626	-0.00552	-0.00382	-0.00189	-0.00143
-30.000	-0.01110	-0.00811	-0.00597	-0.00504	-0.00409	-0.00247	-0.00086	-0.00041
-25.000	-0.00993	-0.00743	-0.00525	-0.00398	-0.00270	-0.00099	0.00051	0.00121
-20.000	-0.00840	-0.00637	-0.00423	-0.00275	-0.00128	0.00037	0.00164	0.00252
-15.000	-0.00637	-0.00484	-0.00289	-0.00141	-0.00001	0.00130	0.00206	0.00294
-10.000	-0.00414	-0.00309	-0.00146	-0.00021	0.00084	0.00152	0.00148	0.00190
-5.000	-0.00213	-0.00151	-0.00027	0.00060	0.00109	0.00092	-0.00012	-0.00023
0.0	-0.00071	-0.00040	0.00044	0.00084	0.00066	-0.00047	-0.00257	-0.00319
5.000	-0.00004	0.00008	0.00053	0.00043	-0.00044	-0.00249	-0.00553	-0.00644
10.000	0.0	-0.00005	-0.00001	-0.00064	-0.00218	-0.00502	-0.00872	-0.00946
15.000	-0.00018	-0.00057	-0.00115	-0.00243	-0.00463	-0.00810	-0.01209	-0.01202
20.000	0.00009	-0.00123	-0.00291	-0.00520	-0.00825	-0.01225	-0.01612	-0.01450

ENGINEER [signature]
DATE 1-2-79

FIGURE 4.1.2.2-94
FLEX DRAG COEFFICIENT INCREMENT (BF=0, SB=25.0=300)



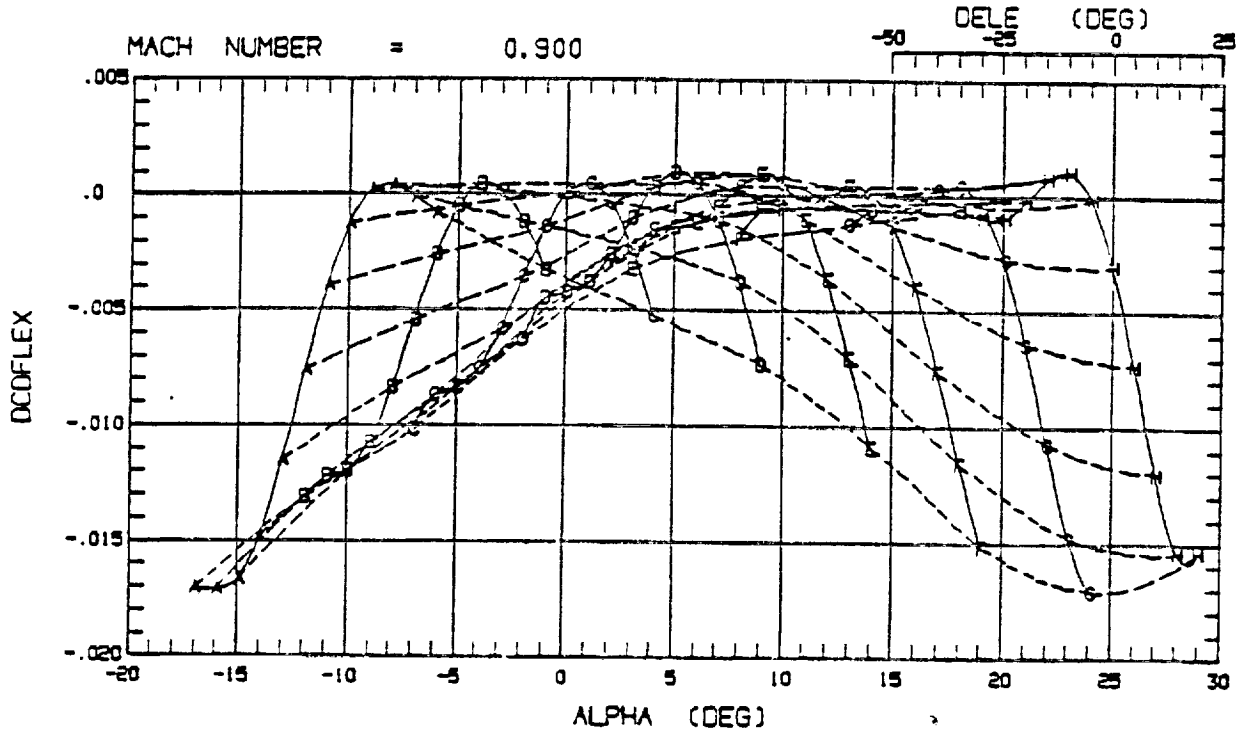
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01525	-0.01231	-0.00915	-0.00612	-0.00343	-0.00162	-0.00104	-0.00066
-30.000	-0.01407	-0.01054	-0.00724	-0.00433	-0.00198	-0.00084	-0.00063	-0.00085
-25.000	-0.01305	-0.00963	-0.00653	-0.00388	-0.00179	-0.00068	-0.00081	-0.00100
-20.000	-0.01122	-0.00827	-0.00556	-0.00323	-0.00139	-0.00044	-0.00059	-0.00047
-15.000	-0.00859	-0.00625	-0.00401	-0.00205	-0.00053	0.00017	-0.00064	0.00033
-10.000	-0.00565	-0.00394	-0.00217	-0.00065	0.00042	0.00069	0.00018	0.00062
-5.000	-0.00300	-0.00184	-0.00054	0.00046	0.00092	0.00051	-0.00053	-0.00033
0.0	-0.00105	-0.00039	0.00046	0.00087	0.00054	-0.00078	-0.00270	-0.00293
5.000	0.00002	0.00024	0.00062	0.00038	-0.00086	-0.00322	-0.00607	-0.00655
10.000	0.00029	0.00004	-0.00005	-0.00097	-0.00311	-0.00547	-0.01007	-0.01050
15.000	-0.00013	-0.00092	-0.00148	-0.00299	-0.00584	-0.00984	-0.01359	-0.01304
20.000	-0.00136	-0.00293	-0.00382	-0.00568	-0.00876	-0.01262	-0.01535	-0.01214

ENGINEER
DATE 4-2-79

FIGURE 4.1.2.2-95
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.Q=300)



CONFIGURATION

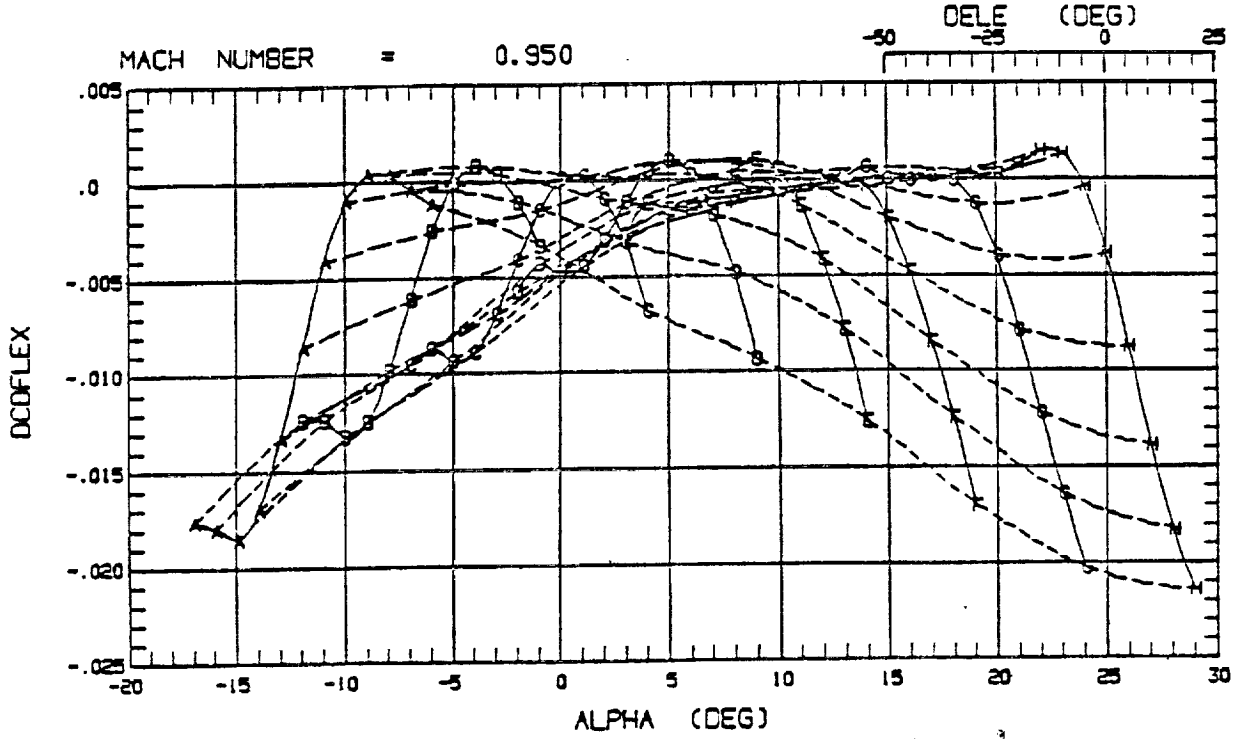
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	REFERENCE DIMENSIONS	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01710	-0.01315	-0.01023	-0.00632	-0.00323	-0.00191	-0.00129	-0.00055
-30.000	-0.01712	-0.01228	-0.00868	-0.00450	-0.00152	-0.00062	-0.00066	-0.00096
-25.000	-0.01673	-0.01199	-0.00838	-0.00426	-0.00143	-0.00063	-0.00087	-0.00096
-20.000	-0.01483	-0.01077	-0.00756	-0.00379	-0.00122	-0.00050	-0.00034	-0.00020
-15.000	-0.01155	-0.00842	-0.00584	-0.00262	-0.00051	-0.00003	0.00022	0.00076
-10.000	-0.00764	-0.00544	-0.00357	-0.00105	0.00038	0.00035	0.00039	0.00103
-5.000	-0.00397	-0.00259	-0.00139	0.00033	0.00088	0.00004	-0.00050	-0.00015
0.0	-0.00126	-0.00051	0.00007	0.00095	0.00048	-0.00141	-0.00281	-0.00308
5.000	0.00018	0.00040	0.00043	0.00048	-0.00108	-0.00409	-0.00646	-0.00740
10.000	0.00038	0.00010	-0.00041	-0.00115	-0.00371	-0.00772	-0.01082	-0.01209
15.000	-0.00016	-0.00122	-0.00236	-0.00381	-0.00711	-0.01166	-0.01483	-0.01546
20.000	-0.00085	-0.00329	-0.00531	-0.00739	-0.01096	-0.01521	-0.01717	-0.01544

ENGINEER [signature]
DATE 4-2-92

FIGURE 4.1.2.2-96
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.Q=300)



CONFIGURATION

BASELINE ORBITER VEHICLE

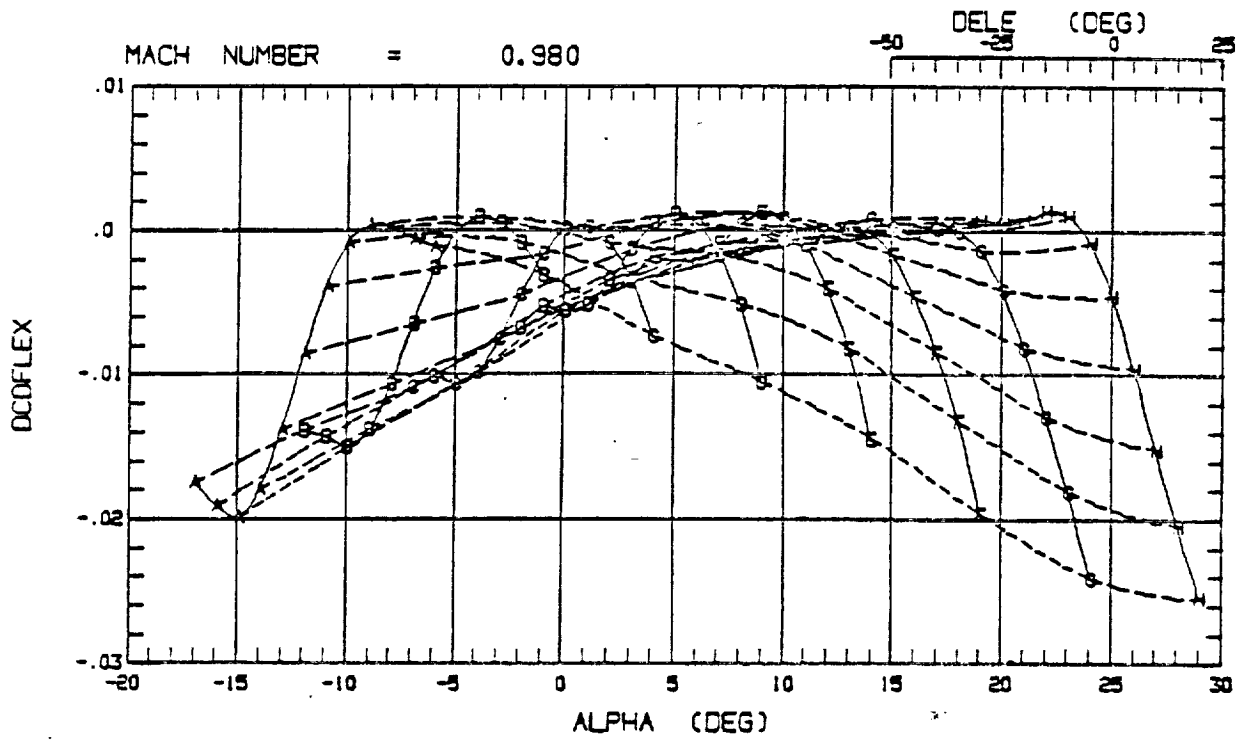
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

REFERENCE DIMENSIONS

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01767	-0.01244	-0.00963	-0.00581	-0.00284	-0.00128	-0.00004	0.00011
-30.000	-0.01805	-0.01244	-0.00871	-0.00435	-0.00122	-0.00003	0.00056	0.00028
-25.000	-0.01659	-0.01330	-0.00938	-0.00478	-0.00158	-0.00051	0.00001	0.00018
-20.000	-0.01703	-0.01252	-0.00893	-0.00452	-0.00154	-0.00067	-0.00013	0.00072
-15.000	-0.01333	-0.00985	-0.00695	-0.00311	-0.00068	-0.00028	0.00009	0.00141
-10.000	-0.00860	-0.00616	-0.00414	-0.00116	0.00043	0.00007	-0.00008	0.00129
-5.000	-0.00416	-0.00262	-0.00154	0.00045	0.00099	-0.00038	-0.00135	-0.00042
0.0	-0.00105	-0.00018	0.00003	0.00099	0.00043	-0.00206	-0.00405	-0.00393
5.000	0.00034	0.00074	0.00019	0.00020	-0.00139	-0.00492	-0.00793	-0.00877
10.000	0.00028	0.00029	-0.00099	-0.00182	-0.00425	-0.00856	-0.01232	-0.01395
15.000	-0.00048	-0.00116	-0.00330	-0.00490	-0.00790	-0.01255	-0.01650	-0.01837
20.000	-0.00129	-0.00343	-0.00689	-0.00938	-0.01269	-0.01709	-0.02039	-0.02153

ENGINEER [signature]
DATE 4-2-79

FIGURE 4.1.2.2-97
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.0=300)



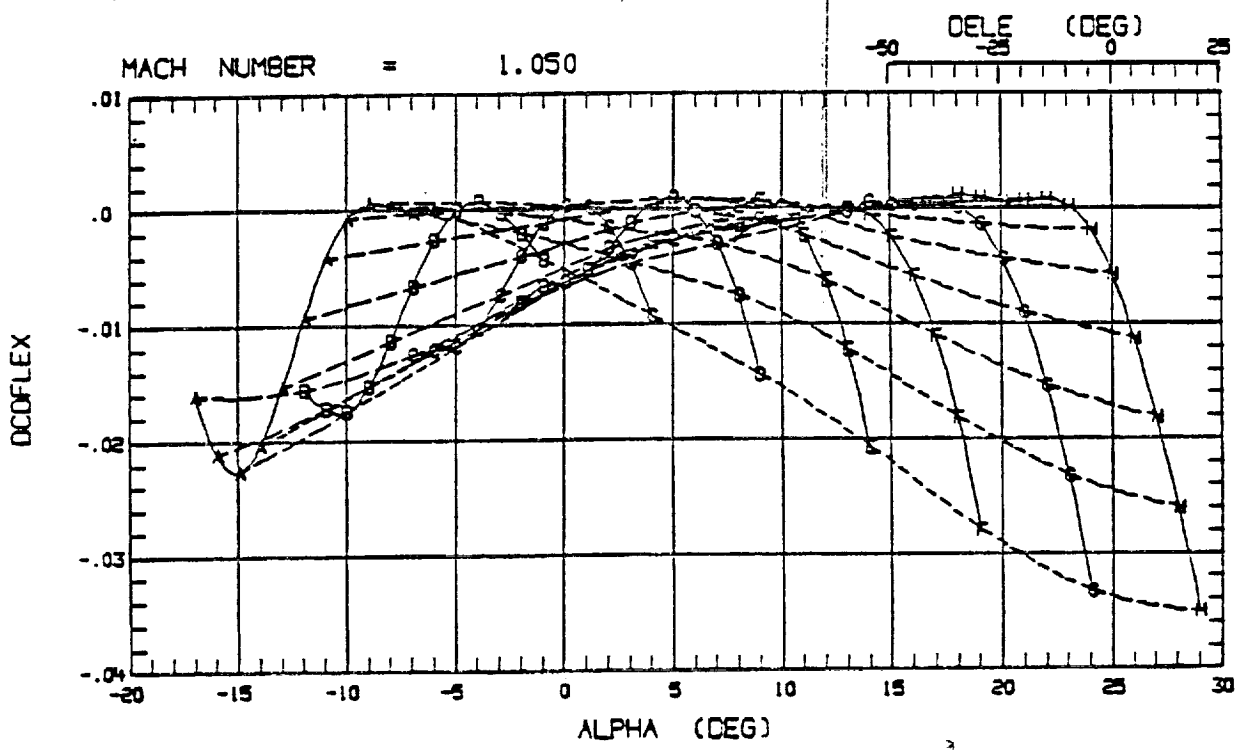
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01754	-0.01395	-0.01087	-0.00682	-0.00384	-0.00173	0.00015	0.00045
-30.000	-0.01916	-0.01438	-0.01017	-0.00533	-0.00191	-0.00037	0.00080	0.00071
-25.000	-0.01995	-0.01510	-0.01070	-0.00566	-0.00222	-0.00088	0.00011	0.00044
-20.000	-0.01805	-0.01388	-0.00994	-0.00521	-0.00204	-0.00098	-0.00015	0.00076
-15.000	-0.01382	-0.01067	-0.00759	-0.00355	-0.00098	-0.00047	0.00001	0.00125
-10.000	-0.00862	-0.00651	-0.00447	-0.00135	0.00036	0.00004	-0.00016	0.00097
-5.000	-0.00386	-0.00258	-0.00165	0.00044	0.00112	-0.00025	-0.00144	-0.00090
0.0	-0.00087	-0.00012	0.00001	0.00110	0.00071	-0.00182	-0.00419	-0.00459
5.000	0.00035	0.00084	0.00020	0.00034	-0.00106	-0.00470	-0.00825	-0.00968
10.000	0.00013	0.00041	-0.00100	-0.00176	-0.00407	-0.00861	-0.01308	-0.01530
15.000	-0.00062	-0.00095	-0.00341	-0.00519	-0.00829	-0.01340	-0.01825	-0.02059
20.000	-0.00121	-0.00317	-0.00745	-0.01063	-0.01452	-0.01977	-0.02420	-0.02683

ENGINEER
DATE 4-2-79

FIGURE 4.1.2.2-98
FLEX DRAG COEFFICIENT INCREMENT (BF=0, SB=25.0=300)



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1078.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

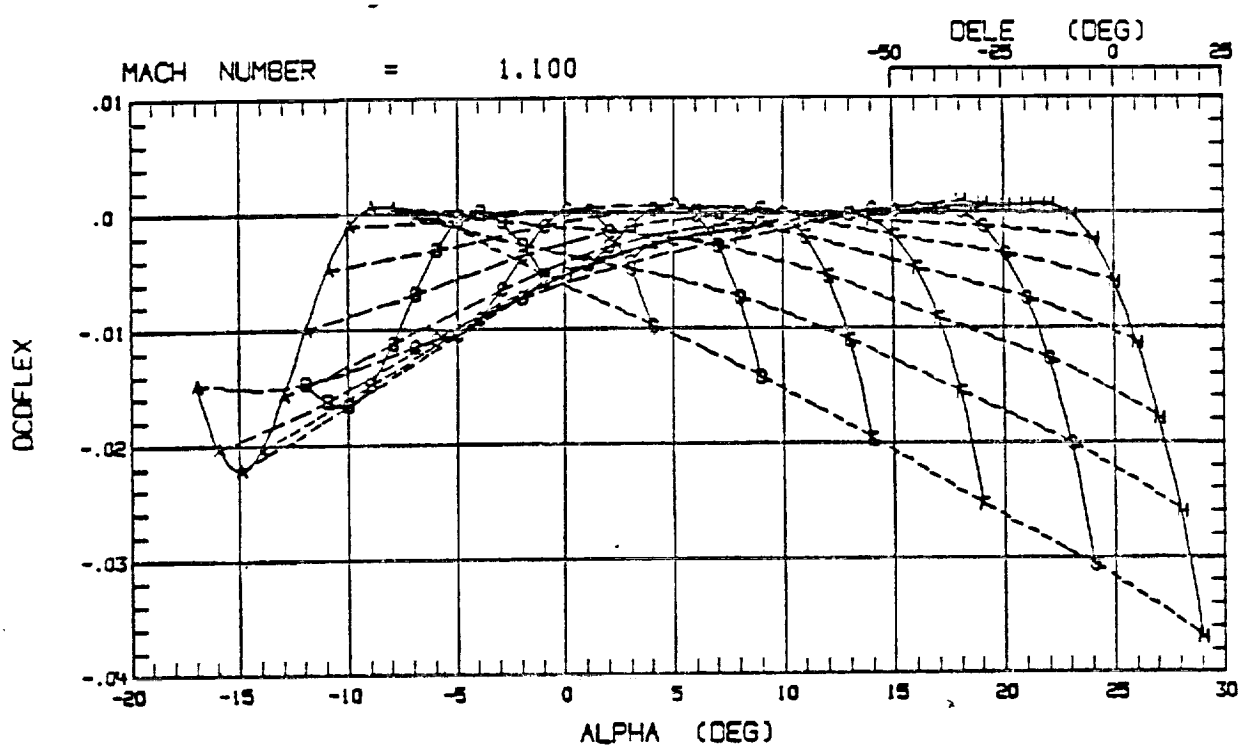
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01615	-0.01558	-0.01259	-0.00818	-0.00473	-0.00250	-0.00040	0.00109
-30.000	-0.02128	-0.01725	-0.01219	-0.00670	-0.00292	-0.00104	0.00045	0.00090
-25.000	-0.02279	-0.01754	-0.01197	-0.00637	-0.00270	-0.00103	0.00022	0.00051
-20.000	-0.02042	-0.01542	-0.01038	-0.00536	-0.00220	-0.00090	0.00018	0.00060
-15.000	-0.01538	-0.01141	-0.00747	-0.00346	-0.00111	-0.00042	0.00031	0.00076
-10.000	-0.00941	-0.00673	-0.00409	-0.00128	0.00006	-0.00011	-0.00001	0.00015
-5.000	-0.00418	-0.00267	-0.00124	0.00040	0.00059	-0.00064	-0.00147	-0.00193
0.0	-0.00077	-0.00013	0.00029	0.00084	-0.00013	-0.00254	-0.00449	-0.00583
5.000	0.00053	0.00055	0.00013	-0.00031	-0.00241	-0.00605	-0.00920	-0.01145
10.000	0.00026	-0.00036	-0.00165	-0.00313	-0.00640	-0.01125	-0.01549	-0.01835
15.000	-0.00040	-0.00222	-0.00482	-0.00768	-0.01229	-0.01832	-0.02334	-0.02618
20.000	0.00001	-0.00441	-0.00945	-0.01446	-0.02095	-0.02909	-0.03341	-0.03515

ENGINEER [signature]
DATE 4-2-87

FIGURE 4.1.2.2-99
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.0=300)



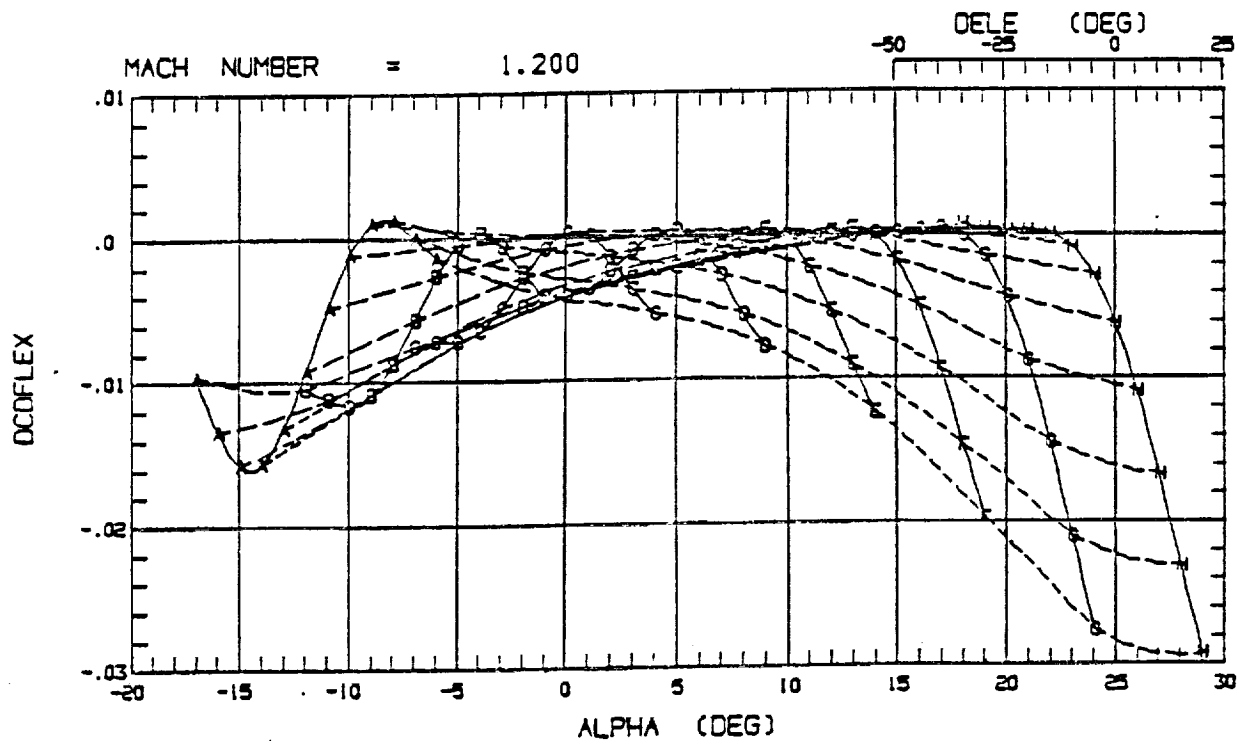
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1078.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1250.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01485	-0.01477	-0.01154	-0.00741	-0.00429	-0.00225	-0.00027	0.00097
-30.000	-0.02031	-0.01631	-0.01089	-0.00583	-0.00262	-0.00102	0.00025	0.00068
-25.000	-0.02224	-0.01666	-0.01054	-0.00537	-0.00234	-0.00097	0.00015	0.00053
-20.000	-0.02040	-0.01485	-0.00913	-0.00448	-0.00193	-0.00086	0.00018	0.00067
-15.000	-0.01581	-0.01127	-0.00661	-0.00292	-0.00111	-0.00053	0.00026	0.00062
-10.000	-0.01008	-0.00698	-0.00385	-0.00111	-0.00021	-0.00033	-0.00007	-0.00026
-5.000	-0.00479	-0.00314	-0.00112	0.00029	0.00021	-0.00073	-0.00128	-0.00246
0.0	-0.00110	-0.00064	0.00027	0.00067	-0.00033	-0.00217	-0.00371	-0.00618
5.000	0.00055	0.00010	0.00012	-0.00034	-0.00219	-0.00492	-0.00752	-0.01139
10.000	0.00047	-0.00082	-0.00165	-0.00256	-0.00565	-0.00927	-0.01286	-0.01799
15.000	-0.00033	-0.00298	-0.00496	-0.00744	-0.01119	-0.01573	-0.02018	-0.02620
20.000	-0.00039	-0.00547	-0.00988	-0.01442	-0.01983	-0.02658	-0.03074	-0.03703

ENGINEER [signature]
DATE 4-2-27

FIGURE 4.1.2.2-100
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.G=300)



CONFIGURATION

BASELINE ORBITER VEHICLE

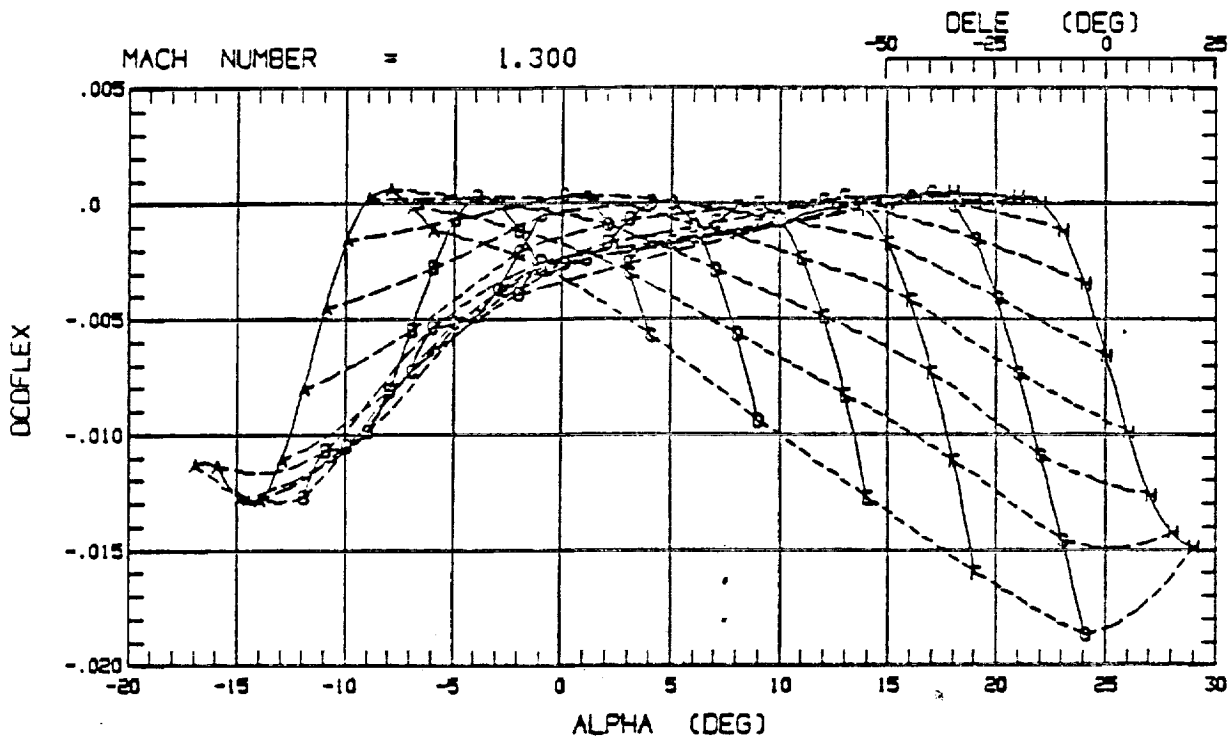
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

REFERENCE DIMENSIONS

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00970	-0.01049	-0.00755	-0.00482	-0.00290	-0.00140	-0.00017	0.00065
-30.000	-0.01347	-0.01122	-0.00723	-0.00425	-0.00233	-0.00094	0.0	0.00032
-25.000	-0.01580	-0.01174	-0.00725	-0.00416	-0.00218	-0.00078	0.00007	0.00017
-20.000	-0.01570	-0.01098	-0.00652	-0.00360	-0.00171	-0.00038	0.00026	0.00017
-15.000	-0.01327	-0.00878	-0.00490	-0.00243	-0.00086	0.00013	0.00035	-0.00004
-10.000	-0.00928	-0.00574	-0.00278	-0.00100	-0.00001	0.00038	-0.00011	-0.00092
-5.000	-0.00487	-0.00270	-0.00084	0.00010	0.00034	-0.00017	-0.00158	-0.00290
0.0	-0.00118	-0.00051	0.00025	0.00033	-0.00032	-0.00191	-0.00445	-0.00625
5.000	0.00095	0.00023	0.00004	-0.00065	-0.00224	-0.00506	-0.00885	-0.01099
10.000	0.00117	-0.00063	-0.00147	-0.00291	-0.00535	-0.00951	-0.01460	-0.01685
15.000	-0.00008	-0.00253	-0.00372	-0.00555	-0.00911	-0.01475	-0.02118	-0.02324
20.000	-0.00145	-0.00413	-0.00540	-0.00772	-0.01244	-0.01980	-0.02769	-0.02927

ENGINEER [signature]
DATE 7-2-79

FIGURE 4.1.2.2-101
FLEX DRAG COEFFICIENT INCREMENT (BF=0, SB=25, Q=300)



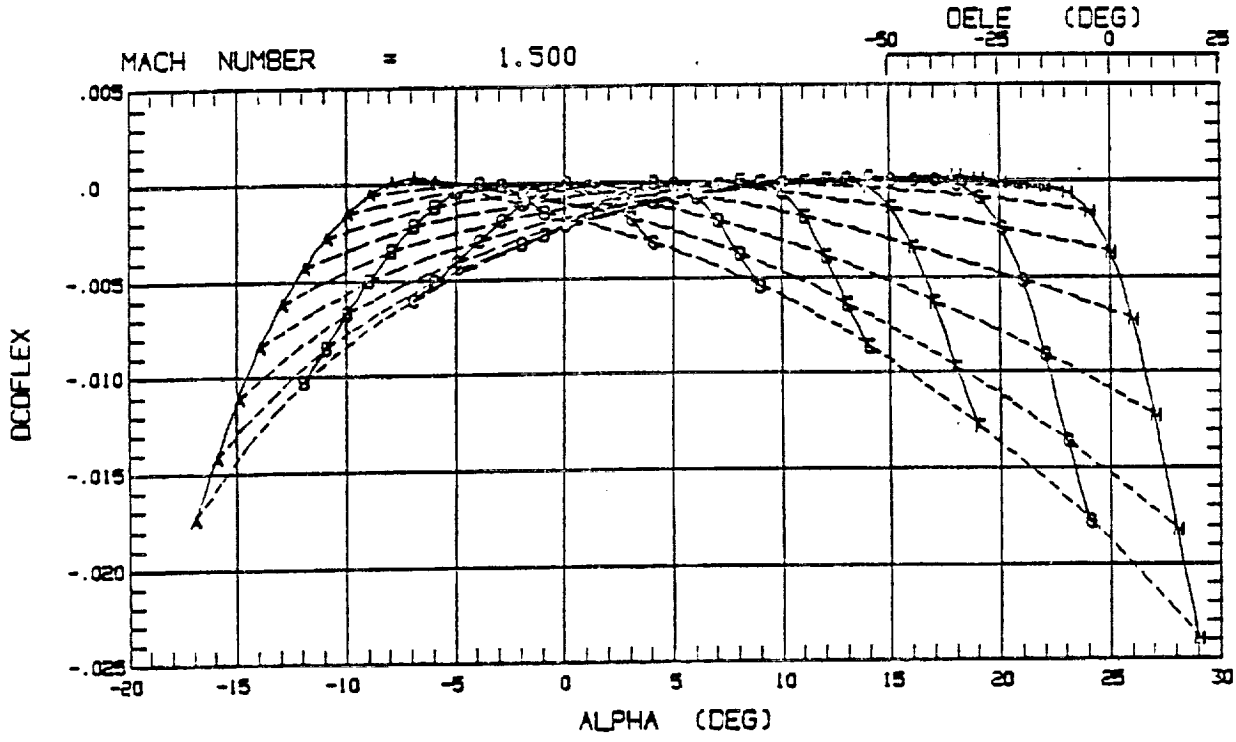
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01136	-0.01274	-0.00733	-0.00393	-0.00259	-0.00142	-0.00003	0.00046
-30.000	-0.01146	-0.01075	-0.00535	-0.00257	-0.00174	-0.00102	-0.00014	-0.00003
-25.000	-0.01280	-0.01057	-0.00524	-0.00251	-0.00175	-0.00092	-0.00007	0.00005
-20.000	-0.01292	-0.00991	-0.00487	-0.00244	-0.00149	-0.00051	0.00025	0.00027
-15.000	-0.01120	-0.00812	-0.00373	-0.00172	-0.00085	0.00002	0.00041	0.00001
-10.000	-0.00810	-0.00552	-0.00210	-0.00074	-0.00022	0.00023	-0.00011	-0.00121
-5.000	-0.00457	-0.00281	-0.00055	-0.00002	-0.00008	-0.00031	-0.00163	-0.00353
0.0	-0.00159	-0.00074	0.00033	-0.00003	-0.00077	-0.00182	-0.00415	-0.00667
5.000	0.00017	0.00021	0.00019	-0.00100	-0.00243	-0.00425	-0.00742	-0.00999
10.000	0.00053	-0.00004	-0.00099	-0.00294	-0.00498	-0.00742	-0.01100	-0.01273
15.000	-0.00019	-0.00122	-0.00305	-0.00574	-0.00836	-0.01123	-0.01465	-0.01432
20.000	-0.00123	-0.00294	-0.00576	-0.00945	-0.01293	-0.01604	-0.01870	-0.01490

ENGINEER DTD
DATE 1-2-92

FIGURE 4.1.2.2-102
FLEX DRAG COEFFICIENT INCREMENT (BF=0, SB=25, Q=300)



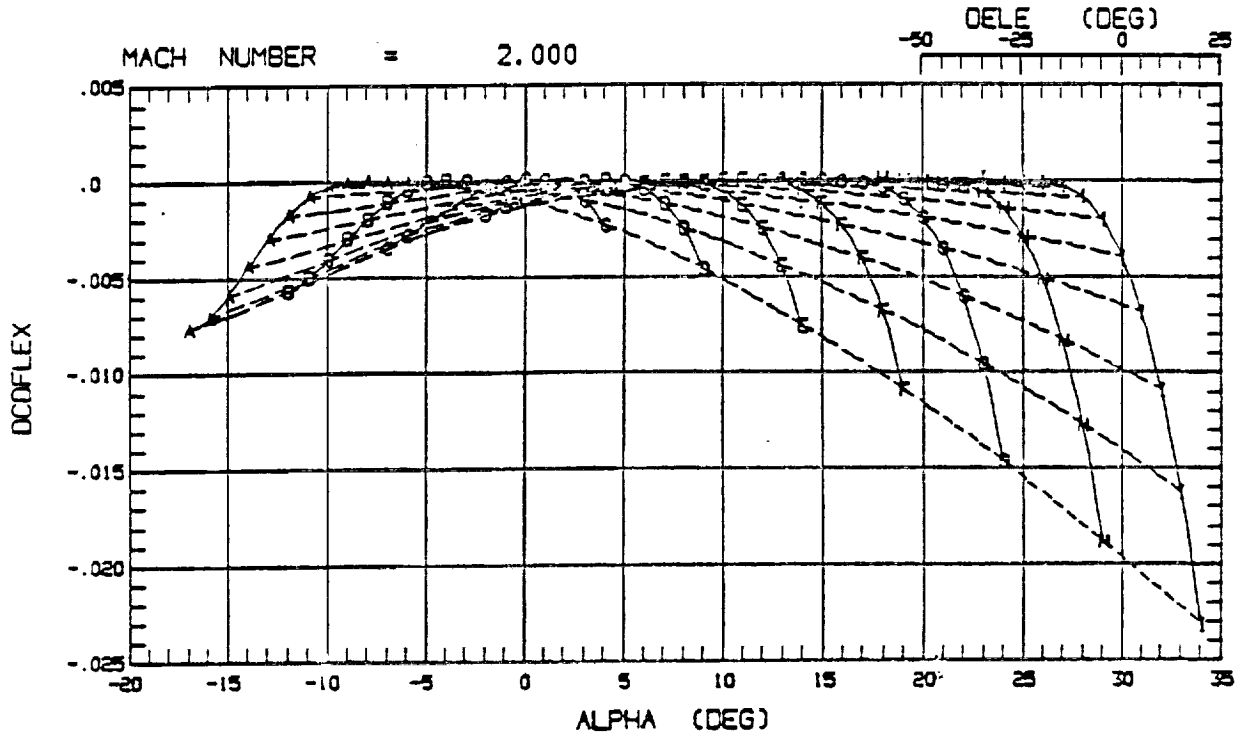
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.01743	-0.01032	-0.00608	-0.00321	-0.00130	-0.00027	0.00008	0.00018
-30.000	-0.01423	-0.00856	-0.00516	-0.00277	-0.00111	-0.00019	0.00011	0.00008
-25.000	-0.01117	-0.00674	-0.00411	-0.00222	-0.00090	-0.00018	0.00001	-0.00016
-20.000	-0.00849	-0.00505	-0.00304	-0.00160	-0.00061	-0.00011	-0.00003	-0.00029
-15.000	-0.00624	-0.00355	-0.00203	-0.00096	-0.00028	0.0	-0.00004	-0.00038
-10.000	-0.00437	-0.00226	-0.00113	-0.00040	-0.00003	-0.00001	-0.00023	-0.00070
-5.000	-0.00281	-0.00121	-0.00044	-0.00008	-0.00008	-0.00042	-0.00094	-0.00169
0.0	-0.00153	-0.00046	-0.00010	-0.00016	-0.00066	-0.00151	-0.00253	-0.00380
5.000	-0.00058	-0.00009	-0.00022	-0.00083	-0.00195	-0.00350	-0.00526	-0.00735
10.000	0.00007	-0.00018	-0.00088	-0.00211	-0.00399	-0.00639	-0.00913	-0.01237
15.000	0.00025	-0.00074	-0.00201	-0.00386	-0.00649	-0.00982	-0.01368	-0.01833
20.000	0.00002	-0.00160	-0.00325	-0.00551	-0.00872	-0.01295	-0.01782	-0.02359

ENGINEER [signature]
DATE 4-2-79

FIGURE 4.1.2.2-103
FLEX DRAG COEFFICIENT INCREMENT (BF=0,SB=25,G=300)



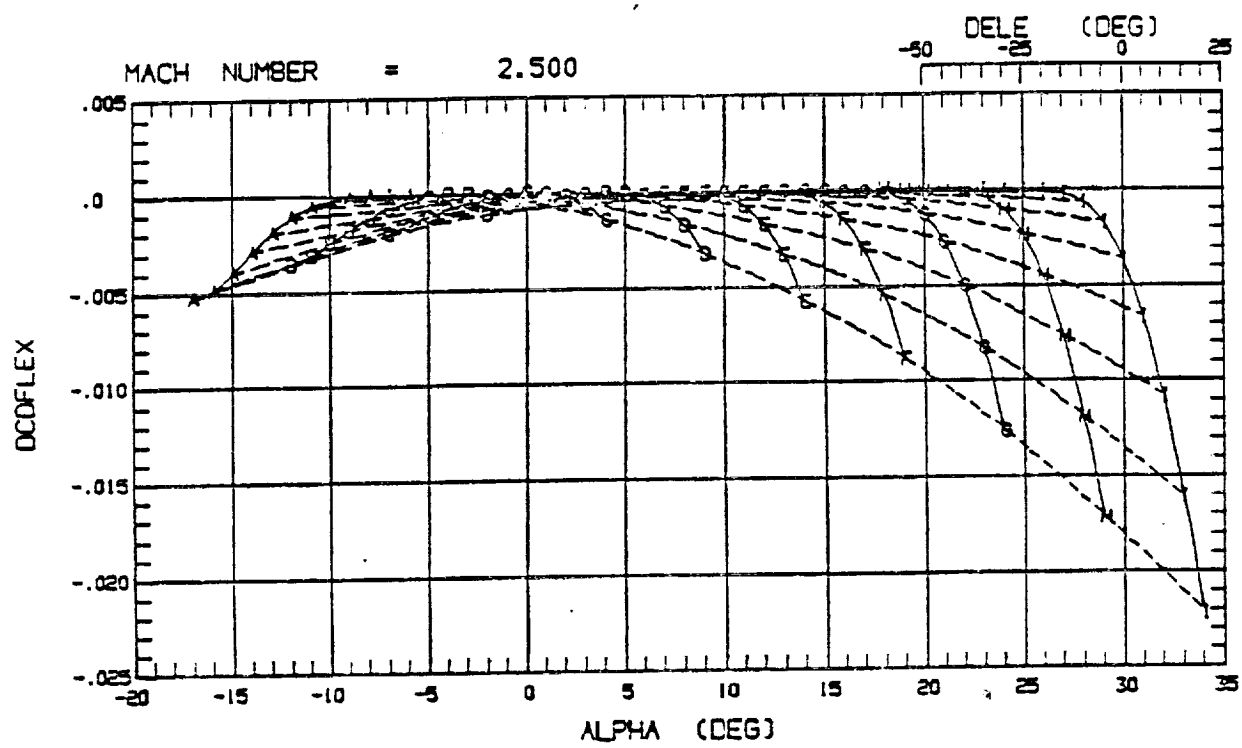
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.550	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	FLEXIBLE DRAG INCREMENT								
-35.000	-0.00768	-0.00577	-0.00349	-0.00178	-0.00076	-0.00023	0.00001	0.00007	0.00004
-30.000	-0.00710	-0.00504	-0.00284	-0.00129	-0.00045	-0.00008	0.00001	-0.00006	-0.00019
-25.000	-0.00593	-0.00410	-0.00219	-0.00092	-0.00029	-0.00006	-0.00004	-0.00012	-0.00021
-20.000	-0.00447	-0.00303	-0.00153	-0.00058	-0.00017	-0.00006	-0.00007	-0.00015	-0.00018
-15.000	-0.00300	-0.00200	-0.00091	-0.00029	-0.00008	-0.00008	-0.00016	-0.00027	-0.00033
-10.000	-0.00174	-0.00112	-0.00040	-0.00007	-0.00007	-0.00022	-0.00042	-0.00066	-0.00088
-5.000	-0.00082	-0.00049	-0.00007	0.0	-0.00022	-0.00057	-0.00099	-0.00150	-0.00206
0.0	-0.00029	-0.00013	0.00006	-0.00012	-0.00060	-0.00124	-0.00201	-0.00296	-0.00404
5.000	-0.00007	0.0	-0.00004	-0.00051	-0.00133	-0.00238	-0.00364	-0.00519	-0.00697
10.000	-0.00004	-0.00007	-0.00038	-0.00124	-0.00254	-0.00416	-0.00608	-0.00839	-0.01100
15.000	-0.00007	-0.00032	-0.00108	-0.00252	-0.00450	-0.00687	-0.00963	-0.01282	-0.01631
20.000	-0.00010	-0.00066	-0.00236	-0.00468	-0.00782	-0.01099	-0.01475	-0.01890	-0.02323

ENGINEER [signature]
DATE 4-2-85

FIGURE 4.1.2.2-104
FLEX DRAG COEFFICIENT INCREMENT (BF=0,SB=25,Q=300)



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1078.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

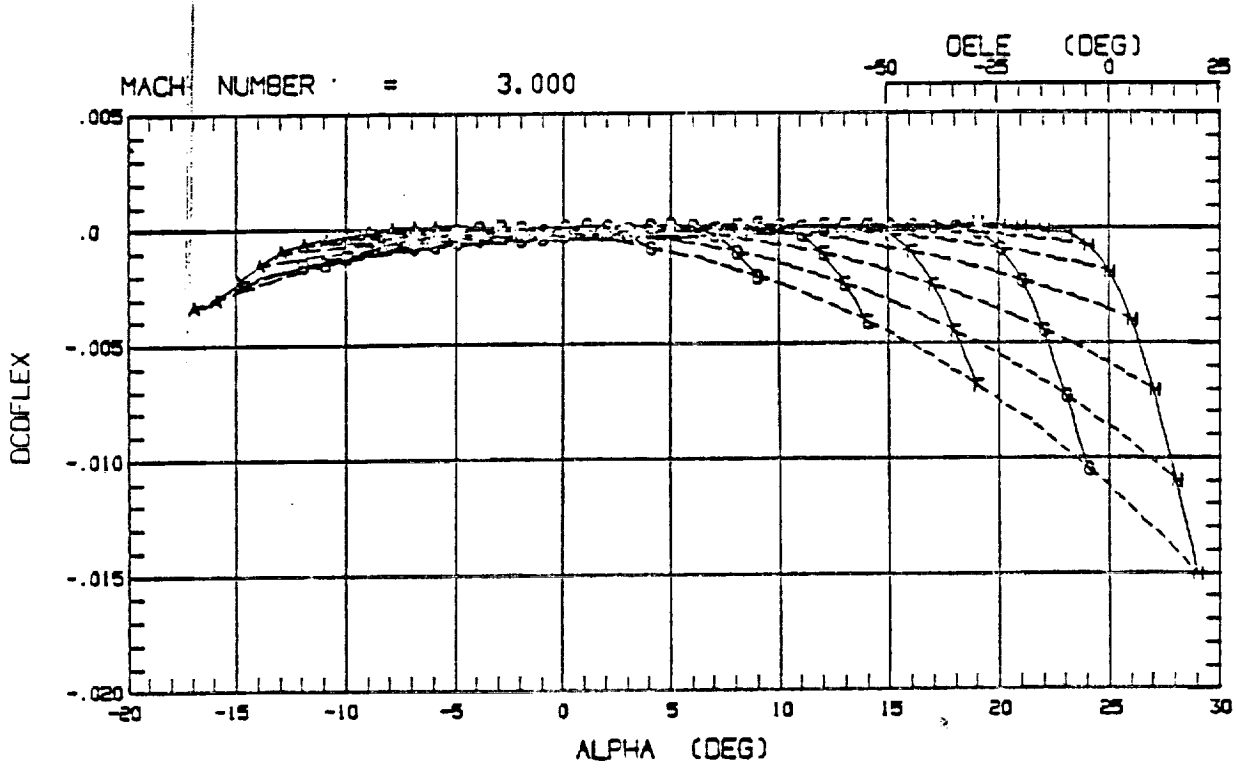
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	FLEXIBLE DRAG INCREMENT								
-35.000	-0.00527	-0.00363	-0.00205	-0.00106	-0.00054	-0.00022	0.0	0.00008	0.00001
-30.000	-0.00491	-0.00315	-0.00160	-0.00069	-0.00028	-0.00008	0.00001	-0.00002	-0.00011
-25.000	-0.00400	-0.00249	-0.00118	-0.00047	-0.00019	-0.00008	-0.00004	-0.00009	-0.00013
-20.000	-0.00293	-0.00182	-0.00082	-0.00033	-0.00016	-0.00010	-0.00007	-0.00011	-0.00011
-15.000	-0.00193	-0.00121	-0.00052	-0.00021	-0.00012	-0.00009	-0.00008	-0.00016	-0.00022
-10.000	-0.00112	-0.00073	-0.00028	-0.00010	-0.00009	-0.00010	-0.00018	-0.00042	-0.00069
-5.000	-0.00056	-0.00038	-0.00009	-0.00003	-0.00011	-0.00025	-0.00052	-0.00108	-0.00178
0.0	-0.00023	-0.00015	0.00002	-0.00005	-0.00029	-0.00067	-0.00131	-0.00238	-0.00374
5.000	-0.00008	-0.00003	0.00001	-0.00025	-0.00079	-0.00157	-0.00276	-0.00455	-0.00676
10.000	-0.00005	-0.00002	-0.00019	-0.00078	-0.00176	-0.00313	-0.00506	-0.00773	-0.01092
15.000	-0.00005	-0.00014	-0.00065	-0.00176	-0.00338	-0.00553	-0.00835	-0.01199	-0.01617
20.000	-0.00001	-0.00038	-0.00146	-0.00331	-0.00580	-0.00899	-0.01267	-0.01725	-0.02223

ENGINEER [signature]
DATE 7-2-77

FIGURE 4.1.2.2-105
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.Q=300)



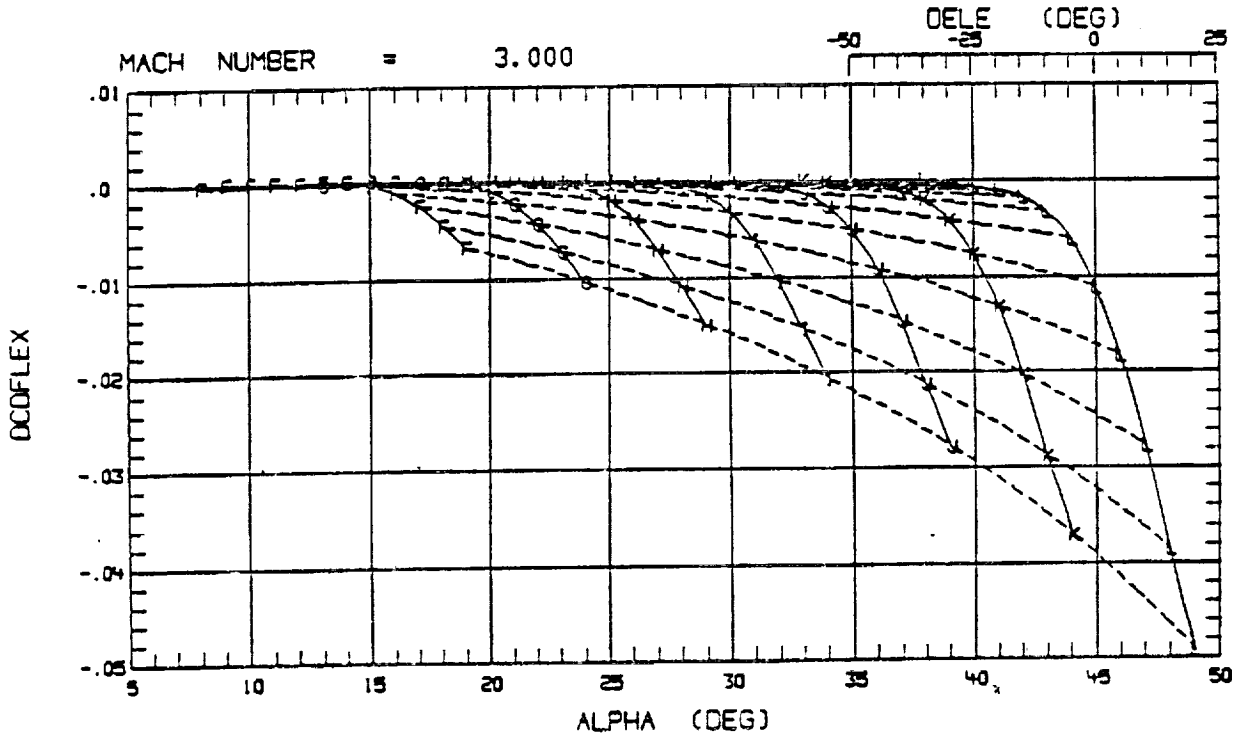
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00337	-0.00157	-0.00081	-0.00053	-0.00042	-0.00032	-0.00020	-0.00007
-30.000	-0.00308	-0.00156	-0.00080	-0.00043	-0.00021	-0.00005	0.00008	0.00015
-25.000	-0.00231	-0.00123	-0.00066	-0.00035	-0.00015	-0.00001	0.00008	0.00008
-20.000	-0.00154	-0.00089	-0.00052	-0.00029	-0.00012	-0.00001	0.00003	-0.00003
-15.000	-0.00097	-0.00064	-0.00040	-0.00021	-0.00006	0.00002	0.00001	-0.00011
-10.000	-0.00063	-0.00047	-0.00027	-0.00009	0.00004	0.00007	-0.00003	-0.00028
-5.000	-0.00043	-0.00032	-0.00012	0.00005	0.00012	0.00003	-0.00027	-0.00081
0.0	-0.00030	-0.00017	0.00002	0.00014	0.00005	-0.00030	-0.00096	-0.00198
5.000	-0.00016	-0.00003	0.00011	0.00005	-0.00033	-0.00111	-0.00233	-0.00406
10.000	-0.00001	0.00006	0.00003	-0.00033	-0.00116	-0.00254	-0.00451	-0.00714
15.000	0.00008	0.00001	-0.00030	-0.00108	-0.00249	-0.00457	-0.00740	-0.01103
20.000	0.00003	-0.00024	-0.00089	-0.00214	-0.00413	-0.00691	-0.01053	-0.01509

ENGINEER [signature]
DATE 7-2-82

FIGURE 4.1.2.2-106
FLEX DRAG COEFFICIENT INCREMENT (BF=0, SB=25.0=300)



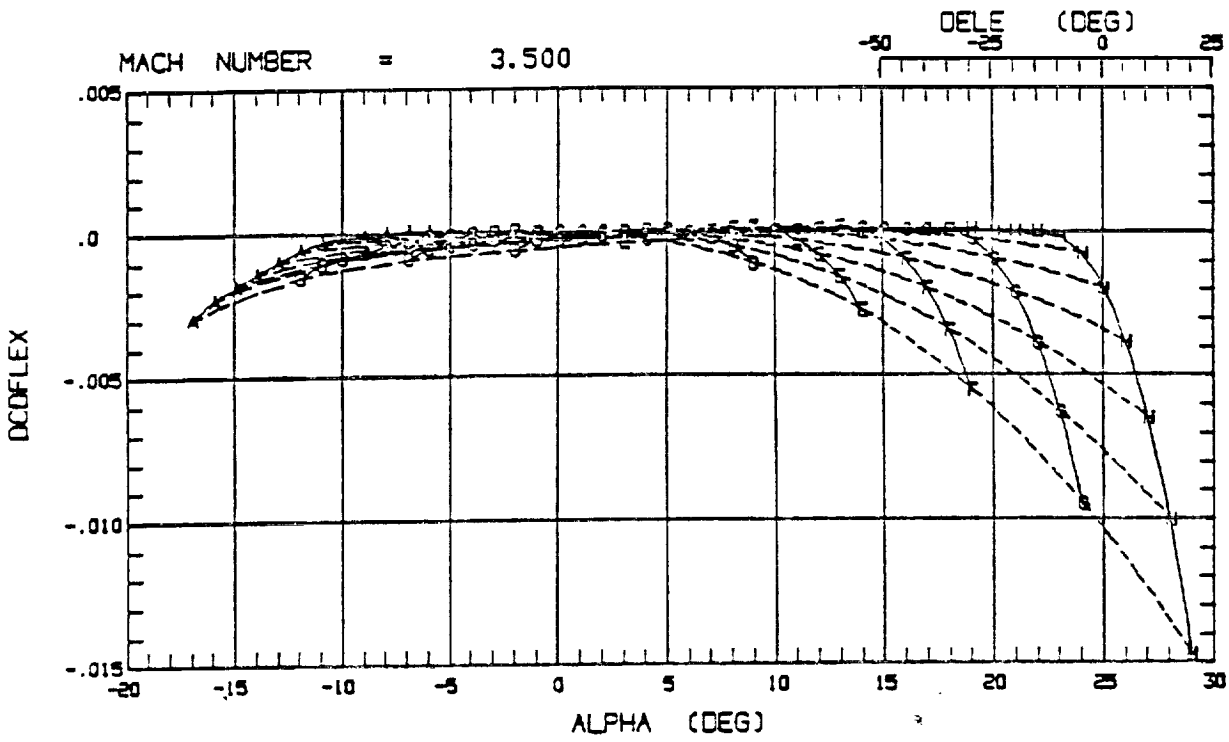
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	FLEXIBLE DRAG INCREMENT						
-35.000	-0.00032	-0.00020	-0.00007	0.00001	0.00001	-0.00006	-0.00009
-30.000	-0.00005	0.00008	0.00015	0.00012	-0.00002	-0.00023	-0.00042
-25.000	-0.00001	0.00008	0.00008	-0.00003	-0.00025	-0.00053	-0.00079
-20.000	-0.00001	0.00003	-0.00003	-0.00019	-0.00046	-0.00081	-0.00117
-15.000	0.00002	0.00001	-0.00011	-0.00035	-0.00073	-0.00124	-0.00186
-10.000	0.00007	-0.00003	-0.00028	-0.00072	-0.00136	-0.00222	-0.00337
-5.000	0.00003	-0.00027	-0.00081	-0.00162	-0.00274	-0.00426	-0.00633
0.0	-0.00030	-0.00096	-0.00198	-0.00340	-0.00530	-0.00784	-0.01127
5.000	-0.00111	-0.00233	-0.00406	-0.00634	-0.00934	-0.01327	-0.01852
10.000	-0.00254	-0.00451	-0.00714	-0.01052	-0.01487	-0.02050	-0.02795
15.000	-0.00457	-0.00740	-0.01103	-0.01562	-0.02144	-0.02994	-0.03880
20.000	-0.00691	-0.01053	-0.01509	-0.02078	-0.02796	-0.03720	-0.04940

ENGINEER [signature]
DATE 7-2-79

FIGURE 4.1.2.2-107
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.Q=300)



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

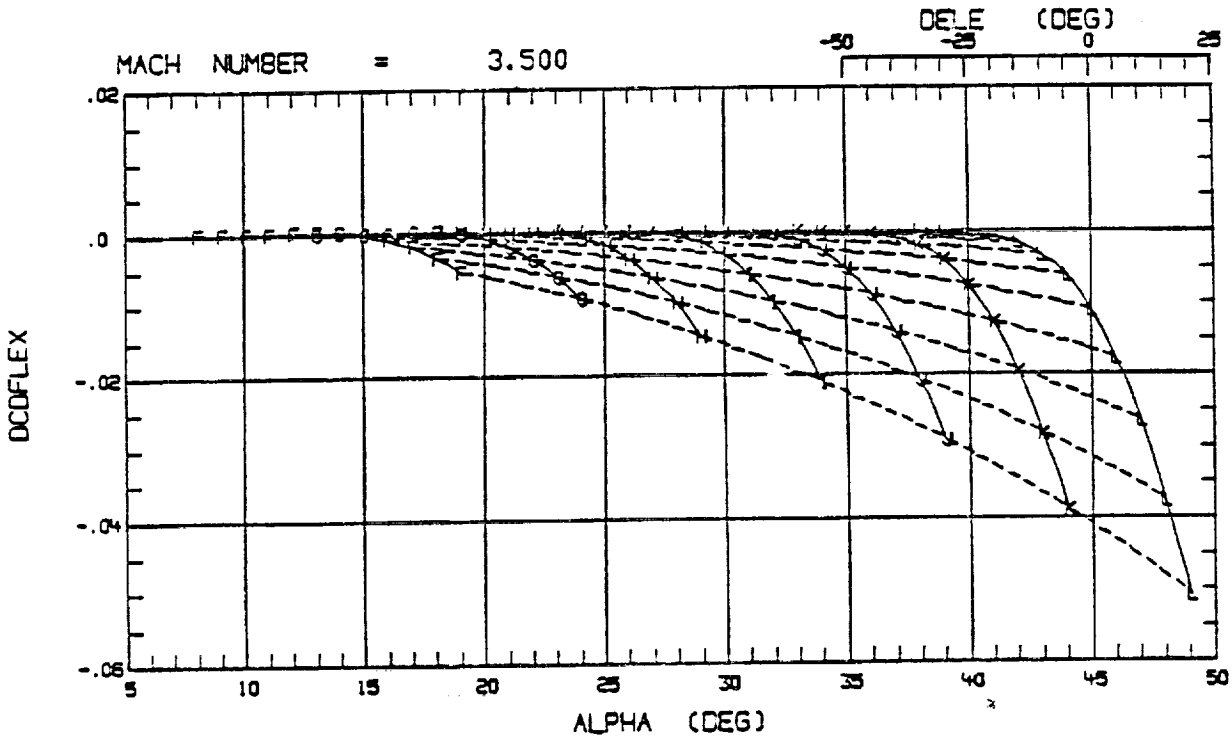
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00295	-0.00157	-0.00095	-0.00063	-0.00039	-0.00020	-0.00005	0.00003
-30.000	-0.00229	-0.00109	-0.00056	-0.00030	-0.00013	0.0	0.00007	0.00007
-25.000	-0.00183	-0.00089	-0.00048	-0.00027	-0.00013	-0.00004	0.0	-0.00002
-20.000	-0.00140	-0.00071	-0.00041	-0.00024	-0.00012	-0.00003	0.0	-0.00004
-15.000	-0.00097	-0.00050	-0.00029	-0.00014	-0.00002	0.00005	0.00005	-0.00005
-10.000	-0.00060	-0.00031	-0.00016	-0.00002	0.00008	0.00011	0.00002	-0.00023
-5.000	-0.00033	-0.00019	-0.00006	0.00005	0.00011	0.00002	-0.00029	-0.00081
0.0	-0.00019	-0.00012	-0.00003	0.00005	-0.00002	-0.00033	-0.00097	-0.00198
5.000	-0.00012	-0.00010	-0.00003	-0.00006	-0.00033	-0.00100	-0.00216	-0.00368
10.000	-0.00005	-0.00005	-0.00004	-0.00024	-0.00084	-0.00203	-0.00391	-0.00653
15.000	0.00004	0.00001	-0.00008	-0.00053	-0.00161	-0.00349	-0.00630	-0.01010
20.000	0.0	-0.00005	-0.00030	-0.00112	-0.00279	-0.00555	-0.00950	-0.01473

ENGINEER DFS
DATE 4-2-79

FIGURE 4.1.2.2- 108
FLEX DRAG COEFFICIENT INCREMENT (SF=0.SB=25.0=300)



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

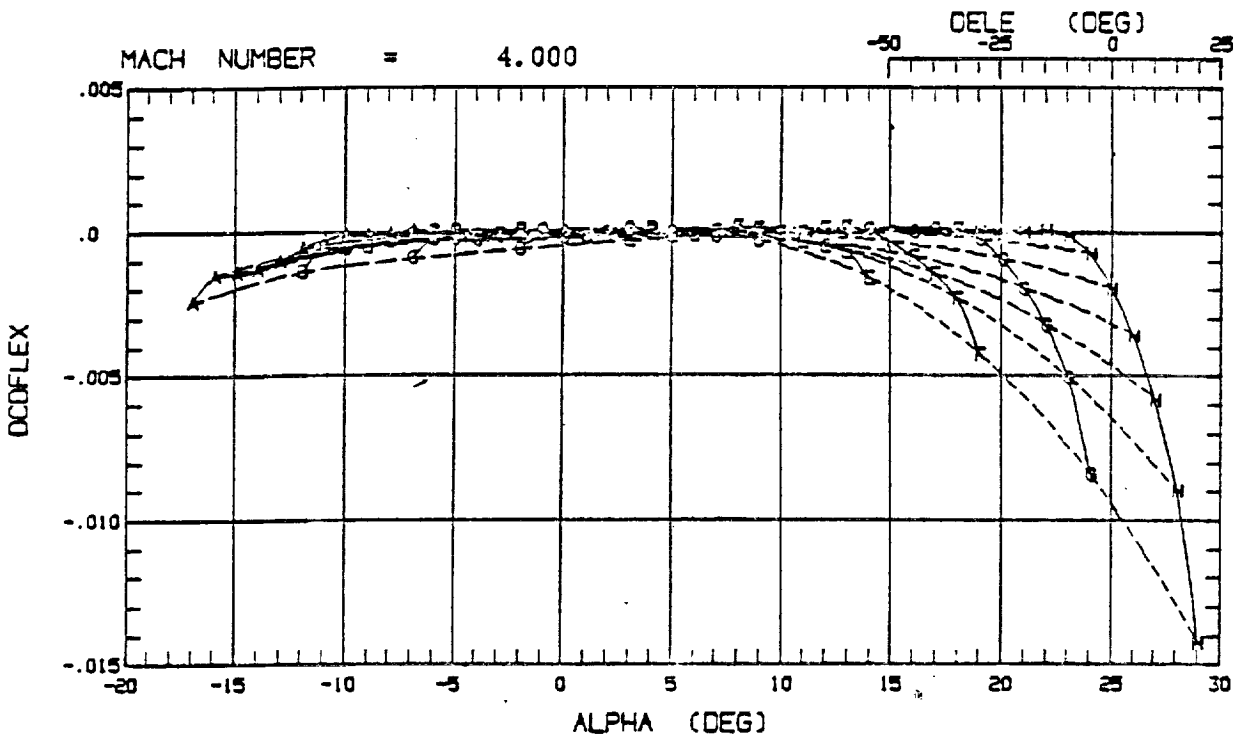
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	FLEXIBLE DRAG INCREMENT						
-35.000	-0.00020	-0.00005	0.00003	0.00003	-0.00001	-0.00006	-0.00007
-30.000	0.0	0.00007	0.00007	0.0	-0.00012	-0.00024	-0.00037
-25.000	-0.00004	0.0	-0.00002	-0.00011	-0.00024	-0.00040	-0.00065
-20.000	-0.00003	0.0	-0.00004	-0.00015	-0.00033	-0.00057	-0.00100
-15.000	0.00005	0.00005	-0.00005	-0.00025	-0.00056	-0.00102	-0.00179
-10.000	0.00011	0.00002	-0.00023	-0.00065	-0.00125	-0.00212	-0.00347
-5.000	0.00002	-0.00028	-0.00081	-0.00162	-0.00273	-0.00426	-0.00649
0.0	-0.00033	-0.00097	-0.00198	-0.00339	-0.00529	-0.00778	-0.01123
5.000	-0.00100	-0.00216	-0.00386	-0.00614	-0.00909	-0.01290	-0.01794
10.000	-0.00203	-0.00391	-0.00653	-0.00997	-0.01430	-0.01976	-0.02678
15.000	-0.00349	-0.00630	-0.01010	-0.01497	-0.02100	-0.02944	-0.03780
20.000	-0.00555	-0.00950	-0.01473	-0.02130	-0.02931	-0.03905	-0.05107

ENGINEER [signature]
DATE 7-2-79

FIGURE 4.1.2.2-109
FLEX DRAG COEFFICIENT INCREMENT (BF=0.SB=25.0=300)



CONFIGURATION

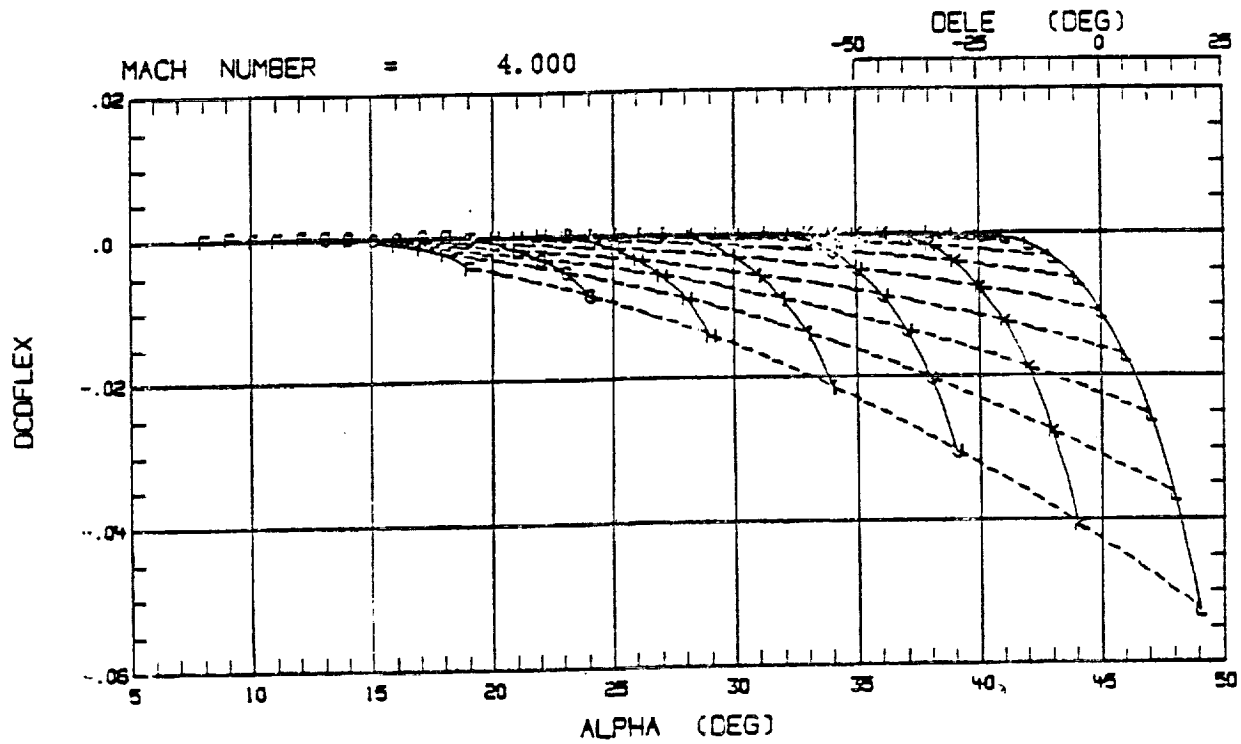
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	FLEXIBLE DRAG INCREMENT							
-35.000	-0.00248	-0.00141	-0.00095	-0.00063	-0.00033	-0.00007	0.00009	0.00010
-30.000	-0.00154	-0.00057	-0.00027	-0.00014	-0.00004	0.00004	0.00006	-0.00001
-25.000	-0.00147	-0.00056	-0.00030	-0.00022	-0.00016	-0.00010	-0.00009	-0.00012
-20.000	-0.00137	-0.00054	-0.00031	-0.00023	-0.00015	-0.00008	-0.00004	-0.00005
-15.000	-0.00103	-0.00035	-0.00017	-0.00010	-0.00001	0.00007	0.00009	0.00003
-10.000	-0.00060	-0.00012	-0.00001	0.00004	0.00011	0.00014	0.00007	-0.00016
-5.000	-0.00027	-0.00001	0.00003	0.00006	0.00008	0.0	-0.00029	-0.00081
0.0	-0.00012	-0.00005	-0.00007	-0.00006	-0.00012	-0.00039	-0.00099	-0.00198
5.000	-0.00011	-0.00016	-0.00018	-0.00019	-0.00037	-0.00091	-0.00193	-0.00365
10.000	-0.00007	-0.00015	-0.00013	-0.00017	-0.00054	-0.00151	-0.00325	-0.00586
15.000	0.00005	0.00002	0.00009	-0.00004	-0.00075	-0.00235	-0.00509	-0.00902
20.000	-0.00003	-0.00001	0.00004	-0.00035	-0.00167	-0.00429	-0.00947	-0.01427

ENGINEER [signature]
DATE 7-2-82

FIGURE 4.1.2.2-110
FLEX DRAG COEFFICIENT INCREMENT (SF=0.SB=25.0=300)

SD72-SH-0060 IM



CONFIGURATION

BASELINE ORBITER VEHICLE

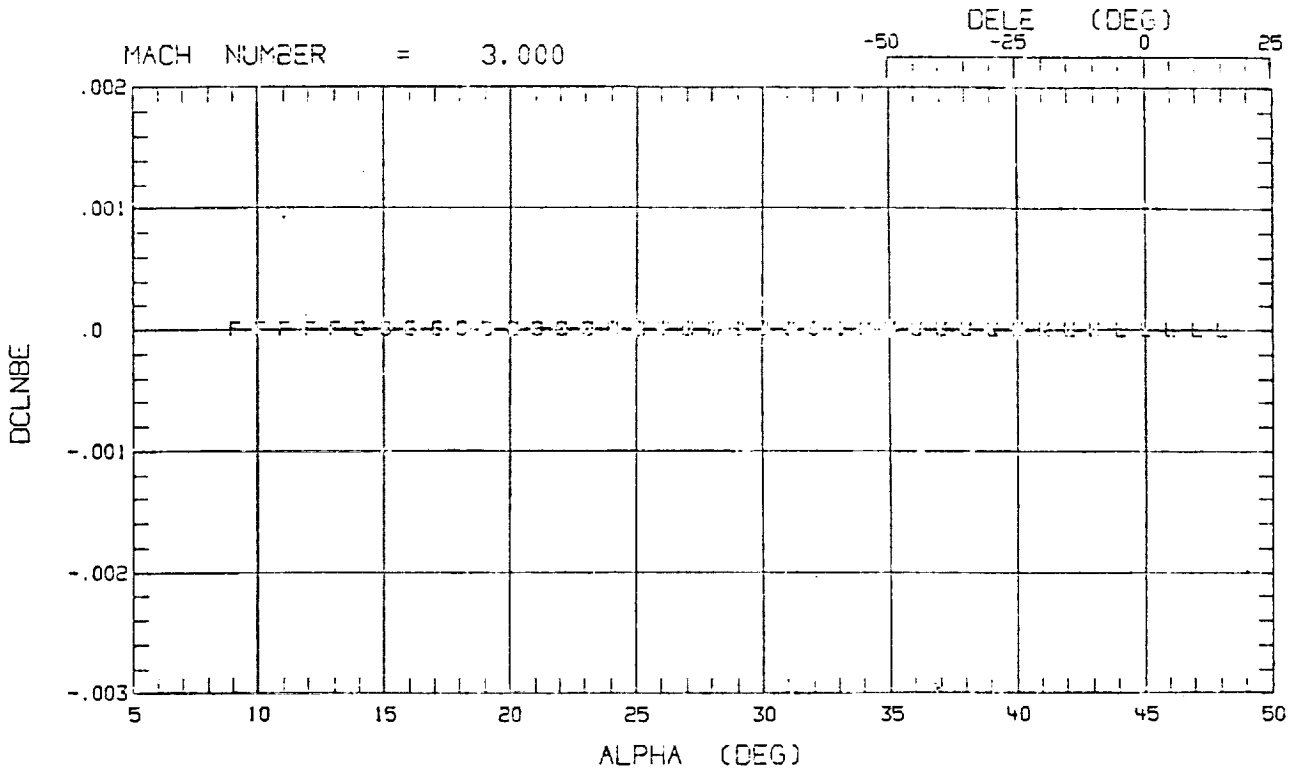
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

REFERENCE DIMENSIONS

	ALPHA (DEG)						
	15.000	20.000	25.000	30.000	35.000	40.000	45.000
	F	G	H	I	J	K	L
DELE (DEG)	FLEXIBLE DRAG INCREMENT						
-35.000	-0.00007	0.00009	0.00010	0.00003	-0.00005	-0.00004	0.0
-30.000	0.00004	0.00006	-0.00001	-0.00011	-0.00020	-0.00023	-0.00034
-25.000	-0.00010	-0.00009	-0.00012	-0.00018	-0.00022	-0.00028	-0.00054
-20.000	-0.00008	-0.00004	-0.00005	-0.00010	-0.00016	-0.00032	-0.00085
-15.000	0.00007	0.00009	0.00003	-0.00011	-0.00034	-0.00075	-0.00169
-10.000	0.00014	0.00007	-0.00016	-0.00054	-0.00110	-0.00196	-0.00351
-5.000	0.0	-0.00028	-0.00081	-0.00160	-0.00270	-0.00423	-0.00662
0.0	-0.00039	-0.00099	-0.00198	-0.00340	-0.00526	-0.00772	-0.01120
5.000	-0.00091	-0.00198	-0.00365	-0.00593	-0.00886	-0.01255	-0.01741
10.000	-0.00151	-0.00325	-0.00586	-0.00934	-0.01369	-0.01900	-0.02565
15.000	-0.00236	-0.00509	-0.00902	-0.01414	-0.02041	-0.02786	-0.03681
20.000	-0.00429	-0.00847	-0.01427	-0.02166	-0.03052	-0.04083	-0.05291

ENGINEER [illegible]
DATE 4-2-72

FIGURE 4.1.2.2-111
FLEX DRAG COEFFICIENT INCREMENT (BF=0,SB=25.0=300)



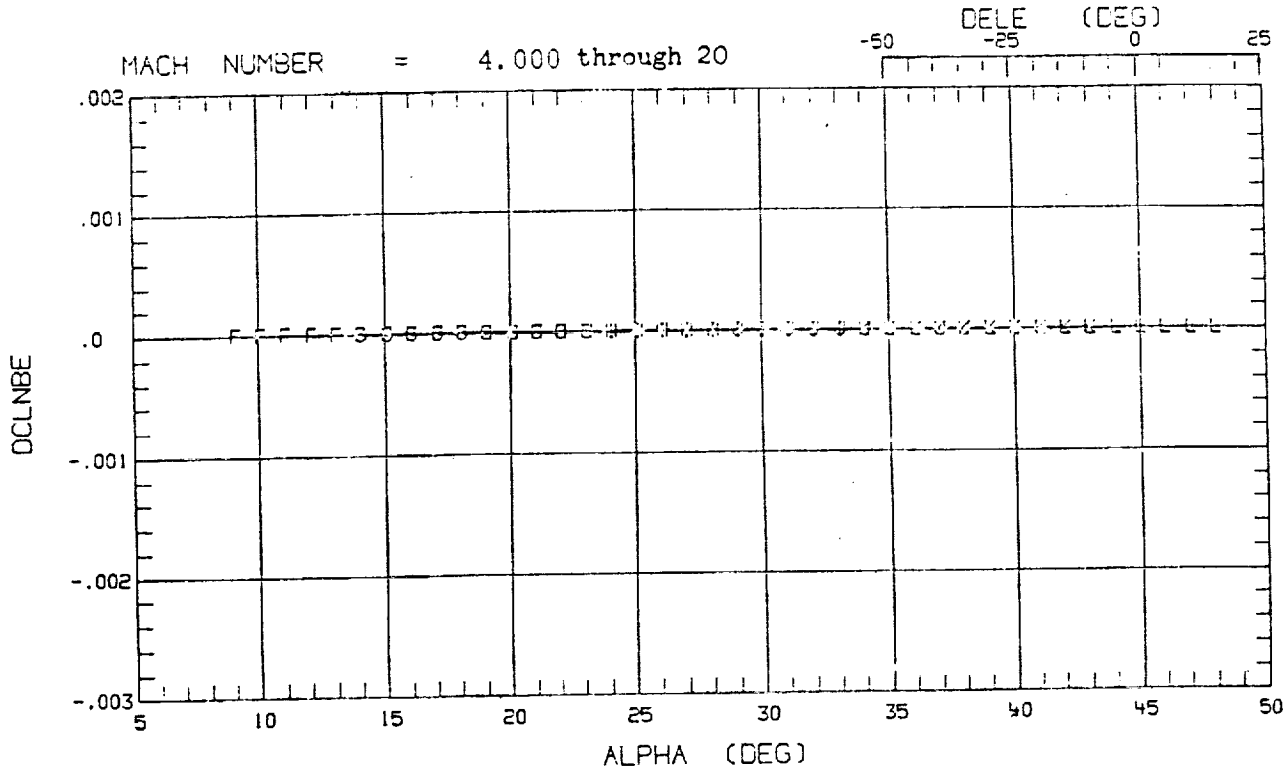
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT						
-30.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-20.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/27/93

FIGURE 4.2.1.2-44
EFFECT OF ELEVON

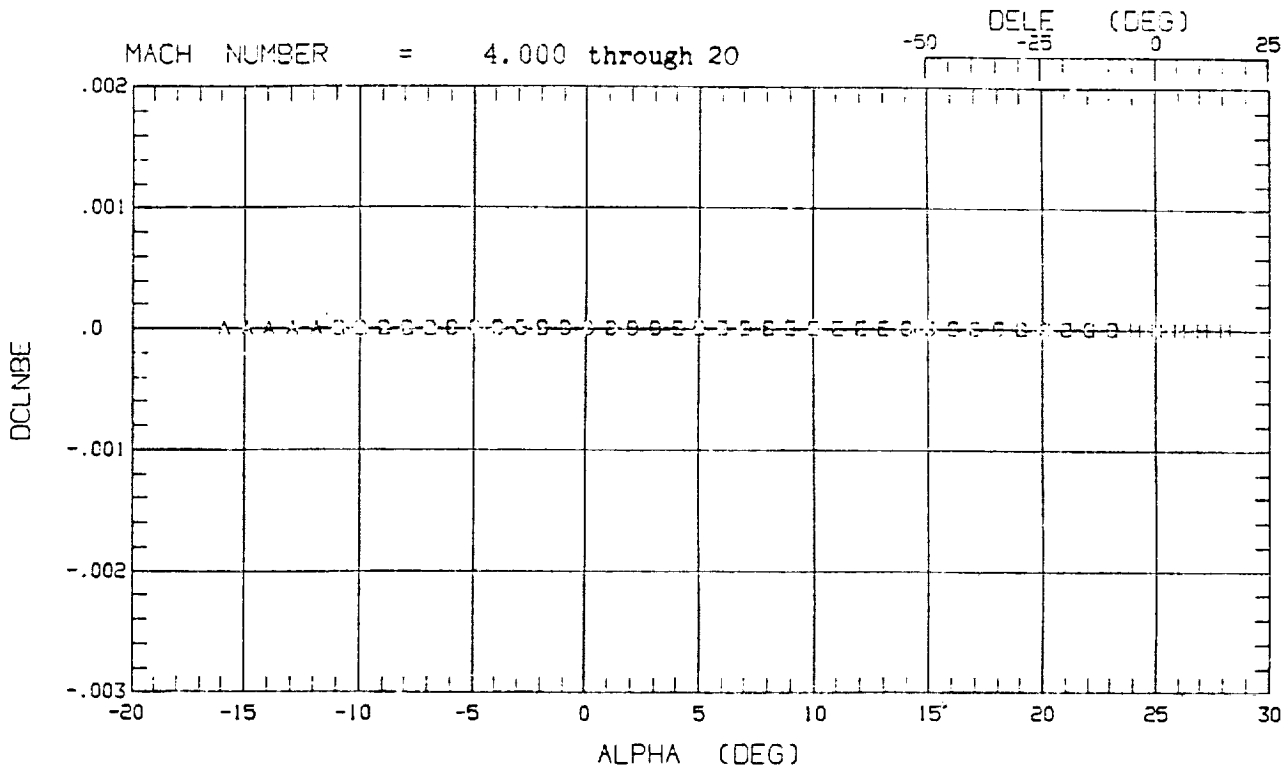


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT						
-30.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-20.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/25/73

FIGURE 4.2.1.2-45
EFFECT OF ELEVON

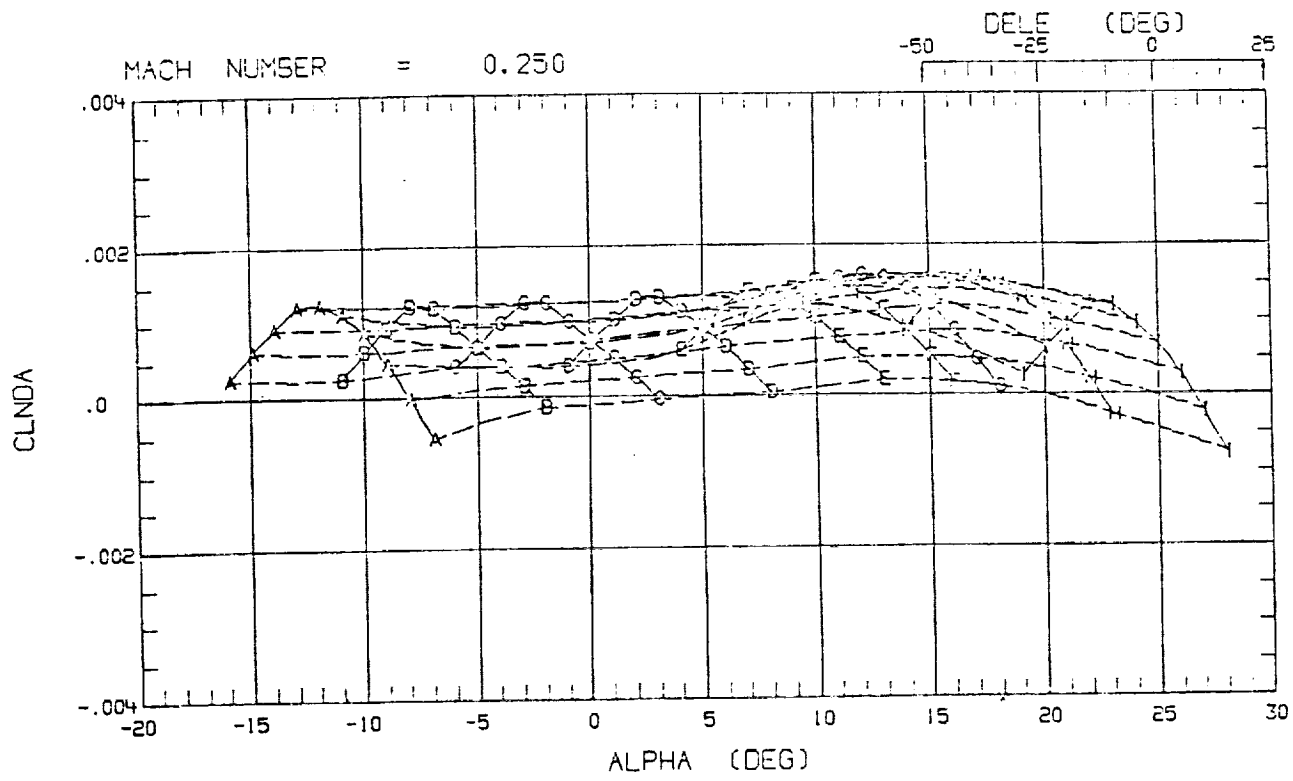


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON YAWING MOMENT INCREMENT							
-30.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-20.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/12/85

FIGURE 4.2.1.2-46
EFFECT OF ELEVON



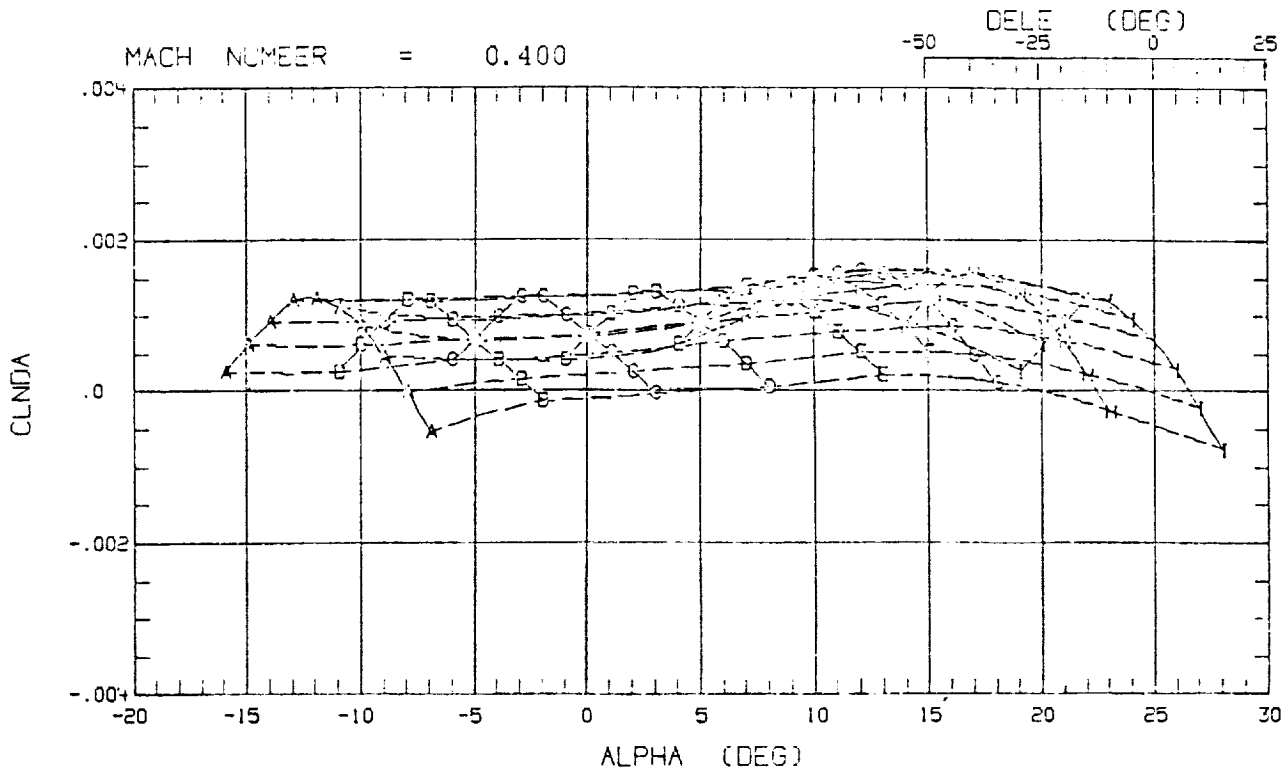
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00025	0.00025	0.00040	0.00040	0.00060	0.00097	0.00120	0.00090	0.00025
-25.000	0.00060	0.00060	0.00063	0.00072	0.00091	0.00121	0.00140	0.00127	0.00060
-20.000	0.00092	0.00092	0.00099	0.00101	0.00120	0.00141	0.00154	0.00150	0.00092
-15.000	0.00120	0.00120	0.00134	0.00127	0.00139	0.00151	0.00159	0.00154	0.00120
-10.000	0.00122	0.00118	0.00123	0.00130	0.00135	0.00148	0.00155	0.00145	0.00118
-5.000	0.00110	0.00093	0.00100	0.00111	0.00121	0.00133	0.00140	0.00128	0.00093
0.0	0.00085	0.00065	0.00075	0.00090	0.00103	0.00113	0.00120	0.00100	0.00065
5.000	0.00045	0.00040	0.00050	0.00065	0.00077	0.00083	0.00085	0.00064	0.00026
10.000	-0.00002	0.00015	0.00025	0.00035	0.00050	0.00051	0.00047	0.00020	-0.00025
15.000	-0.00055	-0.00015	-0.00005	0.00005	0.00020	0.00017	0.00010	-0.00026	-0.00080

ENGINEER [illegible]
DATE 1/15/82

FIGURE 4.2.1.2-47
EFFECT OF AILERON

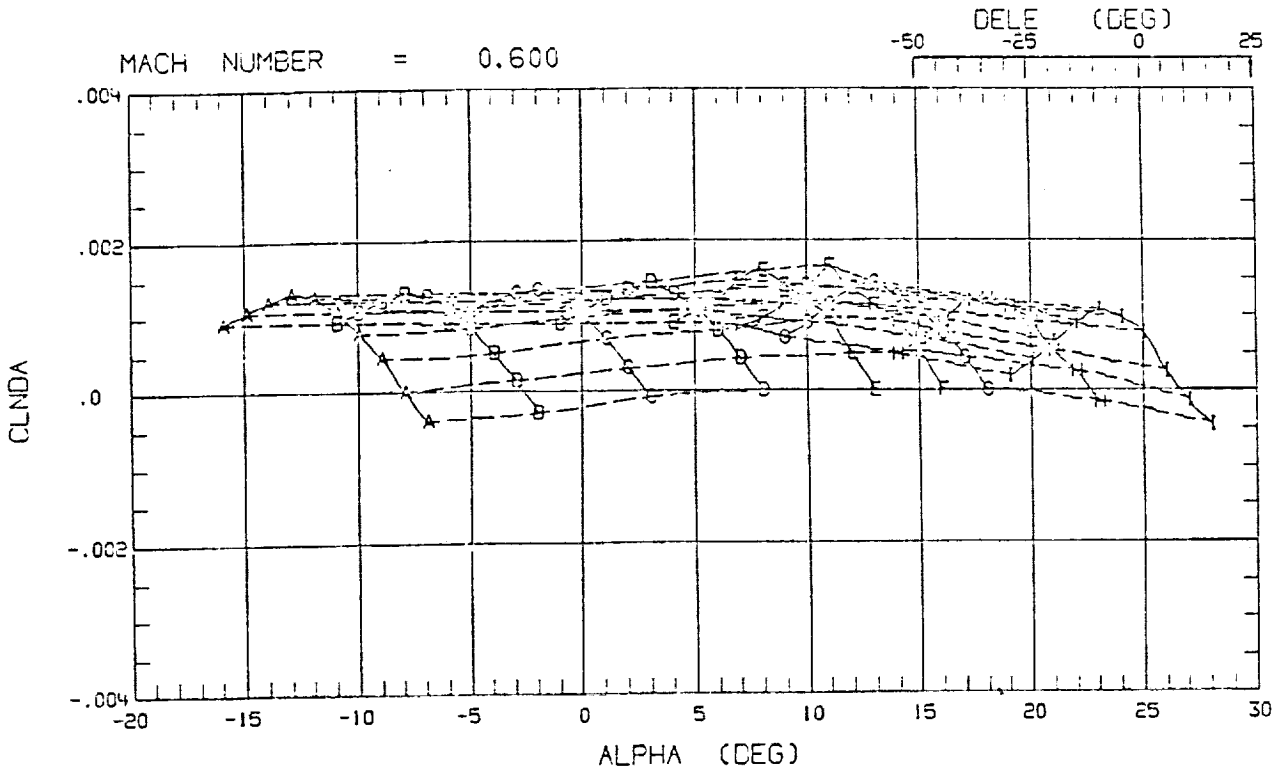


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00025	0.00025	0.00040	0.00040	0.00060	0.00097	0.00120	0.00090	0.00025
-25.000	0.00060	0.00060	0.00068	0.00072	0.00091	0.00121	0.00140	0.00127	0.00060
-20.000	0.00092	0.00092	0.00098	0.00101	0.00120	0.00141	0.00154	0.00150	0.00092
-15.000	0.00120	0.00120	0.00124	0.00127	0.00139	0.00151	0.00159	0.00154	0.00120
-10.000	0.00122	0.00118	0.00123	0.00130	0.00135	0.00148	0.00155	0.00145	0.00118
-5.000	0.00110	0.00093	0.00100	0.00111	0.00121	0.00133	0.00140	0.00128	0.00093
0.0	0.00085	0.00065	0.00075	0.00090	0.00103	0.00113	0.00120	0.00100	0.00065
5.000	0.00045	0.00040	0.00050	0.00065	0.00077	0.00083	0.00085	0.00064	0.00026
10.000	-0.00002	0.00015	0.00025	0.00035	0.00050	0.00051	0.00047	0.00020	-0.00025
15.000	-0.00055	-0.00015	-0.00005	0.00005	0.00020	0.00017	0.00010	-0.00029	-0.00080

ENGINEER
DATE 9-13-82

FIGURE 4.2.1.2- 48
EFFECT OF AILERON



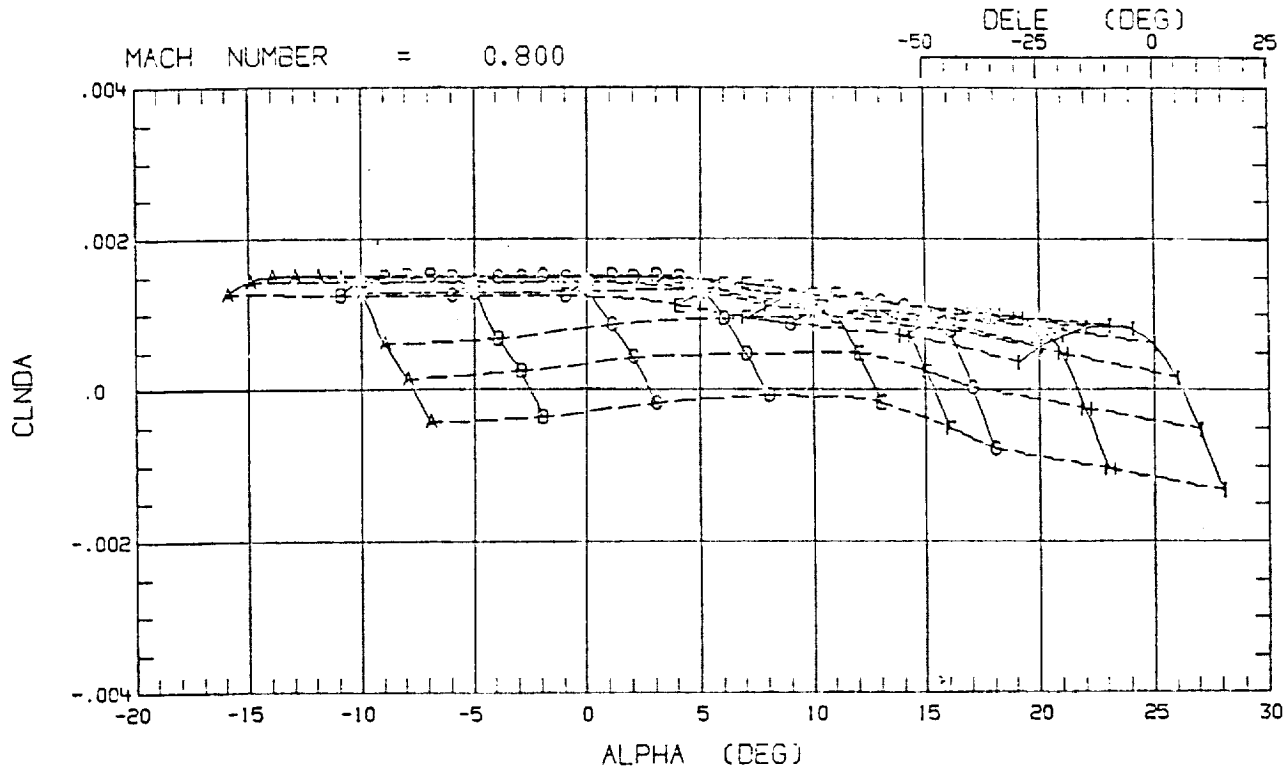
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00091	0.00091	0.00090	0.00090	0.00090	0.00085	0.00070	0.00046	0.00018
-25.000	0.00106	0.00106	0.00106	0.00105	0.00106	0.00095	0.00069	0.00048	0.00038
-20.000	0.00120	0.00120	0.00120	0.00122	0.00120	0.00114	0.00114	0.00091	0.00062
-15.000	0.00129	0.00129	0.00129	0.00133	0.00147	0.00138	0.00134	0.00118	0.00089
-10.000	0.00125	0.00125	0.00133	0.00145	0.00159	0.00164	0.00142	0.00119	0.00106
-5.000	0.00105	0.00110	0.00118	0.00128	0.00139	0.00134	0.00124	0.00110	0.00095
0.0	0.00077	0.00084	0.00098	0.00109	0.00118	0.00112	0.00105	0.00090	0.00076
5.000	0.00045	0.00050	0.00070	0.00080	0.00095	0.00090	0.00076	0.00050	0.00025
10.000	0.0	0.00015	0.00030	0.00043	0.00048	0.00051	0.00043	0.00024	-0.00015
15.000	-0.00039	-0.00028	-0.00008	0.0	0.0	-0.00001	0.0	-0.00017	-0.00046

ENGINEER [illegible]
DATE 9-3-82

FIGURE 4.2.1.2-49
EFFECT OF AILERON



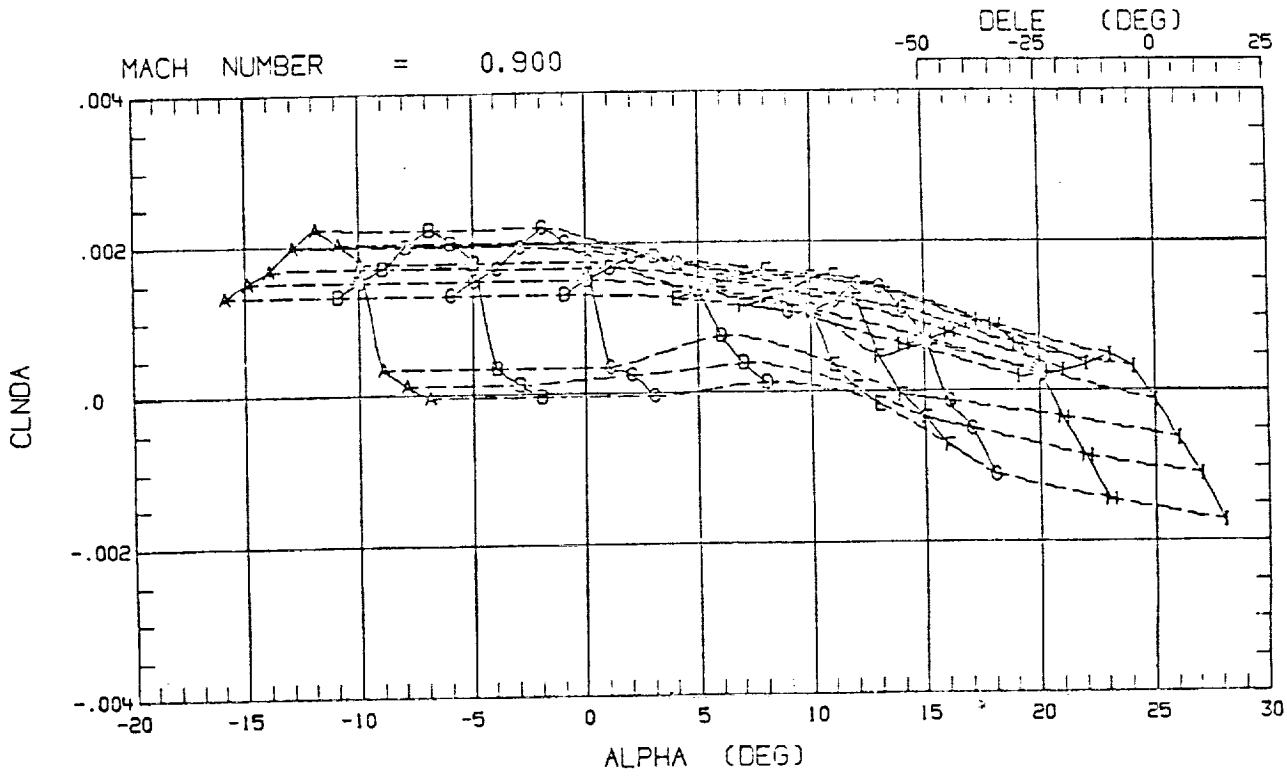
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00126	0.00124	0.00124	0.00124	0.00110	0.00093	0.00085	0.00070	0.00035
-25.000	0.00143	0.00143	0.00142	0.00143	0.00128	0.00110	0.00104	0.00087	0.00056
-20.000	0.00150	0.00148	0.00148	0.00150	0.00138	0.00122	0.00114	0.00099	0.00071
-15.000	0.00150	0.00150	0.00148	0.00148	0.00139	0.00124	0.00118	0.00099	0.00081
-10.000	0.00150	0.00150	0.00150	0.00150	0.00133	0.00123	0.00115	0.00098	0.00084
-5.000	0.00148	0.00148	0.00148	0.00148	0.00120	0.00115	0.00110	0.00094	0.00079
0.0	0.00127	0.00128	0.00130	0.00133	0.00101	0.00103	0.00095	0.00081	0.00059
5.000	0.00060	0.00068	0.00086	0.00094	0.00096	0.00084	0.00077	0.00047	0.00014
10.000	0.00014	0.00025	0.00042	0.00047	0.00047	0.00023	0.00002	-0.00026	-0.00055
15.000	-0.00042	-0.00036	-0.00018	-0.00009	-0.00019	-0.00052	-0.00080	-0.00106	-0.00135

ENGINEER [illegible]
DATE 2-3-78

FIGURE 4.2.1.2- 50
EFFECT OF AILERON



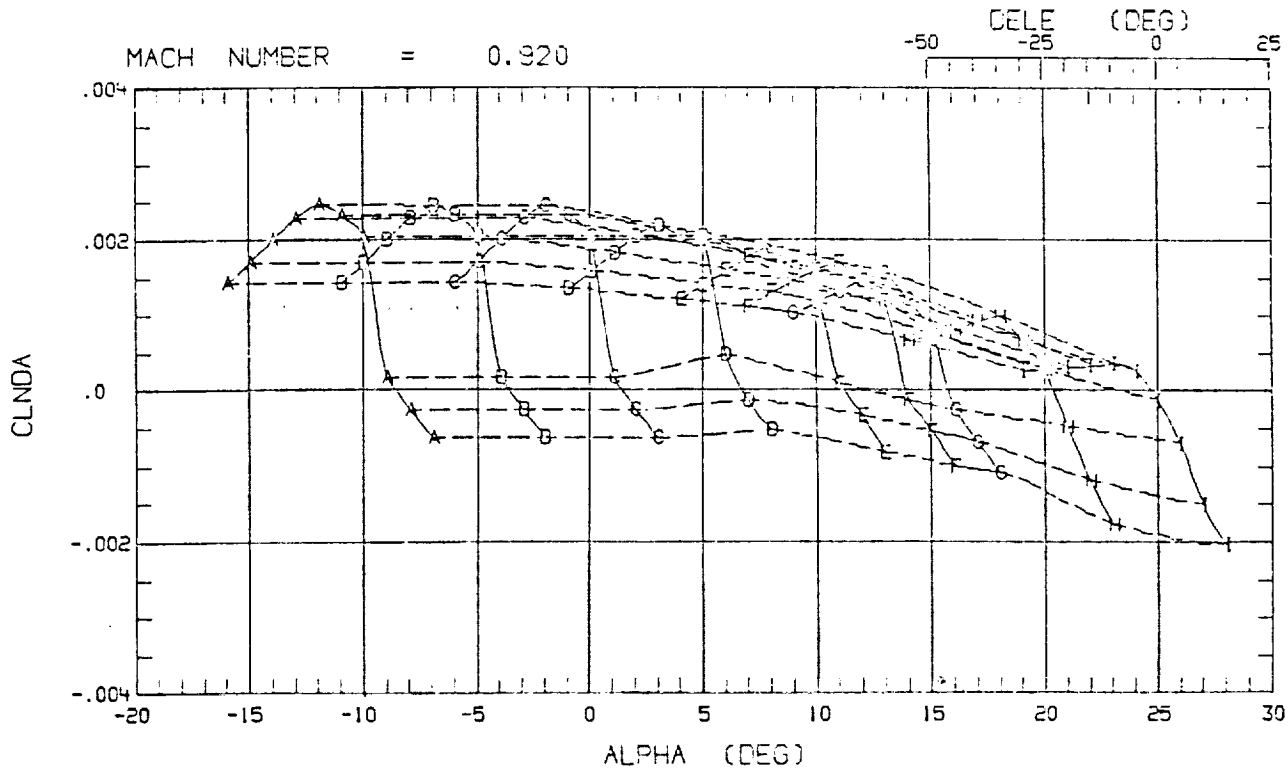
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00131	0.00132	0.00131	0.00132	0.00124	0.00114	0.00106	0.00061	0.00019
-25.000	0.00151	0.00151	0.00151	0.00151	0.00136	0.00123	0.00108	0.00063	0.00021
-20.000	0.00167	0.00169	0.00167	0.00167	0.00147	0.00133	0.00120	0.00077	0.00027
-15.000	0.00197	0.00197	0.00195	0.00180	0.00157	0.00150	0.00142	0.00093	0.00035
-10.000	0.00221	0.00219	0.00221	0.00180	0.00160	0.00153	0.00139	0.00087	0.00046
-5.000	0.00202	0.00202	0.00202	0.00170	0.00141	0.00120	0.00109	0.00060	0.00030
0.0	0.00175	0.00175	0.00175	0.00133	0.00106	0.00045	0.00063	0.00024	-0.00015
5.000	0.00035	0.00035	0.00035	0.00075	0.00035	-0.00006	-0.00015	-0.00037	-0.00064
10.000	0.00013	0.00013	0.00024	0.00038	0.00004	-0.00037	-0.00051	-0.00068	-0.00111
15.000	-0.00005	-0.00004	-0.00005	0.00013	-0.00019	-0.00074	-0.00112	-0.00146	-0.00175

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.2-51
EFFECT OF AILERON



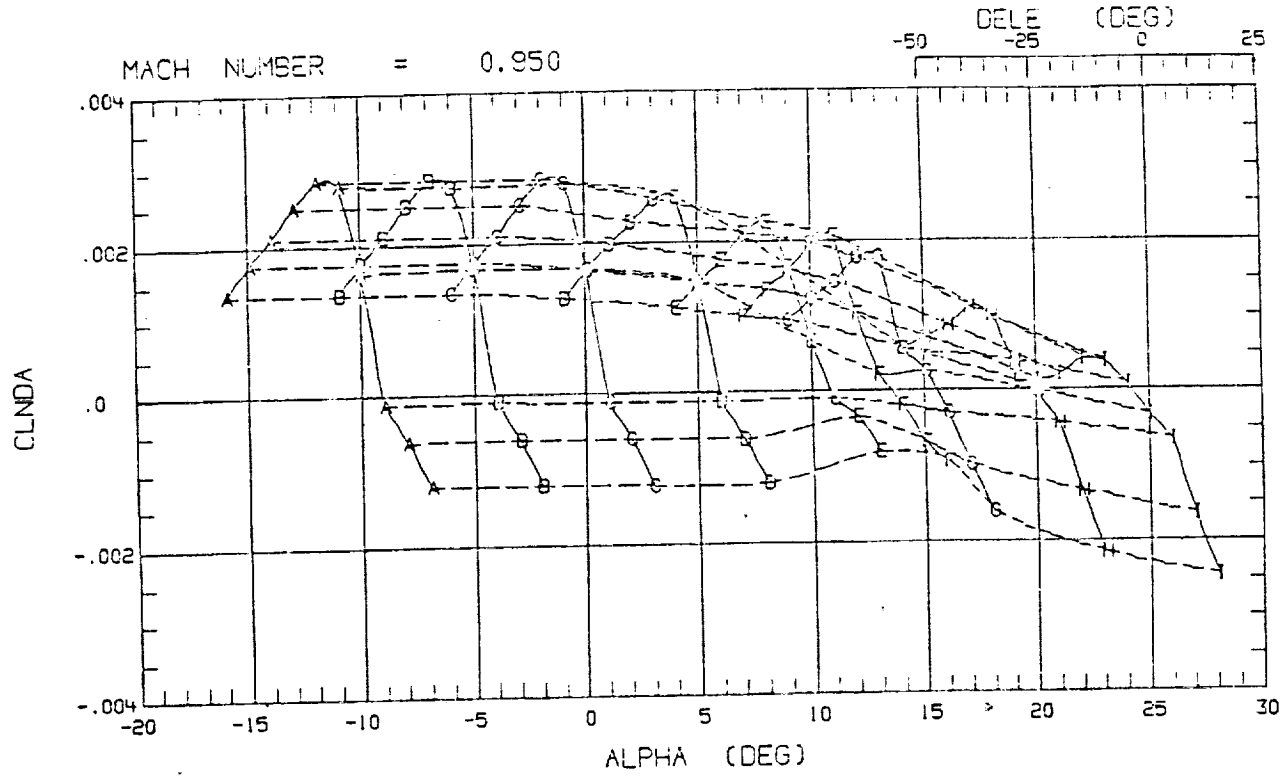
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00142	0.00142	0.00142	0.00133	0.00119	0.00110	0.00101	0.00065	0.00025
-25.000	0.00169	0.00168	0.00169	0.00156	0.00139	0.00129	0.00116	0.00074	0.00027
-20.000	0.00199	0.00199	0.00199	0.00180	0.00158	0.00144	0.00130	0.00080	0.00030
-15.000	0.00228	0.00228	0.00227	0.00204	0.00177	0.00159	0.00145	0.00092	0.00032
-10.000	0.00246	0.00244	0.00244	0.00217	0.00189	0.00169	0.00154	0.00098	0.00035
-5.000	0.00232	0.00231	0.00232	0.00204	0.00161	0.00144	0.00119	0.00065	0.00025
0.0	0.00204	0.00203	0.00203	0.00204	0.00131	0.00117	0.00075	0.00026	-0.00015
5.000	0.00016	0.00016	0.00016	0.00046	0.00008	-0.00015	-0.00026	-0.00049	-0.00071
10.000	-0.00026	-0.00026	-0.00026	-0.00015	-0.00035	-0.00055	-0.00069	-0.00120	-0.00152
15.000	-0.00063	-0.00063	-0.00063	-0.00053	-0.00083	-0.00101	-0.00110	-0.00178	-0.00206

ENGINEER
DATE

FIGURE 4.2.1.2-52
EFFECT OF AILERON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

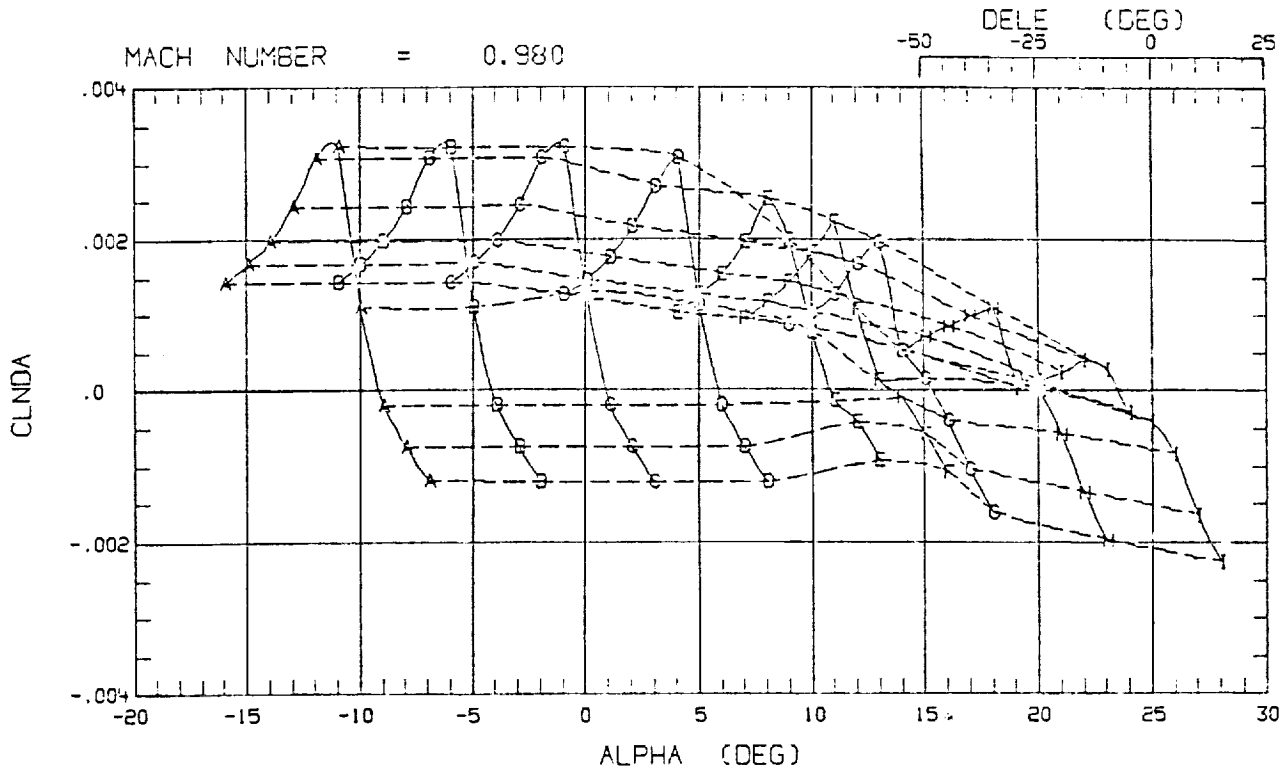
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00135	0.00135	0.00135	0.00126	0.00111	0.00100	0.00094	0.00055	0.00010
-25.000	0.00175	0.00175	0.00175	0.00163	0.00145	0.00135	0.00122	0.00070	0.00012
-20.000	0.00210	0.00210	0.00210	0.00196	0.00175	0.00160	0.00145	0.00085	0.00020
-15.000	0.00250	0.00250	0.00250	0.00225	0.00210	0.00195	0.00176	0.00110	0.00040
-10.000	0.00284	0.00284	0.00294	0.00256	0.00234	0.00205	0.00176	0.00098	0.00036
-5.000	0.00278	0.00275	0.00278	0.00258	0.00165	0.00101	0.00055	0.00037	0.00006
0.0	0.00162	0.00166	0.00164	0.00147	0.00064	0.00020	0.00025	-0.00003	-0.00034
5.000	-0.00012	-0.00011	-0.00012	-0.00012	-0.00010	-0.00021	-0.00030	-0.00045	-0.00068
10.000	-0.00062	-0.00061	-0.00061	-0.00062	-0.00035	-0.00070	-0.00100	-0.00137	-0.00166
15.000	-0.00122	-0.00122	-0.00123	-0.00122	-0.00022	-0.00095	-0.00162	-0.00216	-0.00247

ENGINEER
DATE

FIGURE 4.2.1.2-53
EFFECT OF AILERON



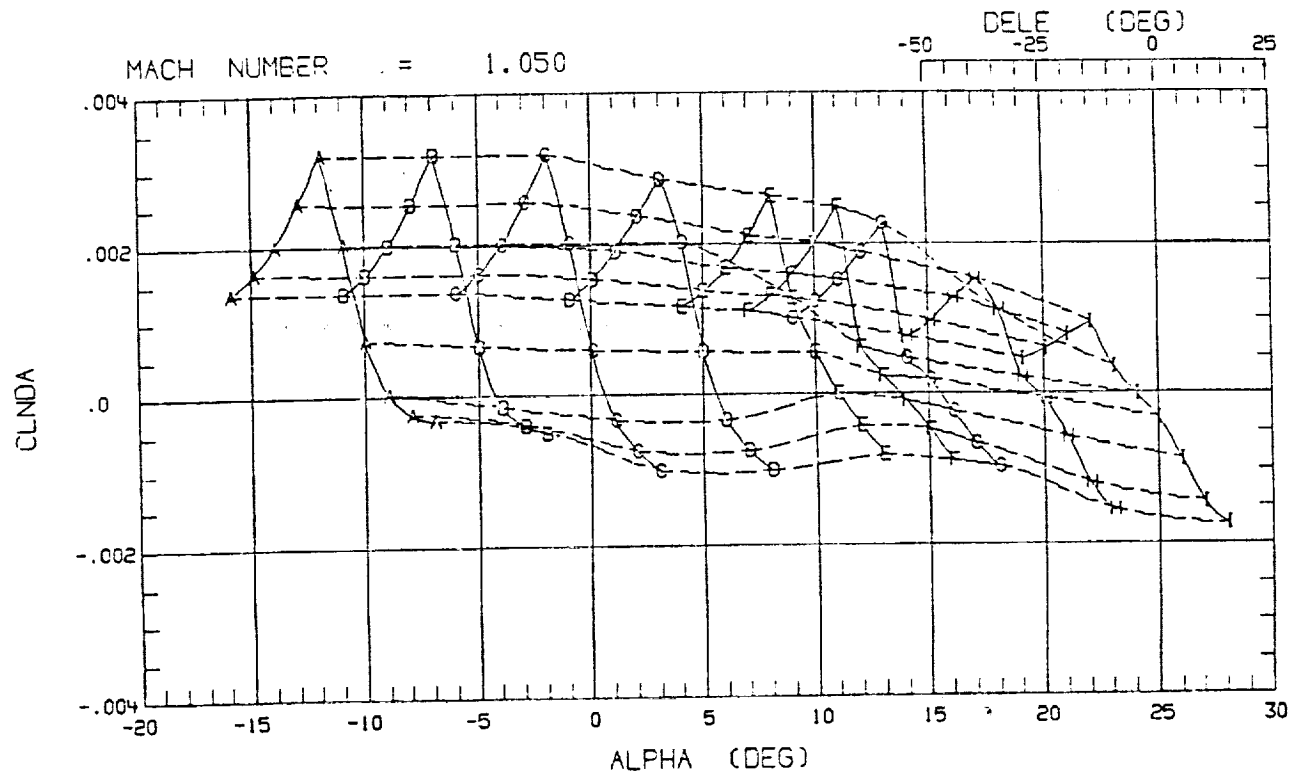
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00143	0.00143	0.00143	0.00125	0.00102	0.00093	0.00086	0.00051	0.00002
-25.000	0.00167	0.00166	0.00168	0.00145	0.00125	0.00115	0.00102	0.00069	0.00012
-20.000	0.00196	0.00197	0.00197	0.00175	0.00153	0.00142	0.00126	0.00084	0.00023
-15.000	0.00242	0.00242	0.00243	0.00215	0.00194	0.00181	0.00167	0.00097	0.00039
-10.000	0.00307	0.00307	0.00306	0.00269	0.00252	0.00222	0.00195	0.00108	0.00026
-5.000	0.00322	0.00321	0.00321	0.00307	0.00196	0.00105	0.00051	0.00014	-0.00031
0.0	0.00110	0.00110	0.00130	0.00112	0.00075	0.00012	0.00015	-0.00001	-0.00043
5.000	-0.00020	-0.00020	-0.00020	-0.00020	-0.00015	-0.00011	-0.00040	-0.00059	-0.00086
10.000	-0.00075	-0.00075	-0.00075	-0.00075	-0.00043	-0.00059	-0.00106	-0.00136	-0.00166
15.000	-0.00120	-0.00122	-0.00122	-0.00122	-0.00094	-0.00110	-0.00162	-0.00199	-0.00227

ENGINEER [signature]
DATE 7-5-22

FIGURE 4.2.1.2-54
EFFECT OF AILERON



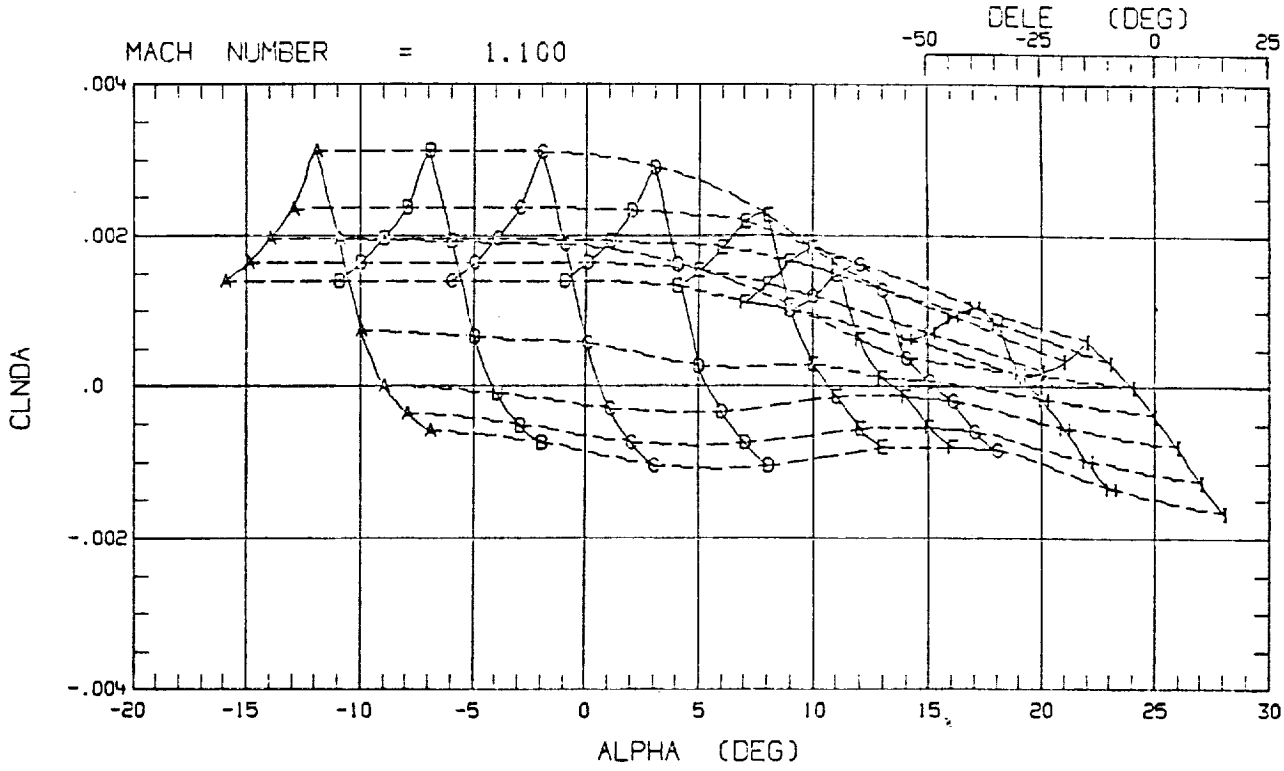
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00136	0.00136	0.00135	0.00125	0.00115	0.00110	0.00100	0.00075	0.00045
-25.000	0.00162	0.00161	0.00161	0.00152	0.00136	0.00129	0.00122	0.00095	0.00059
-20.000	0.00200	0.00199	0.00199	0.00189	0.00165	0.00159	0.00150	0.00125	0.00077
-15.000	0.00255	0.00253	0.00255	0.00236	0.00210	0.00199	0.00186	0.00150	0.00094
-10.000	0.00319	0.00318	0.00318	0.00284	0.00261	0.00247	0.00225	0.00110	0.00035
-5.000	0.00201	0.00201	0.00201	0.00201	0.00125	0.00061	0.00046	0.00021	-0.00003
0.0	0.00074	0.00065	0.00059	0.00056	0.00055	0.00023	0.00018	-0.00008	-0.00034
5.000	0.00002	-0.00017	-0.00034	-0.00034	-0.00001	-0.00010	-0.00024	-0.00059	-0.00089
10.000	-0.00025	-0.00040	-0.00075	-0.00075	-0.00043	-0.00049	-0.00067	-0.00120	-0.00146
15.000	-0.00033	-0.00050	-0.00101	-0.00101	-0.00091	-0.00090	-0.00097	-0.00156	-0.00175

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.2-55
EFFECT OF AILERON



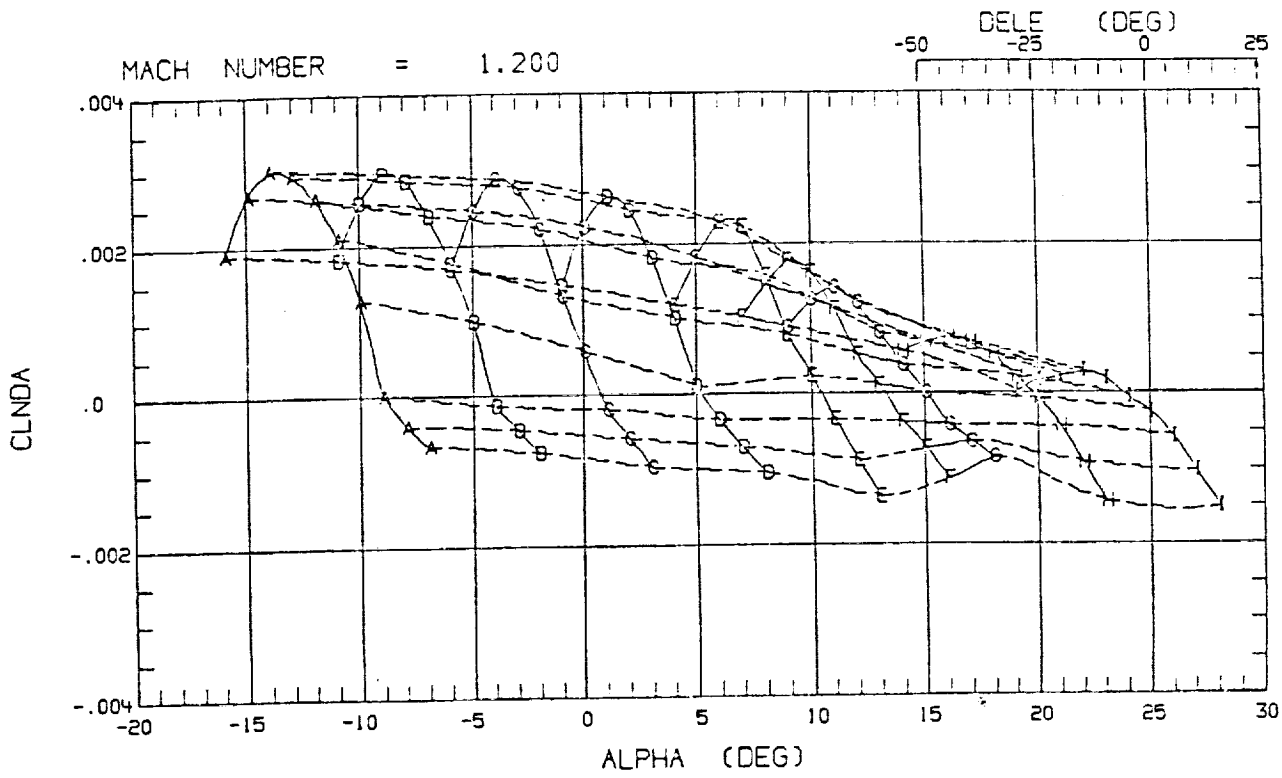
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00139	0.00139	0.00139	0.00139	0.00131	0.00110	0.00100	0.00061	0.00013
-25.000	0.00162	0.00163	0.00162	0.00162	0.00152	0.00134	0.00117	0.00070	0.00019
-20.000	0.00195	0.00195	0.00195	0.00191	0.00183	0.00164	0.00147	0.00091	0.00032
-15.000	0.00234	0.00236	0.00236	0.00231	0.00218	0.00183	0.00161	0.00103	0.00059
-10.000	0.00311	0.00311	0.00309	0.00289	0.00235	0.00161	0.00126	0.00081	0.00030
-5.000	0.00195	0.00190	0.00186	0.00161	0.00105	0.00060	0.00036	0.00016	-0.00002
0.0	0.00074	0.00064	0.00056	0.00026	0.00028	0.00011	0.00006	-0.00019	-0.00040
5.000	0.0	-0.00011	-0.00031	-0.00034	-0.00014	-0.00014	-0.00021	-0.00056	-0.00082
10.000	-0.00036	-0.00052	-0.00076	-0.00076	-0.00056	-0.00055	-0.00061	-0.00100	-0.00128
15.000	-0.00059	-0.00076	-0.00106	-0.00105	-0.00082	-0.00091	-0.00085	-0.00136	-0.00169

ENGINEER
DATE 4-3-25

FIGURE 4.2.1.2-56
EFFECT OF AILERON



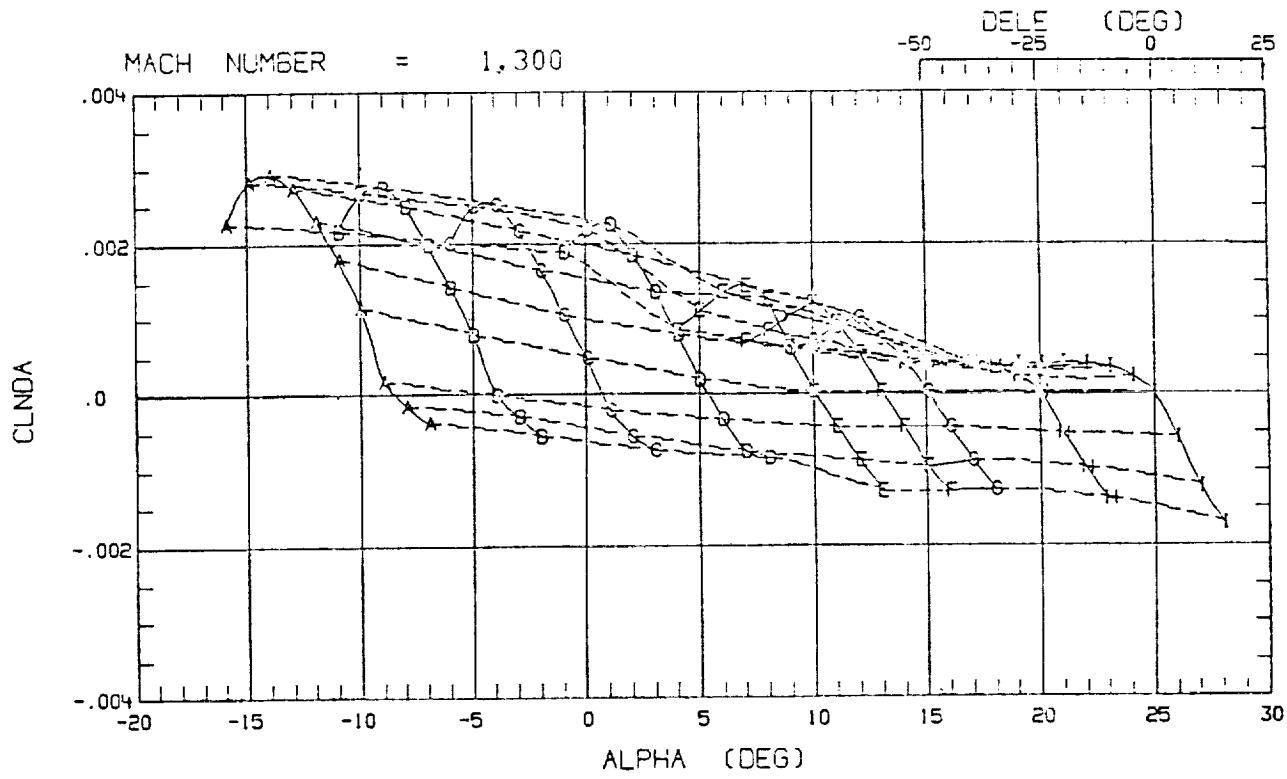
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00189	0.00180	0.00167	0.00145	0.00117	0.00101	0.00087	0.00055	0.00003
-25.000	0.00265	0.00256	0.00244	0.00222	0.00181	0.00144	0.00124	0.00068	0.00015
-20.000	0.00300	0.00295	0.00286	0.00262	0.00228	0.00176	0.00140	0.00073	0.00022
-15.000	0.00293	0.00285	0.00274	0.00244	0.00222	0.00161	0.00119	0.00068	0.00028
-10.000	0.00261	0.00238	0.00220	0.00180	0.00157	0.00111	0.00079	0.00050	0.00019
-5.000	0.00210	0.00175	0.00130	0.00100	0.00077	0.00050	0.00037	0.00021	-0.00007
0.0	0.00125	0.00097	0.00056	0.00011	0.00022	0.00011	0.0	-0.00008	-0.00026
5.000	0.0	-0.00015	-0.00020	-0.00035	-0.00034	-0.00038	-0.00042	-0.00045	-0.00058
10.000	-0.00040	-0.00047	-0.00059	-0.00072	-0.00069	-0.00073	-0.00064	-0.00094	-0.00103
15.000	-0.00068	-0.00078	-0.00097	-0.00106	-0.00139	-0.00114	-0.00086	-0.00146	-0.00152

ENGINEER JB
DATE 9-3-85

FIGURE 4.2.1.2-57
EFFECT OF AILERON



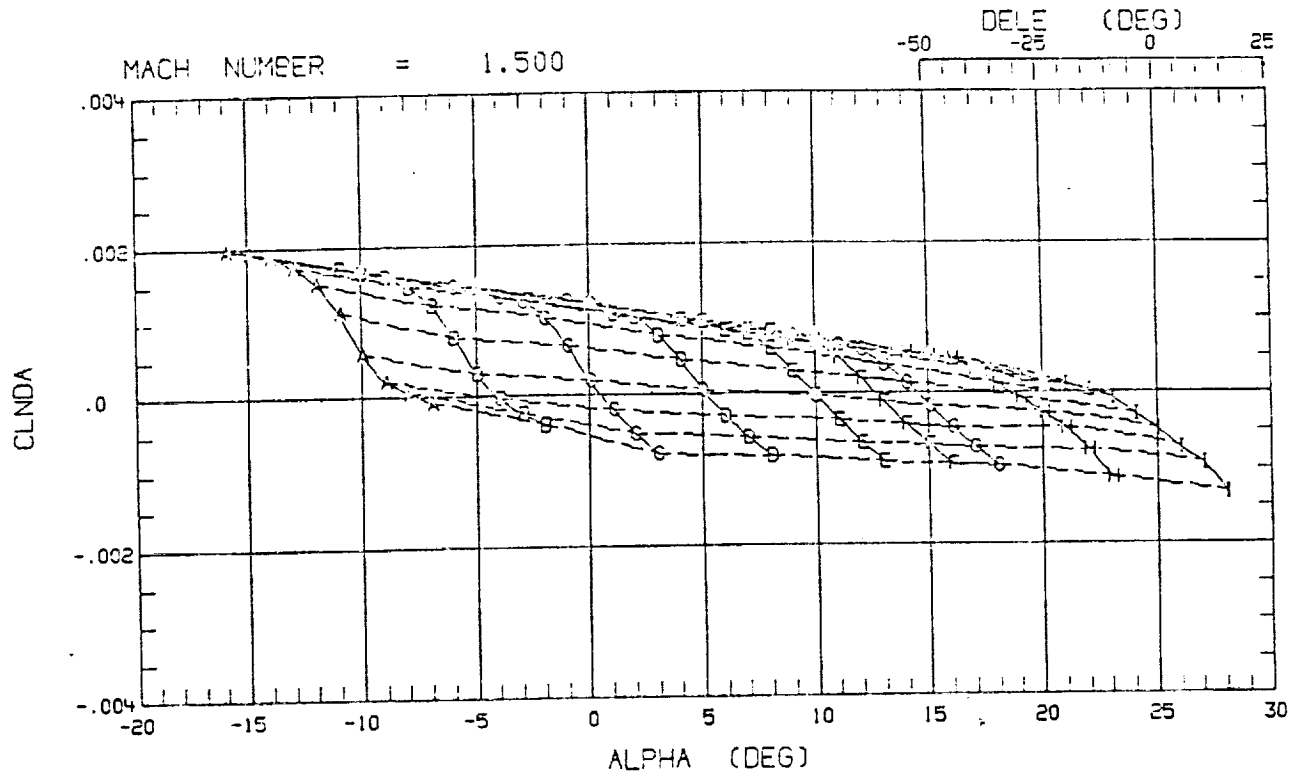
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1075.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00225	0.00215	0.00200	0.00186	0.00084	0.00069	0.00059	0.00039	0.00039
-25.000	0.00281	0.00265	0.00247	0.00217	0.00110	0.00083	0.00069	0.00040	0.00039
-20.000	0.00290	0.00273	0.00249	0.00224	0.00135	0.00103	0.00088	0.00040	0.00040
-15.000	0.00272	0.00247	0.00215	0.00183	0.00143	0.00119	0.00100	0.00040	0.00039
-10.000	0.00230	0.00197	0.00163	0.00135	0.00123	0.00094	0.00072	0.00035	0.00035
-5.000	0.00178	0.00140	0.00103	0.00077	0.00060	0.00053	0.00045	0.00022	0.00022
0.0	0.00114	0.00078	0.00047	0.00019	0.00002	0.00002	0.00002	0.00002	0.0
5.000	0.00016	-0.00003	-0.00022	-0.00035	-0.00045	-0.00045	-0.00045	-0.00052	-0.00059
10.000	-0.00016	-0.00031	-0.00056	-0.00077	-0.00090	-0.00098	-0.00090	-0.00100	-0.00123
15.000	-0.00039	-0.00056	-0.00076	-0.00085	-0.00129	-0.00129	-0.00127	-0.00141	-0.00172

ENGINEER [illegible]
DATE 9-3-82

FIGURE 4.2.1.2-58
EFFECT OF AILERON



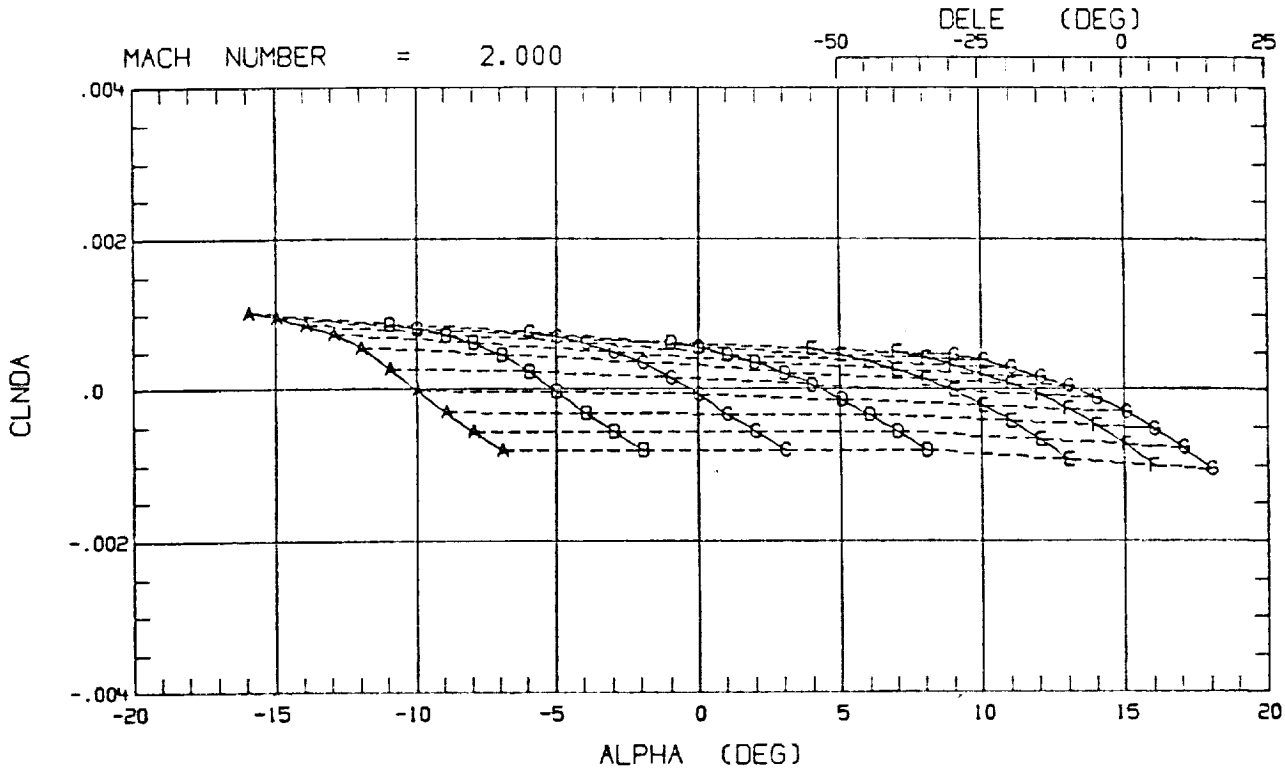
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00195	0.00170	0.00145	0.00123	0.00099	0.00084	0.00076	0.00053	0.00015
-25.000	0.00193	0.00165	0.00142	0.00120	0.00096	0.00082	0.00072	0.00049	0.00013
-20.000	0.00186	0.00158	0.00130	0.00105	0.00093	0.00070	0.00062	0.00045	0.00010
-15.000	0.00173	0.00145	0.00124	0.00101	0.00080	0.00066	0.00056	0.00030	0.00002
-10.000	0.00150	0.00120	0.00102	0.00078	0.00059	0.00046	0.00037	0.00010	-0.00008
-5.000	0.00111	0.00078	0.00084	0.00045	0.00029	0.00019	0.00013	-0.00008	-0.00030
0.0	0.00057	0.00029	0.00018	0.00004	-0.00005	-0.00013	-0.00018	-0.00028	-0.00050
5.000	0.00020	-0.00005	-0.00021	-0.00031	-0.00036	-0.00043	-0.00047	-0.00048	-0.00075
10.000	0.00005	-0.00025	-0.00052	-0.00059	-0.00066	-0.00070	-0.00073	-0.00078	-0.00095
15.000	-0.00010	-0.00040	-0.00080	-0.00084	-0.00092	-0.00095	-0.00097	-0.00114	-0.00134

ENGINEER [illegible]
DATE 9-13-72

FIGURE 4.2.1.2-59
EFFECT OF AILERON



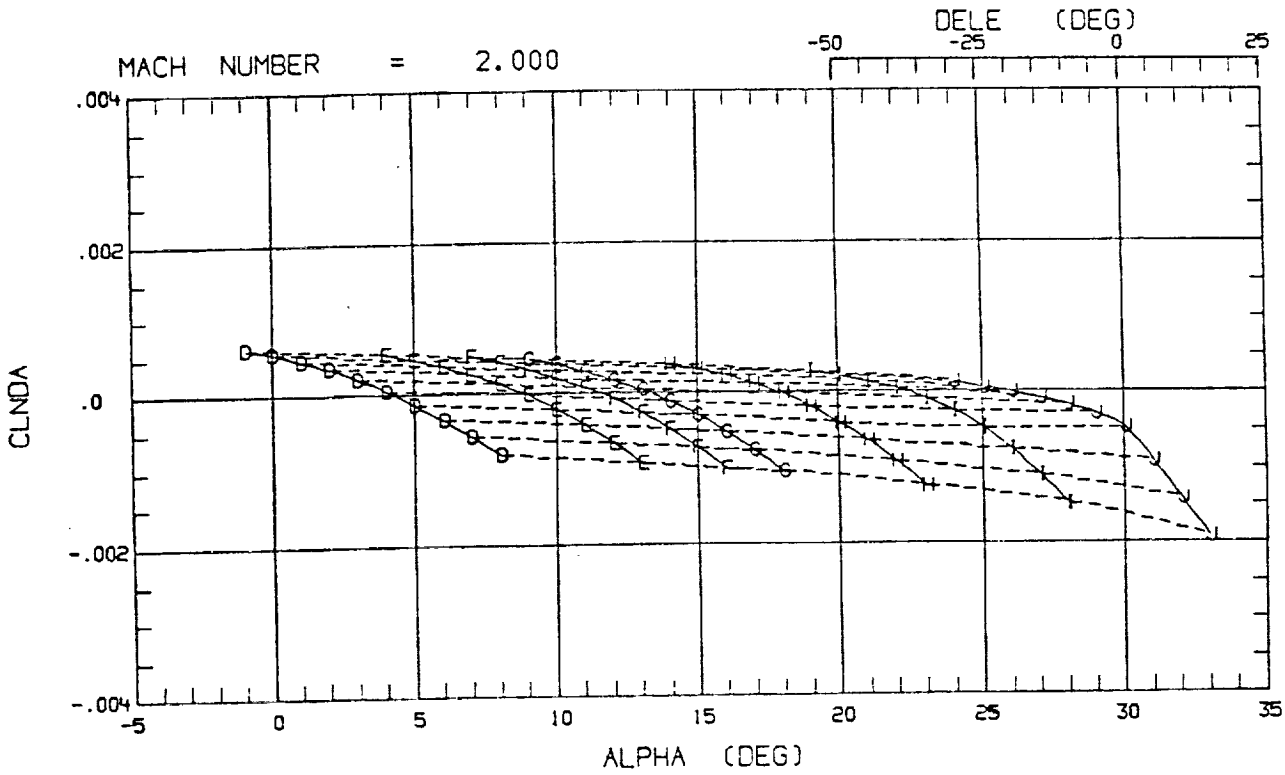
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G
DELE (DEG)	AILERON EFFECTIVENESS						
-30.000	0.00102	0.00086	0.00075	0.00060	0.00053	0.00048	0.00045
-25.000	0.00095	0.00080	0.00069	0.00055	0.00045	0.00041	0.00038
-20.000	0.00085	0.00072	0.00060	0.00045	0.00036	0.00031	0.00028
-15.000	0.00073	0.00060	0.00048	0.00035	0.00025	0.00019	0.00016
-10.000	0.00055	0.00045	0.00035	0.00021	0.00012	0.00007	0.00004
-5.000	0.00027	0.00022	0.00014	0.00005	-0.00003	-0.00008	-0.00012
0.0	-0.00003	-0.00005	-0.00008	-0.00015	-0.00022	-0.00027	-0.00030
5.000	-0.00031	-0.00033	-0.00034	-0.00035	-0.00043	-0.00048	-0.00052
10.000	-0.00057	-0.00057	-0.00057	-0.00057	-0.00067	-0.00073	-0.00078
15.000	-0.00082	-0.00082	-0.00082	-0.00082	-0.00094	-0.00101	-0.00106

ENGINEER JT 3
DATE 2-3-72

FIGURE 4.2.1.2-60
EFFECT OF AILERON

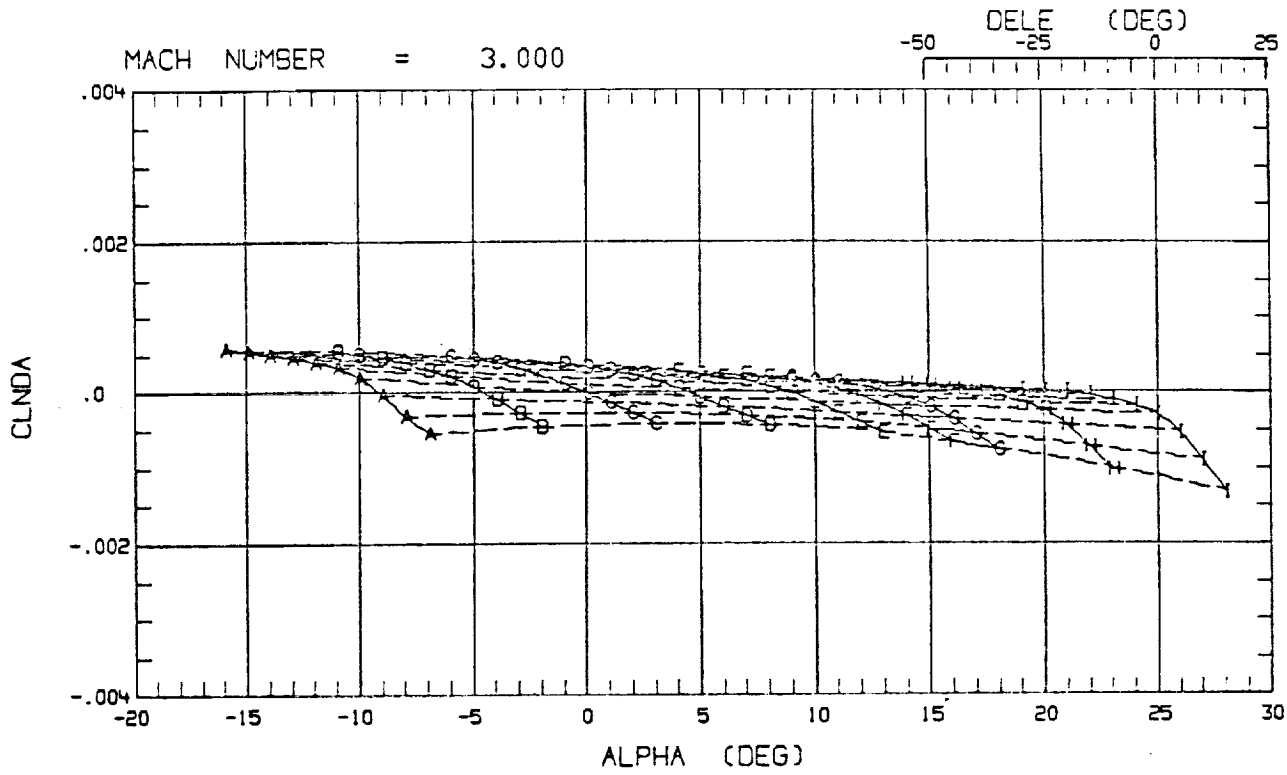


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I	30.000 J
DELE (DEG)	AILERON EFFECTIVENESS						
-30.000	0.00060	0.00053	0.00048	0.00045	0.00036	0.00025	0.00012
-25.000	0.00055	0.00045	0.00041	0.00039	0.00030	0.00021	0.00005
-20.000	0.00045	0.00036	0.00031	0.00028	0.00022	0.00013	-0.00002
-15.000	0.00035	0.00025	0.00019	0.00016	0.00011	0.00004	-0.00010
-10.000	0.00021	0.00012	0.00007	0.00004	-0.00003	-0.00010	-0.00019
-5.000	0.00005	-0.00003	-0.00008	-0.00012	-0.00020	-0.00026	-0.00030
0.0	-0.00015	-0.00022	-0.00027	-0.00030	-0.00042	-0.00048	-0.00048
5.000	-0.00035	-0.00043	-0.00048	-0.00052	-0.00065	-0.00078	-0.00094
10.000	-0.00057	-0.00067	-0.00073	-0.00078	-0.00094	-0.00112	-0.00145
15.000	-0.00082	-0.00094	-0.00101	-0.00106	-0.00125	-0.00150	-0.00195

ENGINEER F³
DATE 9-3-78

FIGURE 4.2.1.2-61
EFFECT OF AILERON



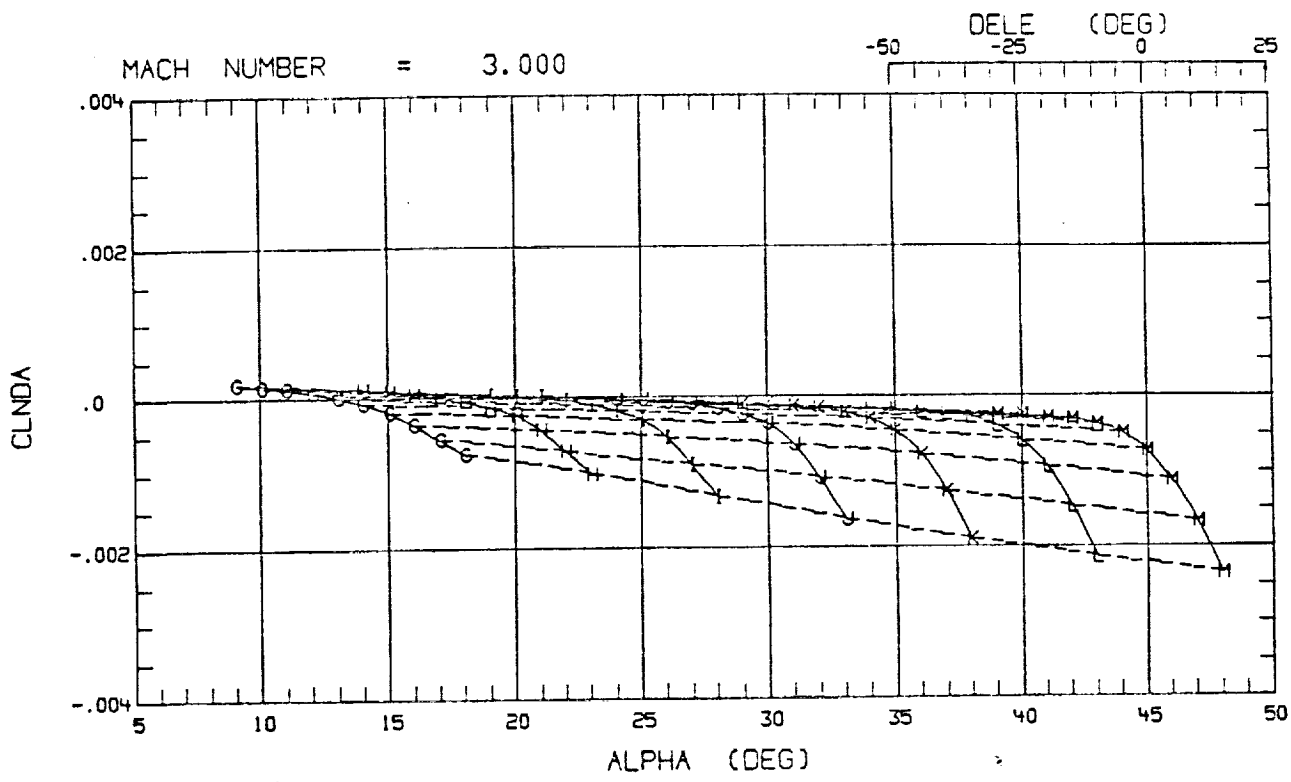
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00056	0.00053	0.00047	0.00037	0.00027	0.00022	0.00019	0.00011	0.00003
-25.000	0.00053	0.00049	0.00043	0.00033	0.00023	0.00018	0.00015	0.00008	0.00001
-20.000	0.00049	0.00044	0.00038	0.00028	0.00019	0.00015	0.00012	0.00005	-0.00001
-15.000	0.00045	0.00038	0.00030	0.00022	0.00014	0.00010	0.00007	0.0	-0.00005
-10.000	0.00039	0.00029	0.00021	0.00014	0.00007	0.00003	0.0	-0.00007	-0.00011
-5.000	0.00032	0.00020	0.00010	0.00004	-0.00002	-0.00006	-0.00008	-0.00014	-0.00019
0.0	0.00019	0.00007	-0.00002	-0.00008	-0.00014	-0.00018	-0.00020	-0.00025	-0.00031
5.000	-0.00005	-0.00010	-0.00015	-0.00021	-0.00028	-0.00033	-0.00036	-0.00045	-0.00054
10.000	-0.00032	-0.00028	-0.00028	-0.00032	-0.00041	-0.00050	-0.00057	-0.00074	-0.00091
15.000	-0.00055	-0.00046	-0.00043	-0.00045	-0.00055	-0.00068	-0.00077	-0.00103	-0.00133

ENGINEER JF
DATE 9-3-78

FIGURE 4.2.1.2-62
EFFECT OF AILERON



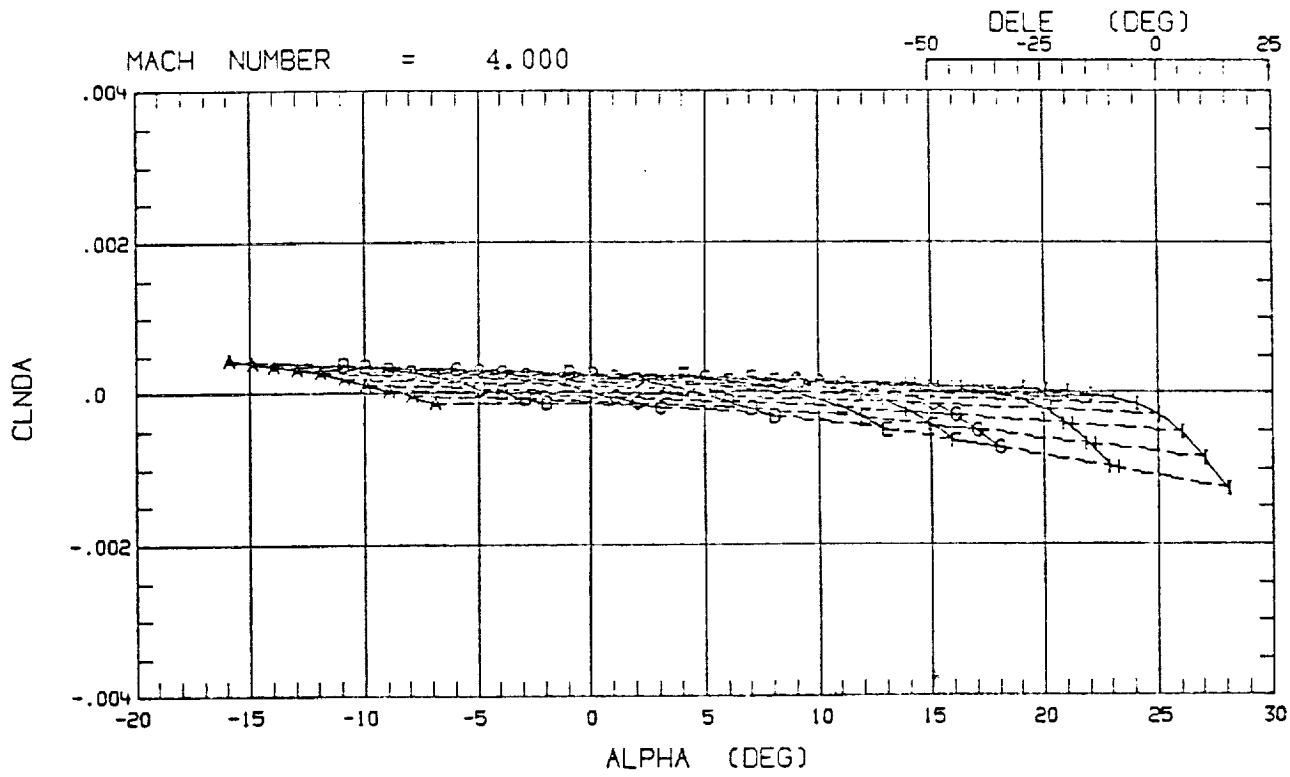
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M
DELE (DEG)	AILERON EFFECTIVENESS						
-30.000	0.00019	0.00011	0.00003	-0.00004	-0.00012	-0.00019	-0.00027
-25.000	0.00015	0.00008	0.00001	-0.00005	-0.00012	-0.00019	-0.00027
-20.000	0.00012	0.00005	-0.00001	-0.00008	-0.00015	-0.00022	-0.00030
-15.000	0.00007	0.0	-0.00005	-0.00010	-0.00016	-0.00024	-0.00032
-10.000	0.0	-0.00007	-0.00011	-0.00016	-0.00022	-0.00029	-0.00038
-5.000	-0.00008	-0.00014	-0.00019	-0.00024	-0.00031	-0.00040	-0.00051
0.0	-0.00020	-0.00025	-0.00031	-0.00037	-0.00047	-0.00060	-0.00075
5.000	-0.00036	-0.00045	-0.00054	-0.00065	-0.00079	-0.00095	-0.00114
10.000	-0.00057	-0.00074	-0.00091	-0.00109	-0.00128	-0.00148	-0.00168
15.000	-0.00077	-0.00103	-0.00133	-0.00164	-0.00191	-0.00215	-0.00237

ENGINEER
DATE 9-3-28

FIGURE 4.2.1.2-63
EFFECT OF AILERON



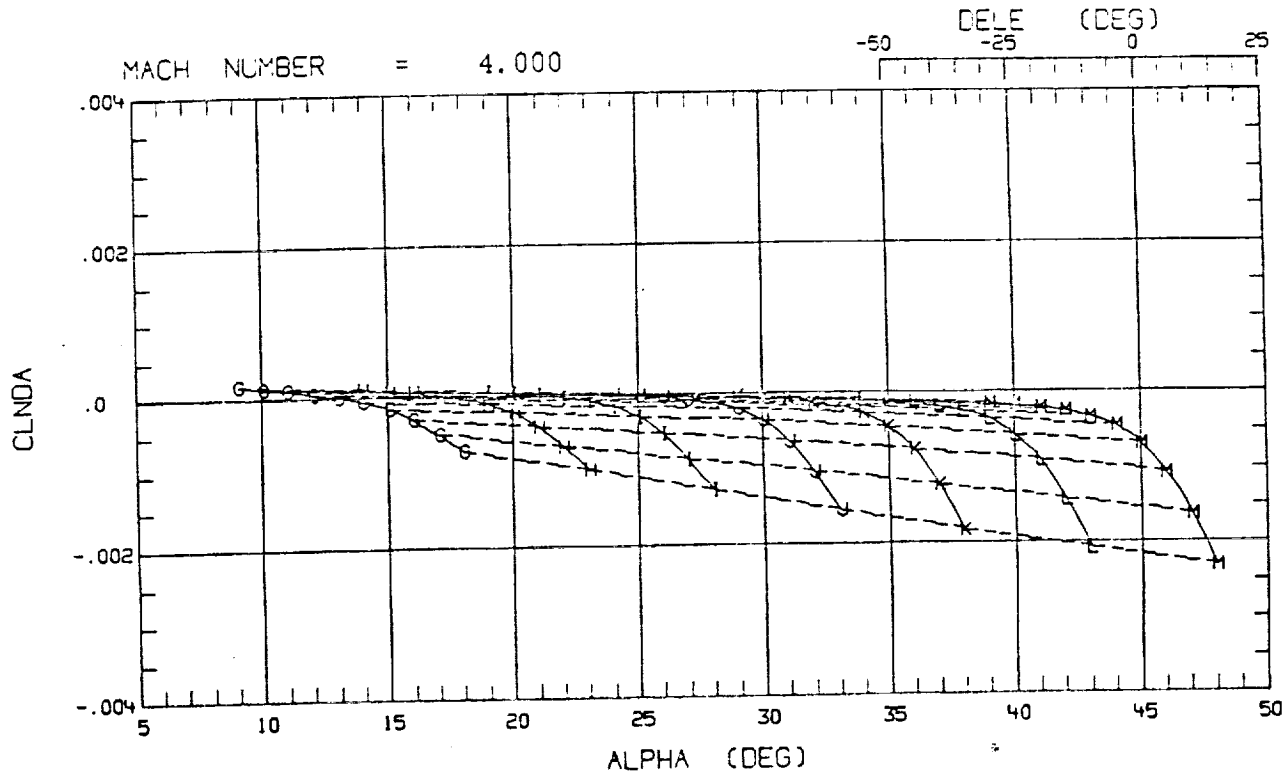
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00042	0.00036	0.00031	0.00026	0.00022	0.00018	0.00016	0.00010	0.00005
-25.000	0.00039	0.00034	0.00029	0.00024	0.00019	0.00015	0.00013	0.00007	0.00002
-20.000	0.00035	0.00031	0.00026	0.00020	0.00015	0.00012	0.00010	0.00006	0.00001
-15.000	0.00031	0.00027	0.00022	0.00016	0.00010	0.00007	0.00005	0.0	-0.00004
-10.000	0.00026	0.00021	0.00016	0.00011	0.00005	0.00003	0.00001	-0.00004	-0.00008
-5.000	0.00018	0.00014	0.00009	0.00004	-0.00001	-0.00004	-0.00006	-0.00011	-0.00016
0.0	0.00010	0.00005	0.0	-0.00005	-0.00010	-0.00013	-0.00016	-0.00023	-0.00030
5.000	0.00003	-0.00001	-0.00007	-0.00013	-0.00021	-0.00027	-0.00031	-0.00042	-0.00053
10.000	-0.00005	-0.00009	-0.00015	-0.00023	-0.00034	-0.00044	-0.00051	-0.00069	-0.00087
15.000	-0.00014	-0.00014	-0.00020	-0.00032	-0.00050	-0.00064	-0.00074	-0.00100	-0.00129

ENGINEER [illegible]
DATE 9-3-78

FIGURE 4.2.1.2-64
EFFECT OF AILERON



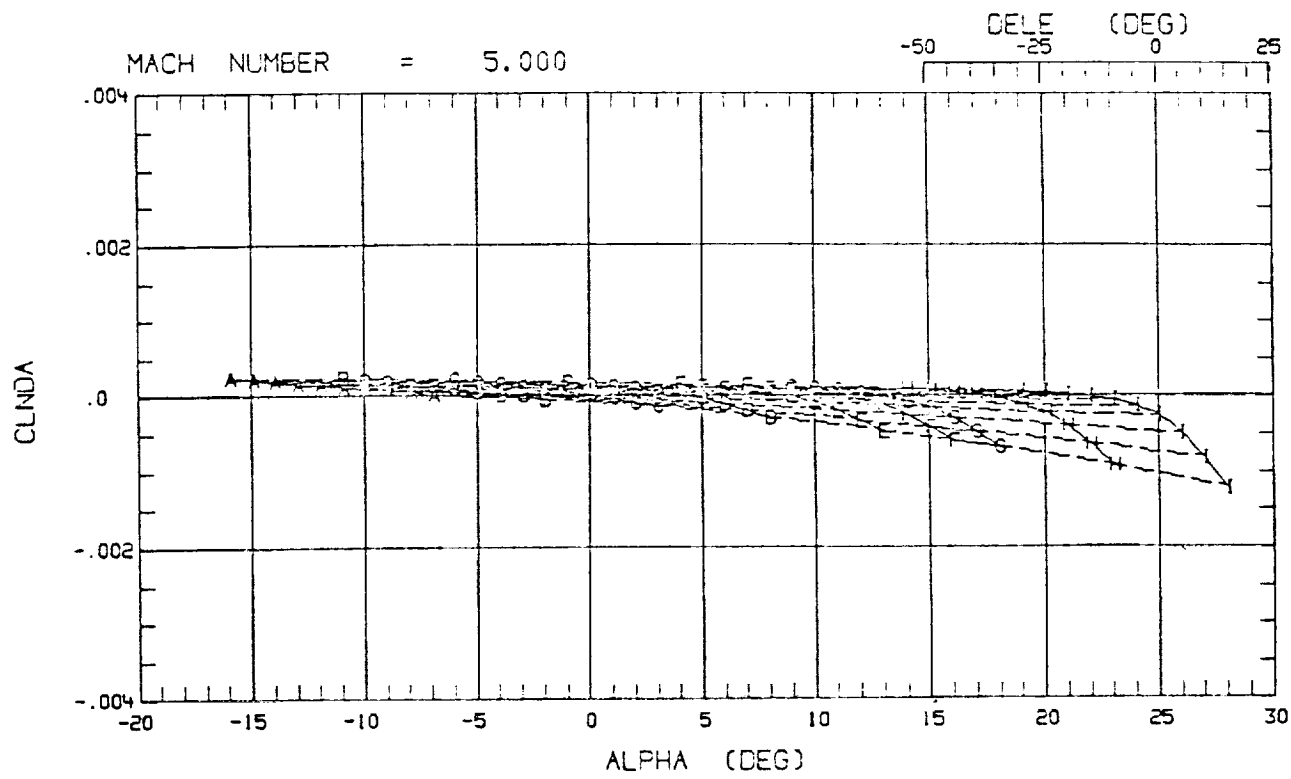
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M
DELE (DEG)	AILERON EFFECTIVENESS						
-30.000	0.00016	0.00010	0.00005	0.0	-0.00005	-0.00010	-0.00016
-25.000	0.00013	0.00007	0.00002	-0.00003	-0.00008	-0.00013	-0.00019
-20.000	0.00010	0.00006	0.00001	-0.00004	-0.00009	-0.00015	-0.00022
-15.000	0.00005	0.0	-0.00004	-0.00009	-0.00014	-0.00020	-0.00027
-10.000	0.00001	-0.00004	-0.00008	-0.00013	-0.00019	-0.00026	-0.00035
-5.000	-0.00006	-0.00011	-0.00016	-0.00021	-0.00028	-0.00037	-0.00047
0.0	-0.00016	-0.00023	-0.00030	-0.00037	-0.00047	-0.00058	-0.00071
5.000	-0.00031	-0.00042	-0.00053	-0.00064	-0.00077	-0.00092	-0.00109
10.000	-0.00051	-0.00069	-0.00087	-0.00105	-0.00124	-0.00144	-0.00164
15.000	-0.00074	-0.00100	-0.00129	-0.00157	-0.00184	-0.00209	-0.00233

ENGINEER EH3
DATE 9-3-78

FIGURE 4.2.1.2-65
EFFECT OF AILERON



CONFIGURATION

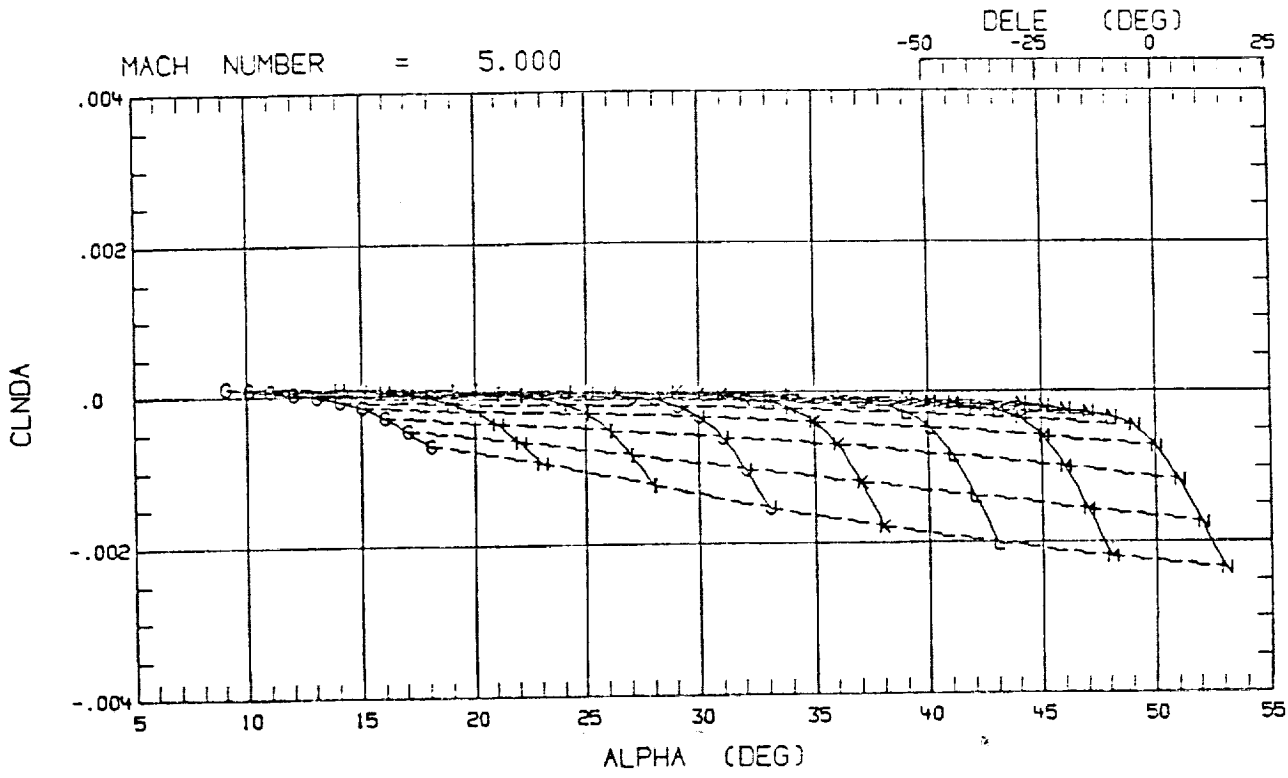
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00023	0.00022	0.00020	0.00017	0.00014	0.00012	0.00011	0.00008	0.00005
-25.000	0.00021	0.00019	0.00017	0.00013	0.00010	0.00009	0.00008	0.00007	0.00004
-20.000	0.00018	0.00016	0.00014	0.00011	0.00009	0.00007	0.00006	0.00004	0.00001
-15.000	0.00015	0.00013	0.00011	0.00008	0.00005	0.00003	0.00002	-0.00001	-0.00003
-10.000	0.00014	0.00012	0.00009	0.00005	0.00001	-0.00001	-0.00002	-0.00005	-0.00007
-5.000	0.00011	0.00008	0.00005	0.00001	-0.00003	-0.00006	-0.00008	-0.00013	-0.00015
0.0	0.00008	0.00004	0.0	-0.00004	-0.00009	-0.00013	-0.00016	-0.00023	-0.00027
5.000	0.00007	0.00001	-0.00005	-0.00012	-0.00020	-0.00026	-0.00030	-0.00041	-0.00050
10.000	0.00005	-0.00001	-0.00010	-0.00021	-0.00034	-0.00043	-0.00049	-0.00065	-0.00084
15.000	-0.00001	-0.00006	-0.00015	-0.00030	-0.00048	-0.00060	-0.00069	-0.00094	-0.00124

ENGINEER [illegible]
DATE 5-3-78

FIGURE 4.2.1.2-66
EFFECT OF AILERON

SD[illegible]-CEN-0006 IM



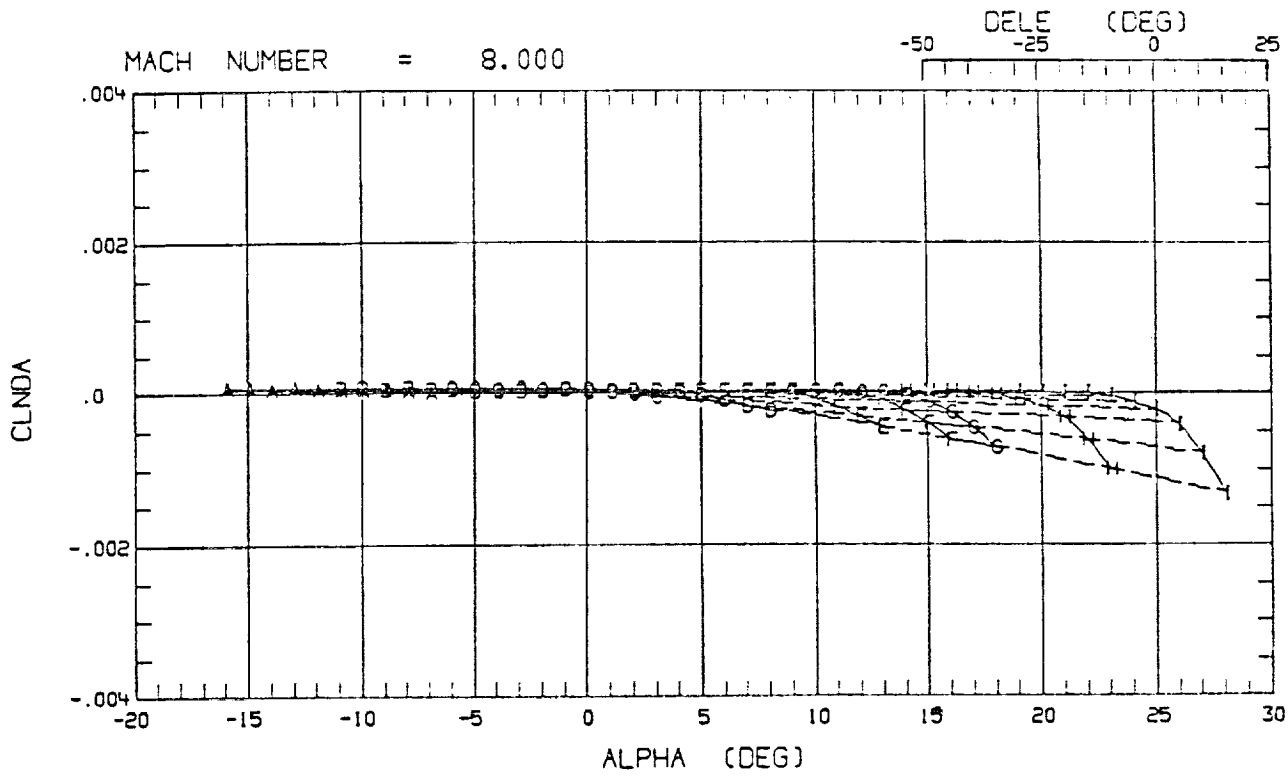
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON EFFECTIVENESS							
-30.000	0.00011	0.00008	0.00005	0.00003	-0.00001	-0.00005	-0.00010	-0.00016
-25.000	0.00008	0.00007	0.00004	0.0	-0.00004	-0.00009	-0.00014	-0.00020
-20.000	0.00006	0.00004	0.00001	-0.00001	-0.00005	-0.00011	-0.00017	-0.00025
-15.000	0.00002	-0.00001	-0.00003	-0.00006	-0.00010	-0.00015	-0.00022	-0.00029
-10.000	-0.00002	-0.00005	-0.00007	-0.00009	-0.00013	-0.00019	-0.00025	-0.00034
-5.000	-0.00008	-0.00013	-0.00015	-0.00018	-0.00023	-0.00029	-0.00037	-0.00047
0.0	-0.00016	-0.00023	-0.00027	-0.00032	-0.00040	-0.00049	-0.00061	-0.00075
5.000	-0.00030	-0.00041	-0.00050	-0.00060	-0.00072	-0.00086	-0.00102	-0.00120
10.000	-0.00049	-0.00065	-0.00084	-0.00103	-0.00122	-0.00140	-0.00158	-0.00176
15.000	-0.00069	-0.00094	-0.00124	-0.00155	-0.00181	-0.00203	-0.00222	-0.00238

ENGINEER
DATE 9-23-78

FIGURE 4.2.1.2-67
EFFECT OF AILERON



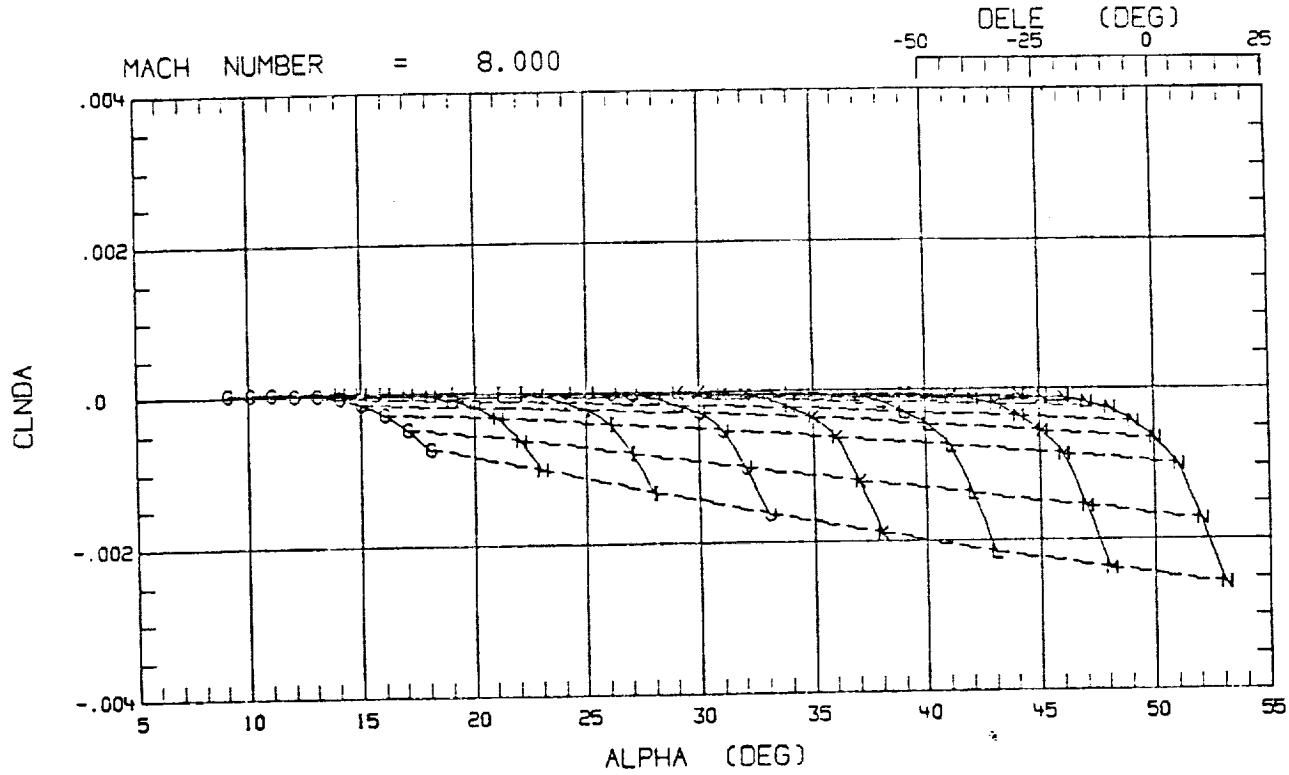
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00006	0.00006	0.00006	0.00004	0.00003	0.00003	0.00003	0.00003	0.00001
-25.000	0.00006	0.00006	0.00006	0.00004	0.00002	0.00002	0.00002	0.00002	0.00001
-20.000	0.00005	0.00005	0.00005	0.00003	0.00002	0.00002	0.00002	0.00002	0.0
-15.000	0.00006	0.00007	0.00006	0.00003	0.00001	0.00001	0.00001	0.00001	-0.00001
-10.000	0.00004	0.00004	0.00004	0.00002	0.0	-0.00001	-0.00001	-0.00003	-0.00005
-5.000	0.00004	0.00005	0.00004	0.00001	-0.00002	-0.00004	-0.00005	-0.00009	-0.00013
0.0	0.00004	0.00003	0.00001	-0.00004	-0.00009	-0.00011	-0.00013	-0.00018	-0.00023
5.000	0.00004	0.00003	-0.00001	-0.00010	-0.00020	-0.00024	-0.00026	-0.00033	-0.00042
10.000	0.00002	0.00003	-0.00003	-0.00018	-0.00033	-0.00041	-0.00047	-0.00062	-0.00082
15.000	0.00001	0.00002	-0.00006	-0.00024	-0.00047	-0.00062	-0.00073	-0.00102	-0.00133

ENGINEER
DATE

FIGURE 4.2.1.2-68
EFFECT OF AILERON



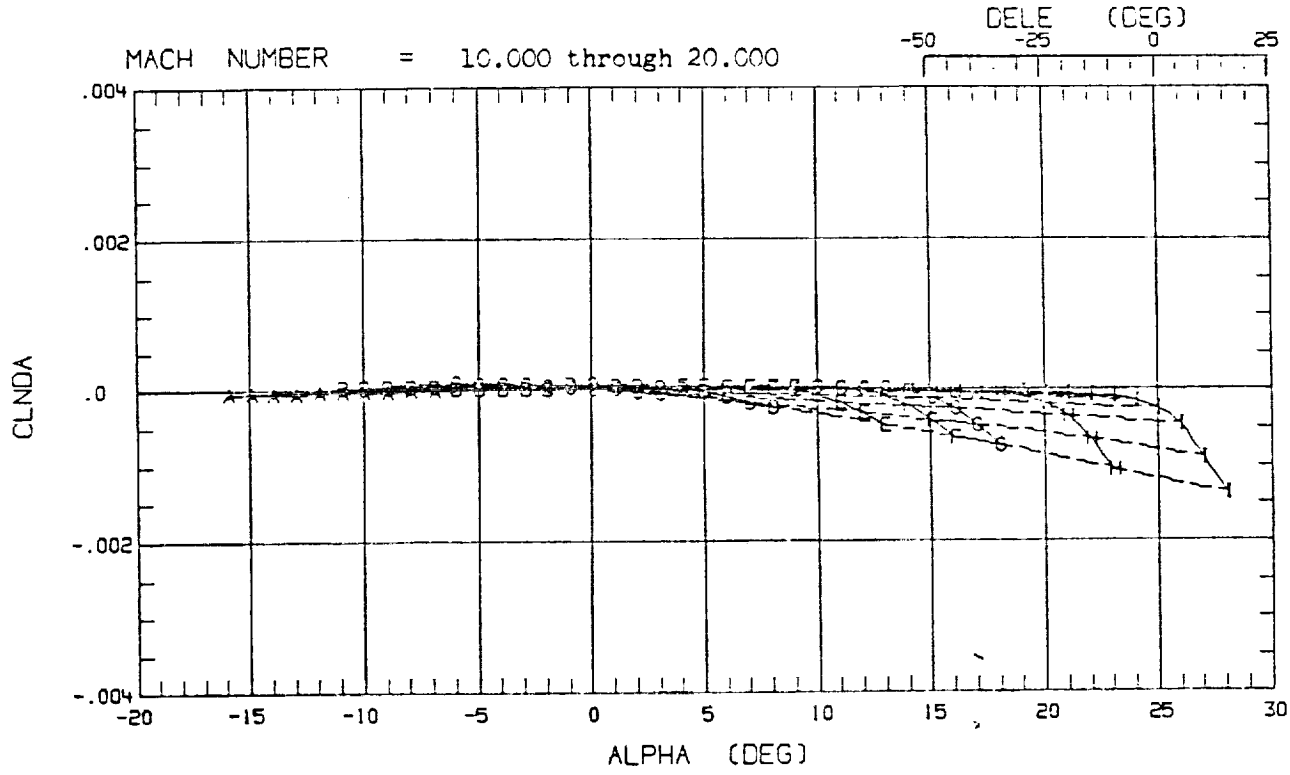
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON EFFECTIVENESS							
-30.000	0.00003	0.00003	0.00001	-0.00001	-0.00003	-0.00005	-0.00007	-0.00009
-25.000	0.00002	0.00002	0.00001	-0.00001	-0.00003	-0.00006	-0.00009	-0.00012
-20.000	0.00002	0.00002	0.0	-0.00003	-0.00005	-0.00008	-0.00010	-0.00013
-15.000	0.00001	0.00001	-0.00001	-0.00004	-0.00007	-0.00010	-0.00014	-0.00018
-10.000	-0.00001	-0.00003	-0.00005	-0.00008	-0.00011	-0.00016	-0.00020	-0.00026
-5.000	-0.00005	-0.00009	-0.00013	-0.00018	-0.00023	-0.00030	-0.00036	-0.00044
0.0	-0.00013	-0.00018	-0.00023	-0.00029	-0.00037	-0.00046	-0.00056	-0.00068
5.000	-0.00026	-0.00033	-0.00042	-0.00052	-0.00063	-0.00075	-0.00087	-0.00101
10.000	-0.00047	-0.00062	-0.00082	-0.00102	-0.00121	-0.00139	-0.00157	-0.00174
15.000	-0.00073	-0.00102	-0.00133	-0.00164	-0.00191	-0.00217	-0.00239	-0.00260

ENGINEER
DATE 5-13-76

FIGURE 4.2.1.2-69
EFFECT OF AILERON



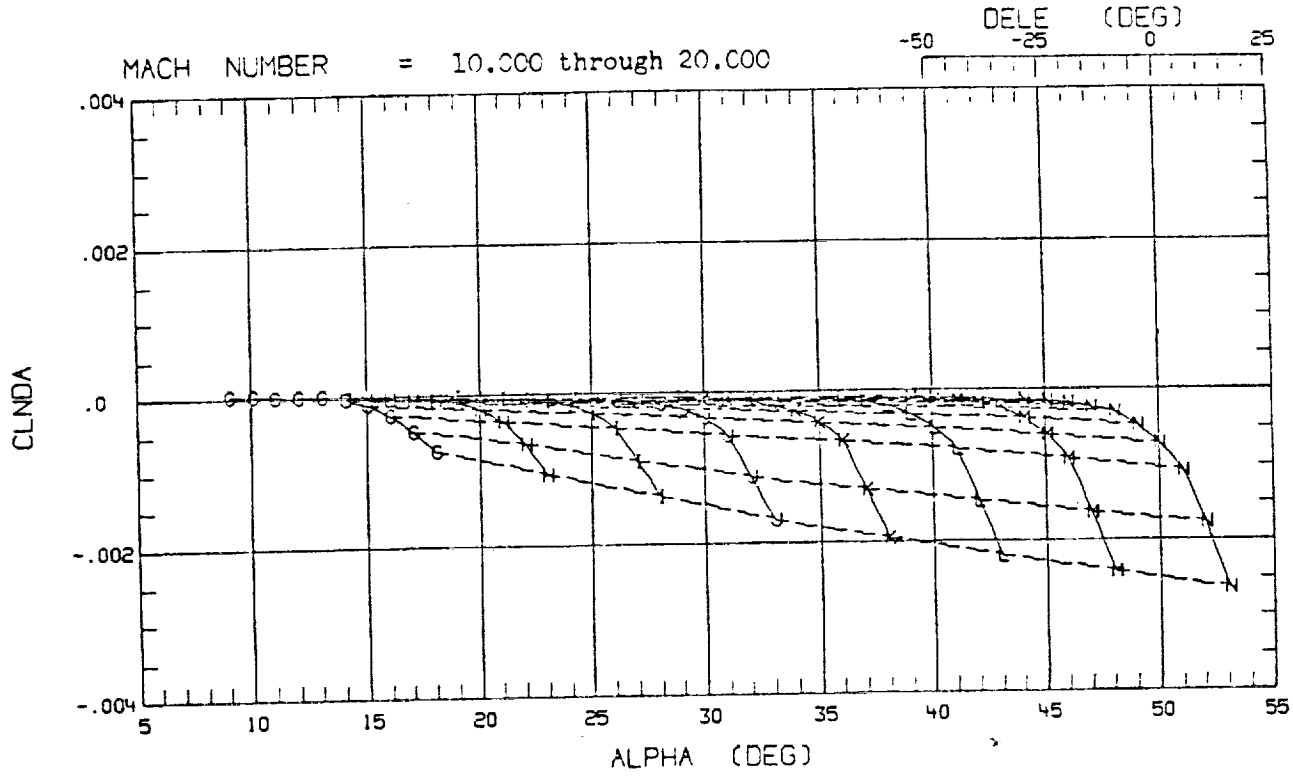
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	-0.00007	0.00003	0.00008	0.00006	0.00004	0.00003	0.00002	-0.00003	-0.00005
-25.000	-0.00007	0.00002	0.00007	0.00005	0.00004	0.00003	0.00002	-0.00004	-0.00006
-20.000	-0.00007	0.00002	0.00007	0.00005	0.00003	0.00002	0.00001	-0.00004	-0.00007
-15.000	-0.00006	0.00002	0.00006	0.00004	0.00002	0.00001	0.0	-0.00006	-0.00009
-10.000	-0.00004	0.00002	0.00005	0.00002	0.0	-0.00001	-0.00001	-0.00007	-0.00011
-5.000	-0.00004	0.00001	0.00003	0.0	-0.00002	-0.00003	-0.00004	-0.00010	-0.00016
0.0	-0.00004	0.0	0.0	-0.00004	-0.00009	-0.00011	-0.00012	-0.00020	-0.00027
5.000	-0.00004	0.0	-0.00001	-0.00010	-0.00019	-0.00023	-0.00026	-0.00037	-0.00047
10.000	-0.00003	0.0	-0.00004	-0.00018	-0.00033	-0.00042	-0.00048	-0.00068	-0.00091
15.000	-0.00003	0.00001	-0.00006	-0.00025	-0.00049	-0.00064	-0.00075	-0.00107	-0.00139

ENGINEER [illegible]
DATE 10-3-91

FIGURE 4.2.1.2-70
EFFECT OF AILERON



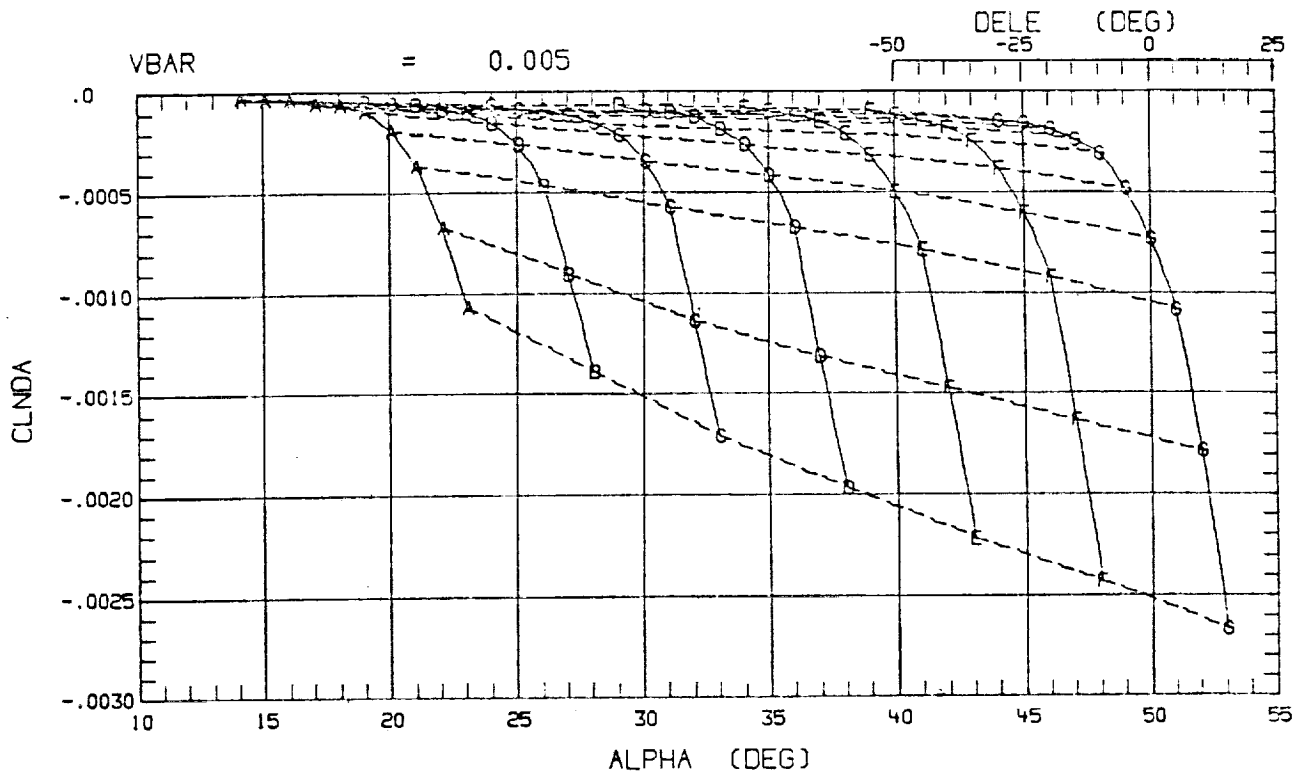
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON EFFECTIVENESS							
-30.000	0.00002	-0.00003	-0.00005	-0.00007	-0.00007	-0.00008	-0.00010	-0.00015
-25.000	0.00002	-0.00004	-0.00006	-0.00009	-0.00010	-0.00010	-0.00012	-0.00016
-20.000	0.00001	-0.00004	-0.00007	-0.00010	-0.00011	-0.00012	-0.00015	-0.00019
-15.000	0.0	-0.00006	-0.00009	-0.00012	-0.00013	-0.00015	-0.00018	-0.00024
-10.000	-0.00001	-0.00007	-0.00011	-0.00016	-0.00019	-0.00021	-0.00025	-0.00031
-5.000	-0.00004	-0.00010	-0.00016	-0.00022	-0.00027	-0.00032	-0.00039	-0.00049
0.0	-0.00012	-0.00020	-0.00027	-0.00035	-0.00042	-0.00050	-0.00061	-0.00074
5.000	-0.00026	-0.00037	-0.00047	-0.00058	-0.00068	-0.00079	-0.00093	-0.00109
10.000	-0.00048	-0.00068	-0.00091	-0.00114	-0.00132	-0.00148	-0.00164	-0.00179
15.000	-0.00075	-0.00107	-0.00139	-0.00171	-0.00197	-0.00222	-0.00244	-0.00257

ENGINEER WWT
DATE 10-1-79

FIGURE 4.2.1.2-71
EFFECT OF AILERON

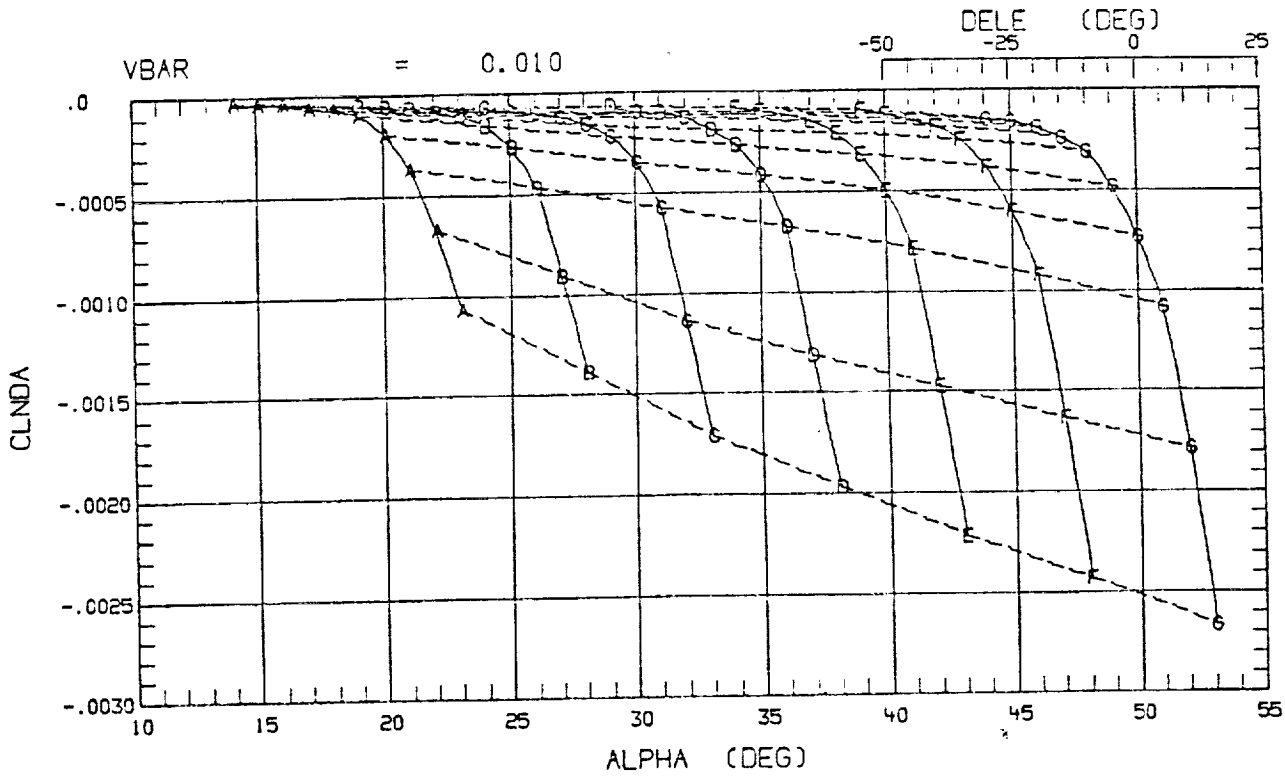


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON YAWING MOMENT DERIVATIVE						
-30.000	-0.00003	-0.00005	-0.00007	-0.00007	-0.00008	-0.00010	-0.00015
-25.000	-0.00004	-0.00006	-0.00009	-0.00010	-0.00010	-0.00012	-0.00016
-20.000	-0.00004	-0.00007	-0.00010	-0.00011	-0.00012	-0.00015	-0.00019
-15.000	-0.00006	-0.00009	-0.00012	-0.00013	-0.00015	-0.00018	-0.00024
-10.000	-0.00007	-0.00011	-0.00016	-0.00019	-0.00021	-0.00025	-0.00031
-5.000	-0.00010	-0.00016	-0.00022	-0.00027	-0.00032	-0.00039	-0.00049
0.0	-0.00020	-0.00027	-0.00035	-0.00042	-0.00050	-0.00061	-0.00074
5.000	-0.00037	-0.00047	-0.00058	-0.00068	-0.00079	-0.00093	-0.00109
10.000	-0.00068	-0.00091	-0.00114	-0.00132	-0.00148	-0.00164	-0.00179
15.000	-0.00107	-0.00139	-0.00171	-0.00197	-0.00222	-0.00244	-0.00267

ENGINEER
DATE 8-3-78

FIGURE 4.2.1.2-72
EFFECT OF AILERON



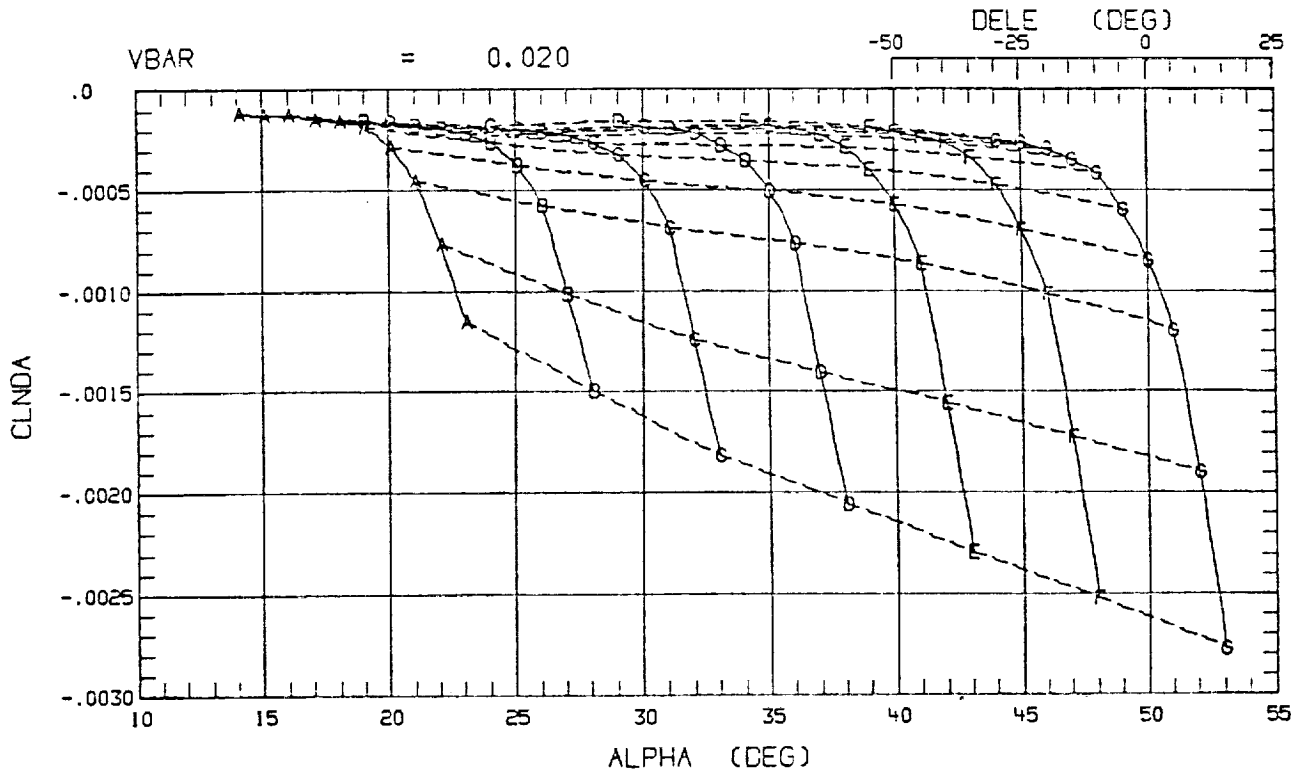
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON YAWING MOMENT DERIVATIVE						
-30.000	-0.00003	-0.00005	-0.00007	-0.00007	-0.00008	-0.00010	-0.00015
-25.000	-0.00004	-0.00006	-0.00009	-0.00010	-0.00010	-0.00012	-0.00016
-20.000	-0.00004	-0.00007	-0.00010	-0.00011	-0.00012	-0.00015	-0.00019
-15.000	-0.00006	-0.00009	-0.00012	-0.00013	-0.00015	-0.00018	-0.00024
-10.000	-0.00007	-0.00011	-0.00016	-0.00019	-0.00021	-0.00025	-0.00031
-5.000	-0.00010	-0.00016	-0.00022	-0.00027	-0.00032	-0.00039	-0.00049
0.0	-0.00020	-0.00027	-0.00035	-0.00042	-0.00050	-0.00061	-0.00074
5.000	-0.00037	-0.00047	-0.00058	-0.00068	-0.00079	-0.00093	-0.00109
10.000	-0.00068	-0.00091	-0.00114	-0.00132	-0.00148	-0.00164	-0.00179
15.000	-0.00107	-0.00139	-0.00171	-0.00197	-0.00222	-0.00244	-0.00257

ENGINEER [illegible]
DATE 12-[illegible]

FIGURE 4.2.1.2-73
EFFECT OF AILERON



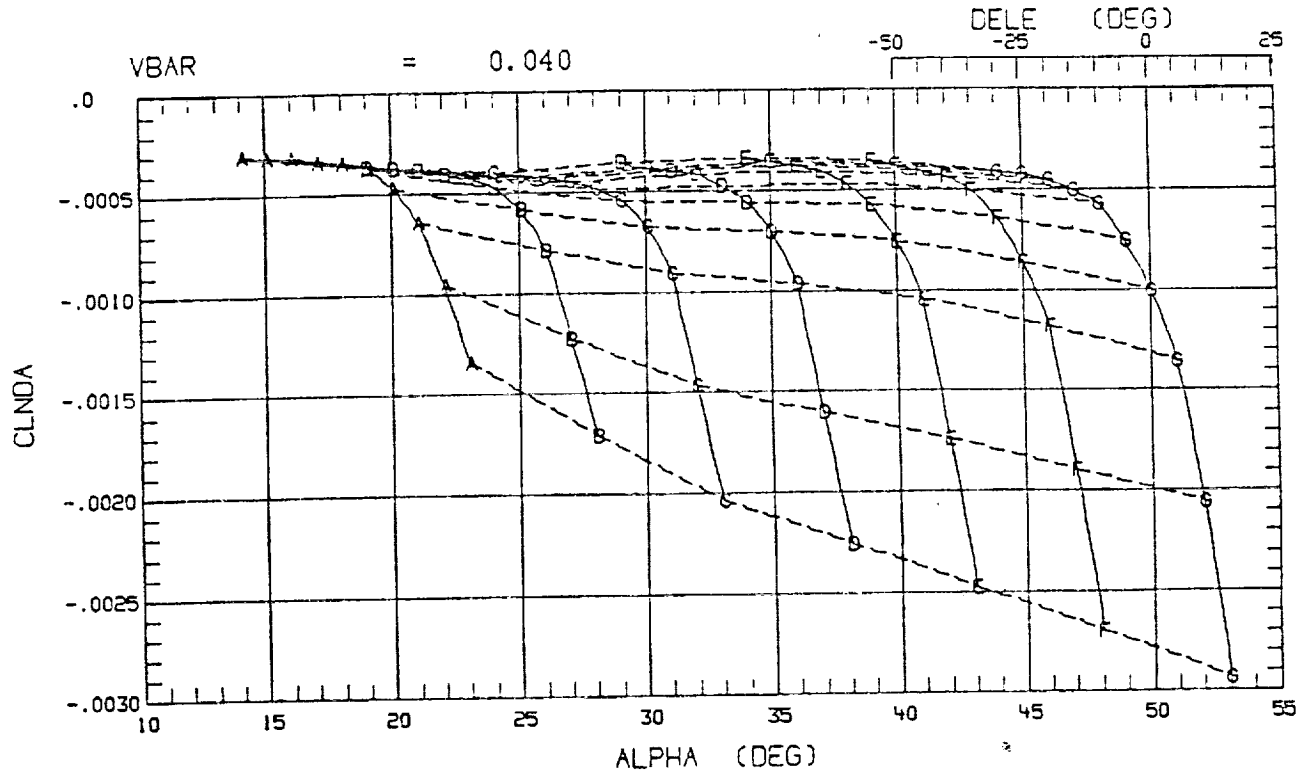
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON YAWING MOMENT DERIVATIVE						
-30.000	-0.00012	-0.00016	-0.00018	-0.00016	-0.00016	-0.00019	-0.00026
-25.000	-0.00013	-0.00017	-0.00020	-0.00019	-0.00018	-0.00021	-0.00027
-20.000	-0.00013	-0.00018	-0.00021	-0.00020	-0.00020	-0.00024	-0.00030
-15.000	-0.00015	-0.00020	-0.00023	-0.00022	-0.00023	-0.00027	-0.00035
-10.000	-0.00016	-0.00022	-0.00027	-0.00028	-0.00029	-0.00034	-0.00042
-5.000	-0.00019	-0.00027	-0.00033	-0.00036	-0.00040	-0.00048	-0.00060
0.0	-0.00029	-0.00038	-0.00046	-0.00051	-0.00058	-0.00070	-0.00085
5.000	-0.00046	-0.00056	-0.00069	-0.00077	-0.00087	-0.00102	-0.00120
10.000	-0.00077	-0.00102	-0.00125	-0.00141	-0.00156	-0.00173	-0.00190
15.000	-0.00116	-0.00150	-0.00182	-0.00206	-0.00230	-0.00253	-0.00278

ENGINEER
DATE 10-3-78

FIGURE 4.2.1.2-74
EFFECT OF AILERON

SI [illegible] C IM



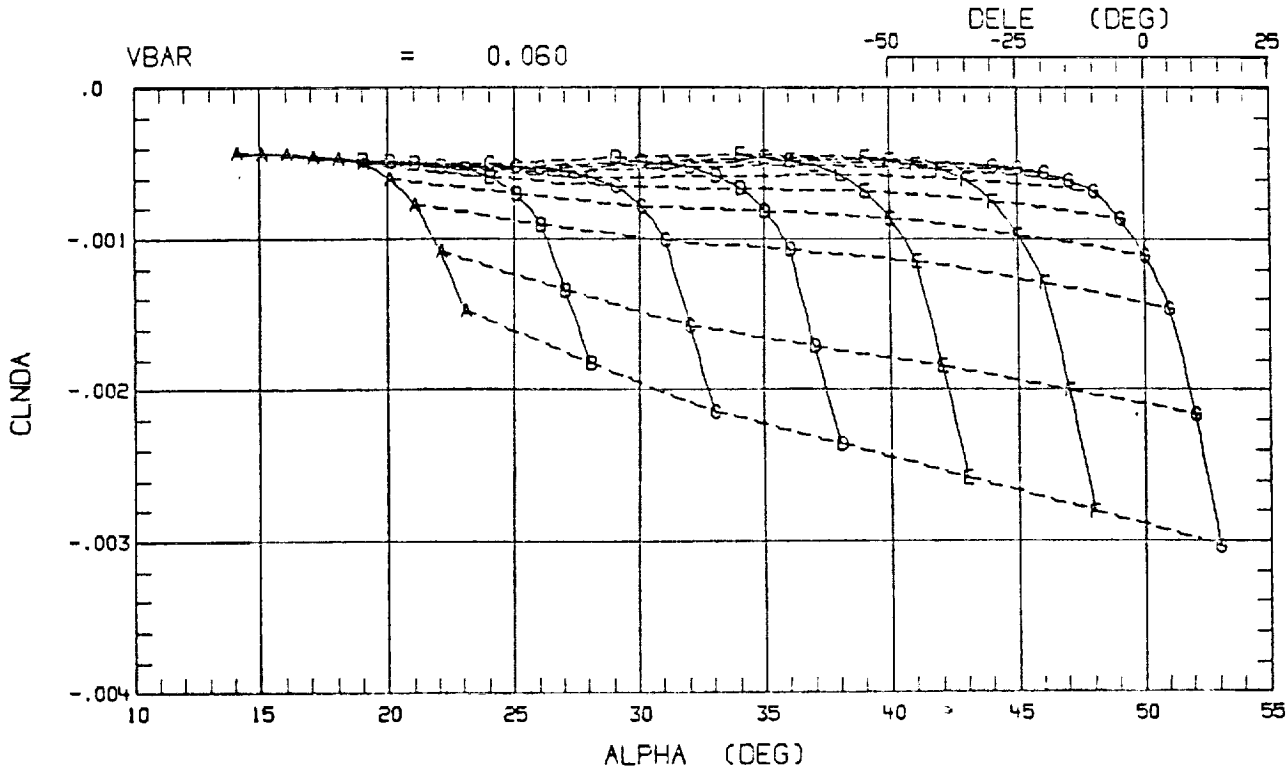
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON YAWING MOMENT DERIVATIVE						
-30.000	-0.00031	-0.00037	-0.00040	-0.00036	-0.00034	-0.00036	-0.00042
-25.000	-0.00032	-0.00038	-0.00042	-0.00039	-0.00036	-0.00038	-0.00043
-20.000	-0.00032	-0.00039	-0.00043	-0.00040	-0.00038	-0.00041	-0.00046
-15.000	-0.00034	-0.00041	-0.00045	-0.00042	-0.00041	-0.00044	-0.00051
-10.000	-0.00035	-0.00043	-0.00049	-0.00048	-0.00047	-0.00051	-0.00058
-5.000	-0.00038	-0.00048	-0.00055	-0.00056	-0.00058	-0.00065	-0.00076
0.0	-0.00048	-0.00059	-0.00068	-0.00071	-0.00076	-0.00087	-0.00101
5.000	-0.00065	-0.00079	-0.00091	-0.00097	-0.00105	-0.00119	-0.00136
10.000	-0.00096	-0.00123	-0.00147	-0.00161	-0.00174	-0.00190	-0.00206
15.000	-0.00135	-0.00171	-0.00204	-0.00226	-0.00248	-0.00270	-0.00294

ENGINEER
DATE 10-31-72

FIGURE 4.2.1.2-75
EFFECT OF AILERON



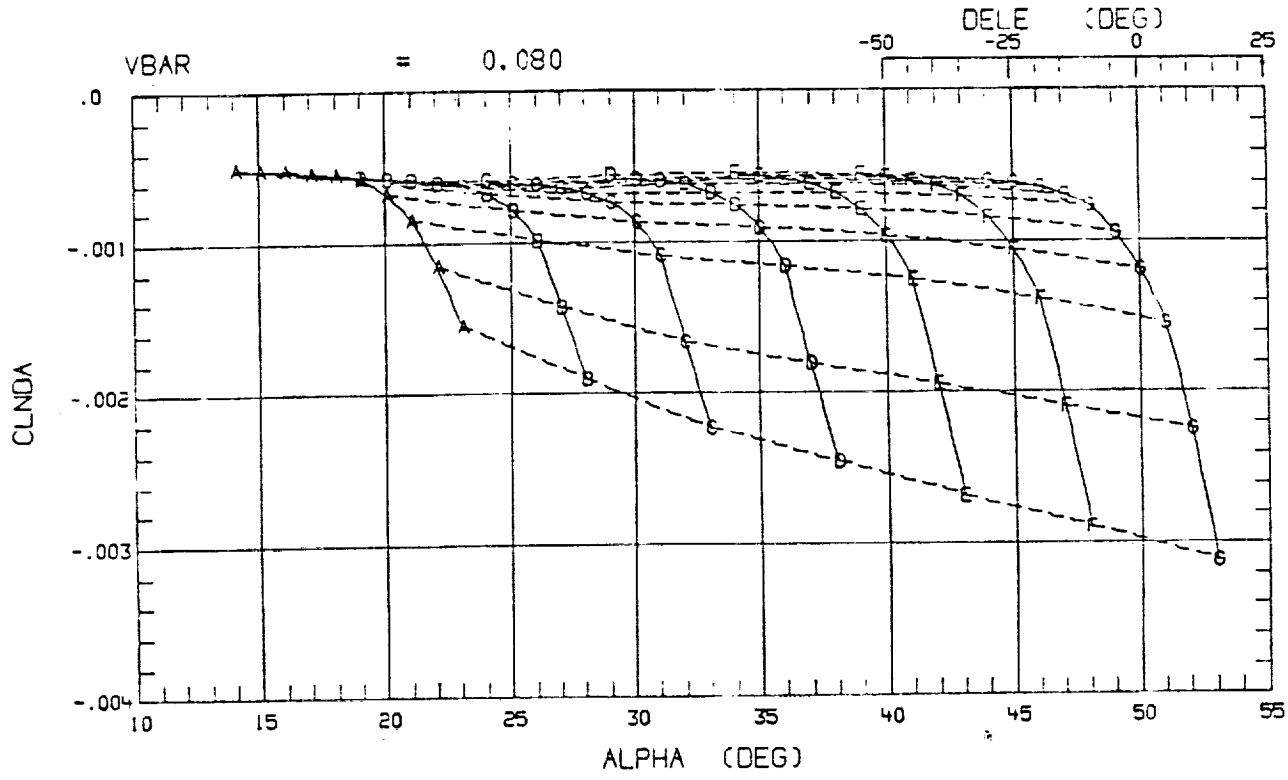
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON YAWING MOMENT DERIVATIVE						
-30.000	-0.00044	-0.00049	-0.00051	-0.00047	-0.00045	-0.00047	-0.00053
-25.000	-0.00045	-0.00050	-0.00053	-0.00050	-0.00047	-0.00049	-0.00054
-20.000	-0.00045	-0.00051	-0.00054	-0.00051	-0.00049	-0.00052	-0.00057
-15.000	-0.00047	-0.00053	-0.00056	-0.00053	-0.00052	-0.00055	-0.00062
-10.000	-0.00048	-0.00055	-0.00060	-0.00059	-0.00058	-0.00062	-0.00069
-5.000	-0.00051	-0.00060	-0.00066	-0.00067	-0.00069	-0.00076	-0.00097
0.0	-0.00061	-0.00071	-0.00079	-0.00082	-0.00087	-0.00098	-0.00112
5.000	-0.00078	-0.00091	-0.00102	-0.00108	-0.00116	-0.00130	-0.00147
10.000	-0.00109	-0.00135	-0.00158	-0.00172	-0.00185	-0.00201	-0.00217
15.000	-0.00148	-0.00183	-0.00215	-0.00237	-0.00259	-0.00281	-0.00305

ENGINEER
DATE

FIGURE 4.2.1.2-76
EFFECT OF AILERON

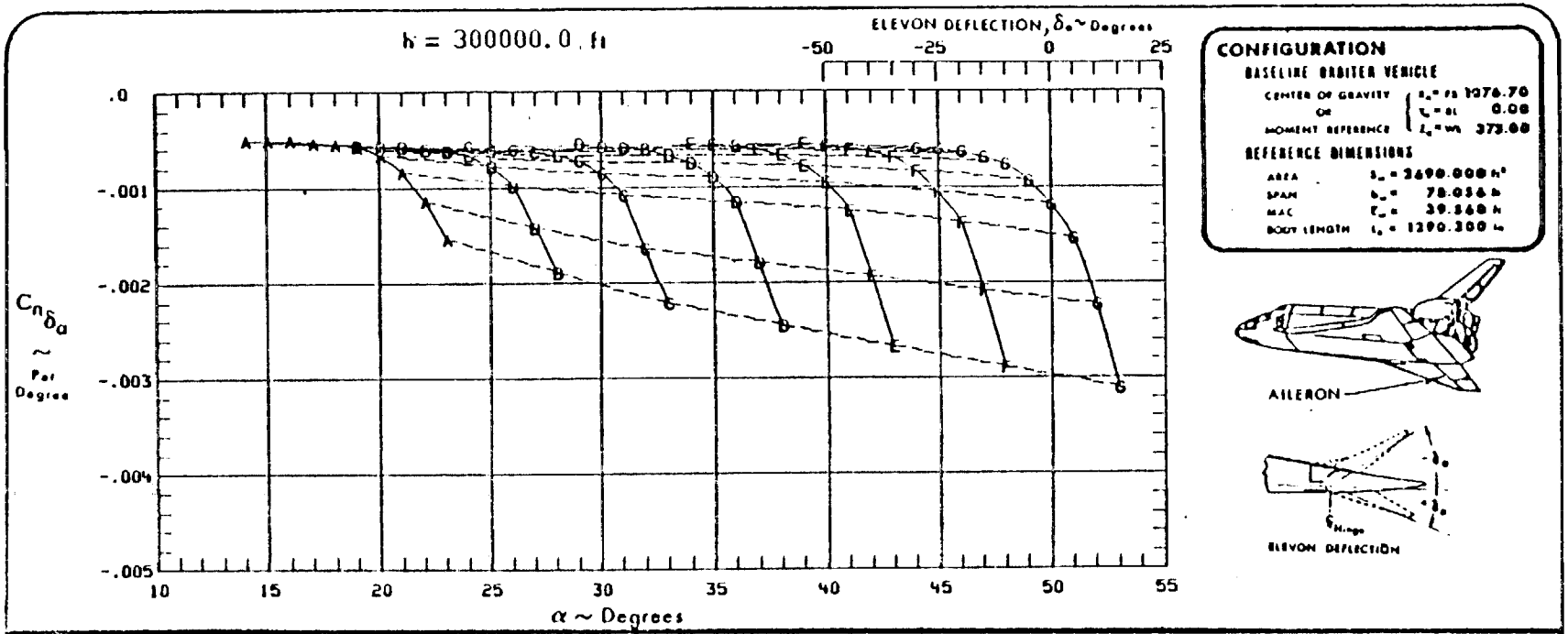


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON YAWING MOMENT DERIVATIVE						
-30.000	-0.00051	-0.00057	-0.00059	-0.00056	-0.00055	-0.00056	-0.00061
-25.000	-0.00052	-0.00058	-0.00061	-0.00059	-0.00057	-0.00058	-0.00062
-20.000	-0.00052	-0.00059	-0.00062	-0.00060	-0.00059	-0.00061	-0.00065
-15.000	-0.00054	-0.00061	-0.00064	-0.00062	-0.00062	-0.00064	-0.00070
-10.000	-0.00055	-0.00063	-0.00068	-0.00068	-0.00068	-0.00071	-0.00077
-5.000	-0.00058	-0.00068	-0.00074	-0.00076	-0.00079	-0.00085	-0.00095
0.0	-0.00068	-0.00079	-0.00087	-0.00091	-0.00097	-0.00107	-0.00120
5.000	-0.00085	-0.00099	-0.00110	-0.00117	-0.00126	-0.00139	-0.00155
10.000	-0.00116	-0.00143	-0.00166	-0.00181	-0.00195	-0.00210	-0.00225
15.000	-0.00155	-0.00191	-0.00223	-0.00246	-0.00269	-0.00290	-0.00313

ENGINEER
DATE 5-1-78

FIGURE 4.2.1.2- 77
EFFECT OF AILERON

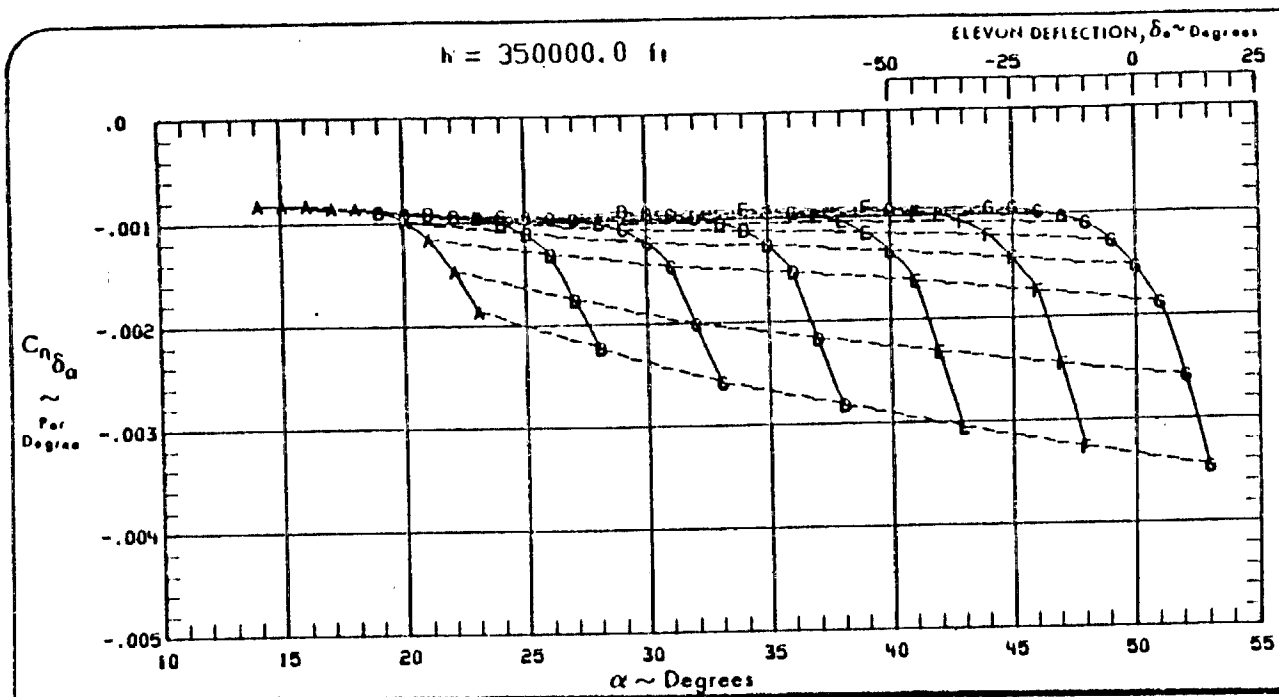


δ_e ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{n_{\delta_a}}$ ~ per Degree												
-30.000							-0.00051	-0.00057	-0.00059	-0.00056	-0.00055	-0.00056	-0.00061
-25.000							-0.00052	-0.00058	-0.00061	-0.00059	-0.00057	-0.00058	-0.00062
-20.000							-0.00052	-0.00059	-0.00062	-0.00060	-0.00059	-0.00061	-0.00065
-15.000							-0.00054	-0.00061	-0.00064	-0.00062	-0.00062	-0.00064	-0.00070
-10.000							-0.00055	-0.00063	-0.00068	-0.00068	-0.00068	-0.00071	-0.00077
-5.000							-0.00058	-0.00068	-0.00076	-0.00076	-0.00079	-0.00085	-0.00095
0.0							-0.00068	-0.00079	-0.00087	-0.00091	-0.00097	-0.00107	-0.00120
5.000							-0.00085	-0.00099	-0.00110	-0.00117	-0.00126	-0.00139	-0.00155
10.000							-0.00116	-0.00143	-0.00166	-0.00181	-0.00195	-0.00210	-0.00225
15.000							-0.00155	-0.00191	-0.00223	-0.00246	-0.00269	-0.00290	-0.00313

ENGINEER
DATE
REVISED

Figure 4.2.1.2-78
EFFECT OF AILERON

Rockwell International
Space Division



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

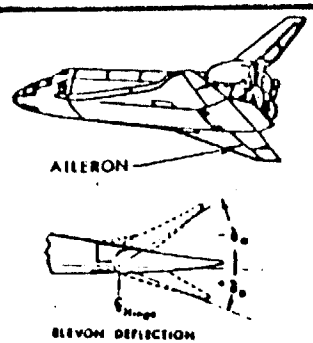
REFERENCE DIMENSIONS

AREA S_w = 2690.000 ft²

SPAN b_w = 78.056 ft

MAC $\bar{c}_w$ = 39.560 ft

BODY LENGTH l_b = 1290.300 in



δ_e ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{n_{\delta_a}}$ ~ per Degree												
-30.000							-0.00083	-0.00091	-0.00095	-0.00093	-0.00093	-0.00093	-0.00095
-25.000							-0.00084	-0.00092	-0.00097	-0.00096	-0.00095	-0.00095	-0.00096
-20.000							-0.00084	-0.00093	-0.00098	-0.00097	-0.00097	-0.00098	-0.00099
-15.000							-0.00086	-0.00095	-0.00100	-0.00099	-0.00100	-0.00101	-0.00104
-10.000							-0.00087	-0.00097	-0.00104	-0.00105	-0.00106	-0.00108	-0.00111
-5.000							-0.00090	-0.00102	-0.00110	-0.00113	-0.00117	-0.00122	-0.00129
0.0							-0.00100	-0.00113	-0.00123	-0.00128	-0.00135	-0.00144	-0.00154
5.000							-0.00117	-0.00133	-0.00146	-0.00154	-0.00164	-0.00176	-0.00189
10.000							-0.00148	-0.00177	-0.00202	-0.00218	-0.00233	-0.00247	-0.00259
15.000							-0.00187	-0.00225	-0.00259	-0.00283	-0.00307	-0.00327	-0.00347

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Figure 4.2.1.2-79

EFFECT OF AILERON

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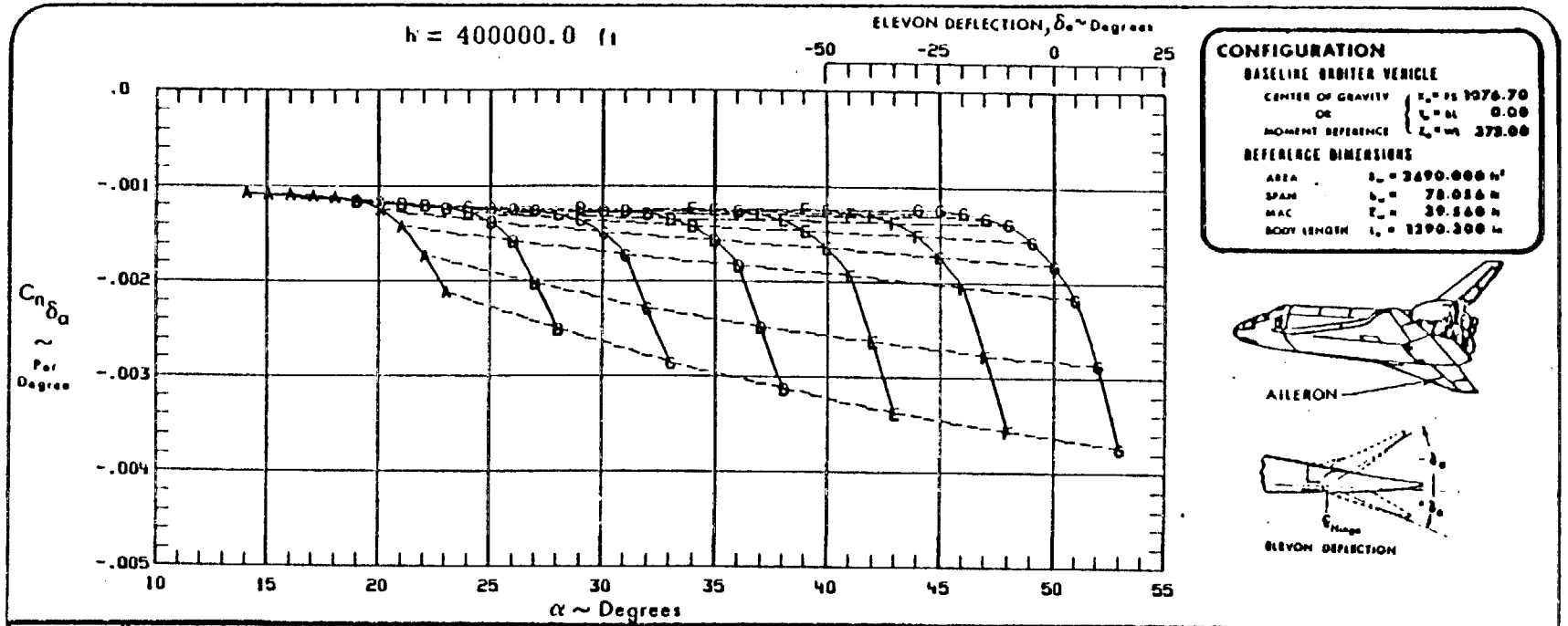

δ_e ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{n_{\delta_a}}$ ~ per Degree												
-30.000							-0.00109	-0.00118	-0.00123	-0.00124	-0.00124	-0.00124	-0.00124
-25.000							-0.00110	-0.00119	-0.00125	-0.00127	-0.00126	-0.00126	-0.00125
-20.000							-0.00110	-0.00120	-0.00126	-0.00128	-0.00128	-0.00129	-0.00128
-15.000							-0.00112	-0.00122	-0.00128	-0.00130	-0.00131	-0.00132	-0.00133
-10.000							-0.00113	-0.00124	-0.00132	-0.00136	-0.00137	-0.00139	-0.00140
-5.000							-0.00116	-0.00129	-0.00138	-0.00144	-0.00148	-0.00153	-0.00158
0.0							-0.00126	-0.00140	-0.00151	-0.00159	-0.00166	-0.00175	-0.00183
5.000							-0.00143	-0.00160	-0.00174	-0.00185	-0.00195	-0.00207	-0.00218
10.000							-0.00174	-0.00204	-0.00230	-0.00249	-0.00264	-0.00278	-0.00288
15.000							-0.00213	-0.00252	-0.00287	-0.00314	-0.00338	-0.00358	-0.00376

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Figure 4.2.1.2-80
EFFECT OF AILERON

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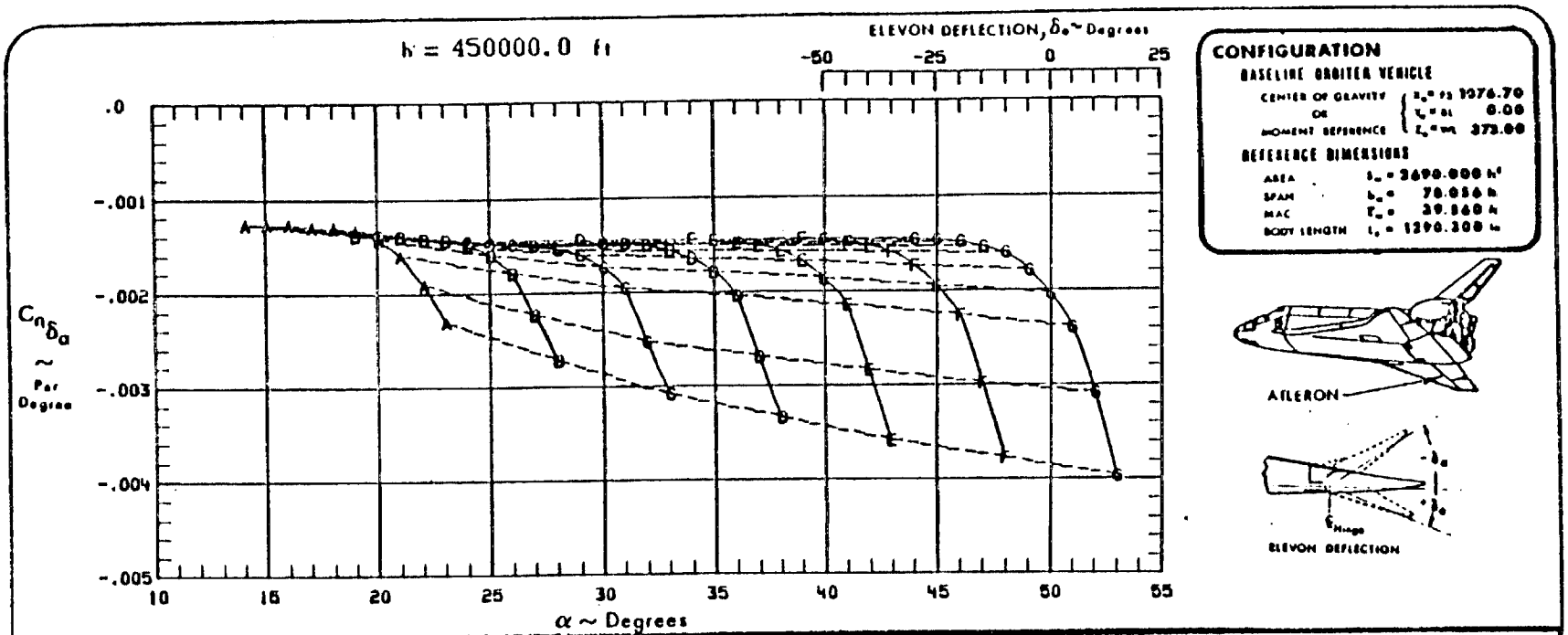

δ_a ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{n_{\delta_a}}$ ~ per Degree												
-30.000							-0.00127	-0.00139	-0.00146	-0.00145	-0.00145	-0.00145	-0.00146
-25.000							-0.00128	-0.00140	-0.00148	-0.00148	-0.00147	-0.00147	-0.00147
-20.000							-0.00128	-0.00141	-0.00149	-0.00149	-0.00149	-0.00150	-0.00150
-15.000							-0.00130	-0.00143	-0.00151	-0.00151	-0.00152	-0.00153	-0.00155
-10.000							-0.00131	-0.00145	-0.00155	-0.00157	-0.00158	-0.00160	-0.00162
-5.000							-0.00134	-0.00150	-0.00161	-0.00165	-0.00169	-0.00174	-0.00180
0.0							-0.00144	-0.00161	-0.00174	-0.00180	-0.00187	-0.00196	-0.00205
5.000							-0.00161	-0.00181	-0.00197	-0.00206	-0.00216	-0.00228	-0.00240
10.000							-0.00192	-0.00225	-0.00253	-0.00270	-0.00285	-0.00299	-0.00310
15.000							-0.00231	-0.00273	-0.00310	-0.00335	-0.00359	-0.00379	-0.00398

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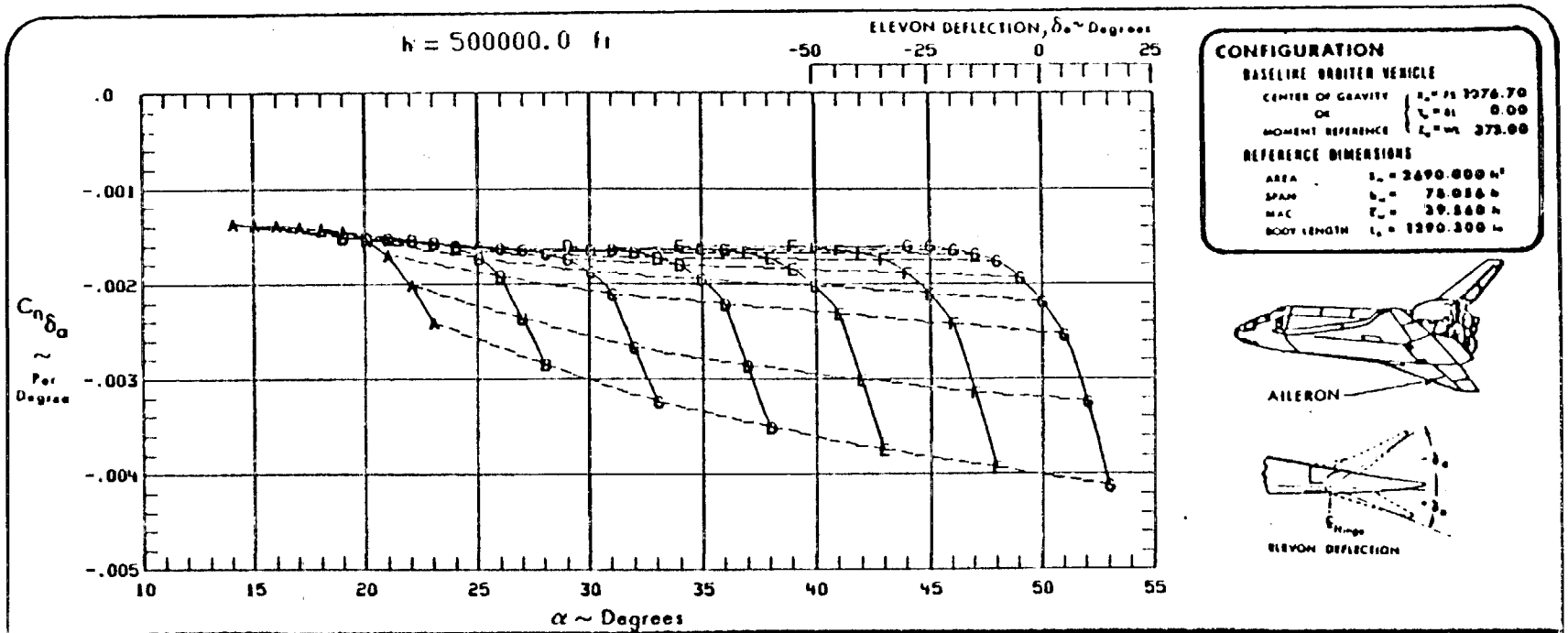
Figure 4.2.1.2-81
EFFECT OF AILERON



δ_e ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{n_{\delta_a}}$ ~ per Degree												
-30.000							-0.00138	-0.00152	-0.00161	-0.00162	-0.00162	-0.00161	-0.00161
-25.000							-0.00139	-0.00153	-0.00163	-0.00165	-0.00164	-0.00163	-0.00162
-20.000							-0.00139	-0.00154	-0.00164	-0.00166	-0.00166	-0.00166	-0.00165
-15.000							-0.00141	-0.00156	-0.00166	-0.00168	-0.00169	-0.00169	-0.00170
-10.000							-0.00142	-0.00158	-0.00170	-0.00174	-0.00175	-0.00176	-0.00177
-5.000							-0.00145	-0.00163	-0.00176	-0.00182	-0.00186	-0.00190	-0.00195
0.0							-0.00155	-0.00174	-0.00189	-0.00197	-0.00204	-0.00212	-0.00220
5.000							-0.00172	-0.00194	-0.00212	-0.00223	-0.00233	-0.00244	-0.00255
10.000							-0.00203	-0.00238	-0.00268	-0.00287	-0.00302	-0.00315	-0.00325
15.000							-0.00242	-0.00286	-0.00325	-0.00352	-0.00376	-0.00395	-0.00413

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Figure 4.2.1.2-82
EFFECT OF AILERON

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Rockwell International
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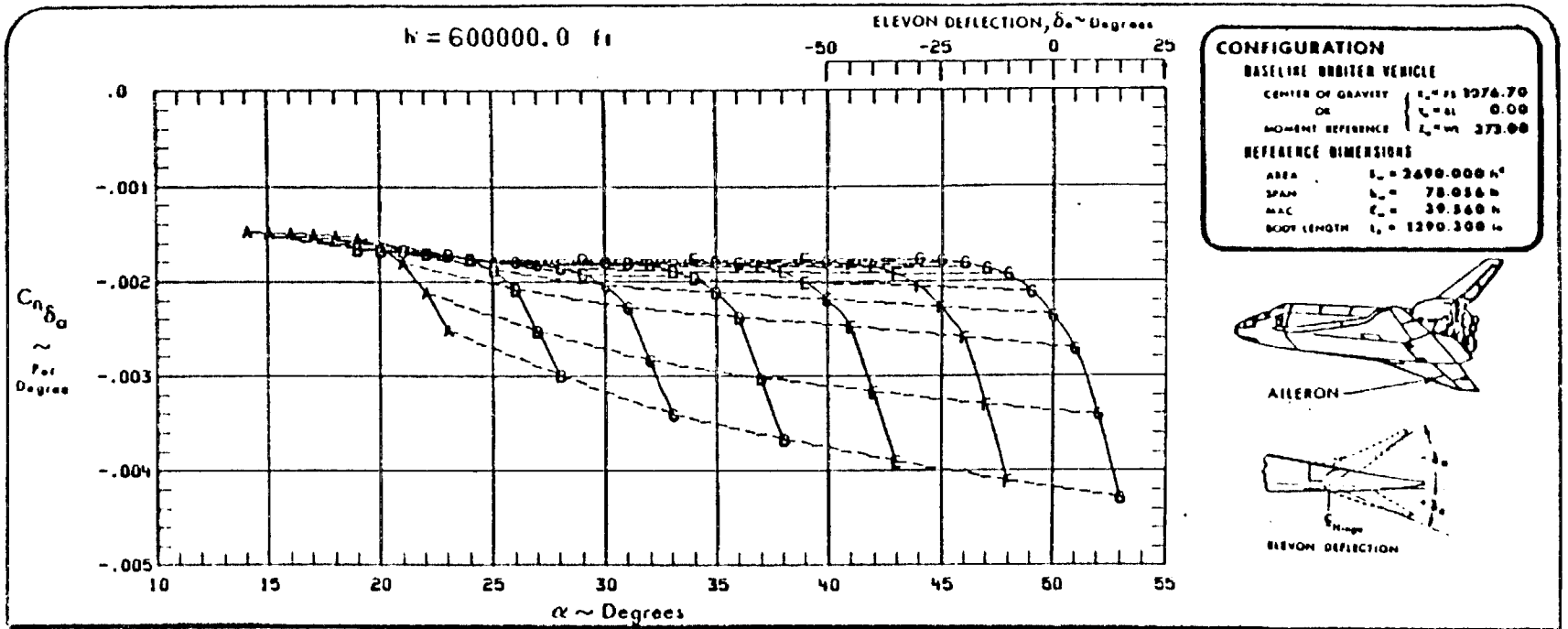

δ_a ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{n_{\delta_a}}$ ~ per Degree												
-30.000							-0.00148	-0.00167	-0.00178	-0.00178	-0.00178	-0.00178	-0.00178
-25.000							-0.00149	-0.00168	-0.00180	-0.00181	-0.00180	-0.00180	-0.00179
-20.000							-0.00149	-0.00169	-0.00181	-0.00182	-0.00182	-0.00183	-0.00182
-15.000							-0.00151	-0.00171	-0.00183	-0.00184	-0.00185	-0.00186	-0.00187
-10.000							-0.00152	-0.00173	-0.00187	-0.00190	-0.00191	-0.00193	-0.00194
-5.000							-0.00155	-0.00178	-0.00193	-0.00198	-0.00202	-0.00207	-0.00212
0.0							-0.00165	-0.00189	-0.00206	-0.00213	-0.00220	-0.00229	-0.00237
5.000							-0.00182	-0.00209	-0.00229	-0.00239	-0.00249	-0.00261	-0.00272
10.000							-0.00213	-0.00253	-0.00285	-0.00303	-0.00318	-0.00332	-0.00342
15.000							-0.00252	-0.00301	-0.00342	-0.00368	-0.00392	-0.00412	-0.00430

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Figure 4.2.1.2-83
EFFECT OF AILERON

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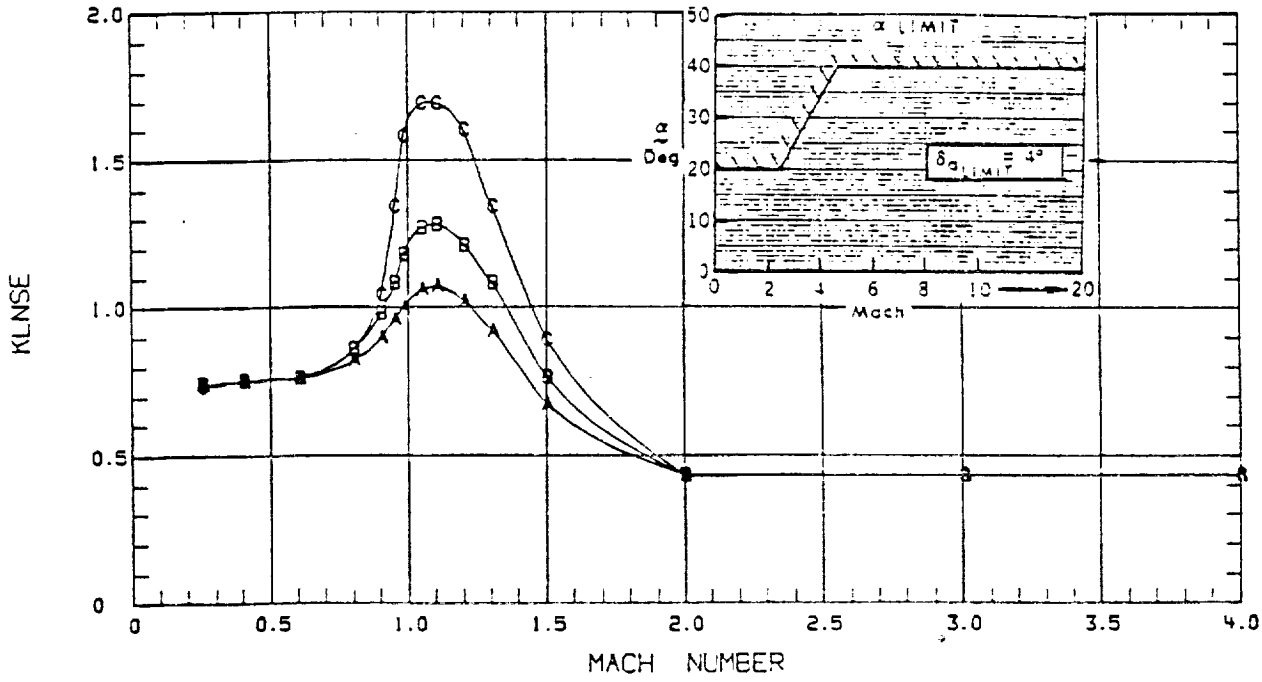
Rockwell International
Space Division



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	DELE (DEG)		
	-5.000	0.0	5.000
	A	B	C
MACH NUMBER	YAWING MOMENT PARTIAL SPAN FACTOR		
0.250	0.74000	0.74000	0.73000
0.400	0.75000	0.75000	0.75000
0.600	0.76000	0.76000	0.76000
0.800	0.82000	0.86000	0.86000
0.900	0.90000	0.98000	1.04000
0.950	0.96000	1.08000	1.34000
0.980	1.00000	1.18000	1.58000
1.050	1.06000	1.27000	1.69000
1.100	1.07000	1.29000	1.69000
1.200	1.02000	1.21000	1.60000
1.300	0.92000	1.08000	1.34000
1.500	0.67000	0.76000	0.89000
2.000	0.43000	0.43000	0.43000
3.000	0.43000	0.43000	0.43000
4.000	0.43000	0.43000	0.43000
5.000	0.43000	0.43000	0.43000
8.000	0.43000	0.43000	0.43000
10.000	0.43000	0.43000	0.43000
15.000	0.43000	0.43000	0.43000
20.000	0.43000	0.43000	0.43000

NOTE: In the event partial span factors are required which exceed the given limits, the Aero Data Unit at Rockwell International should be contacted before extrapolation of the given data.

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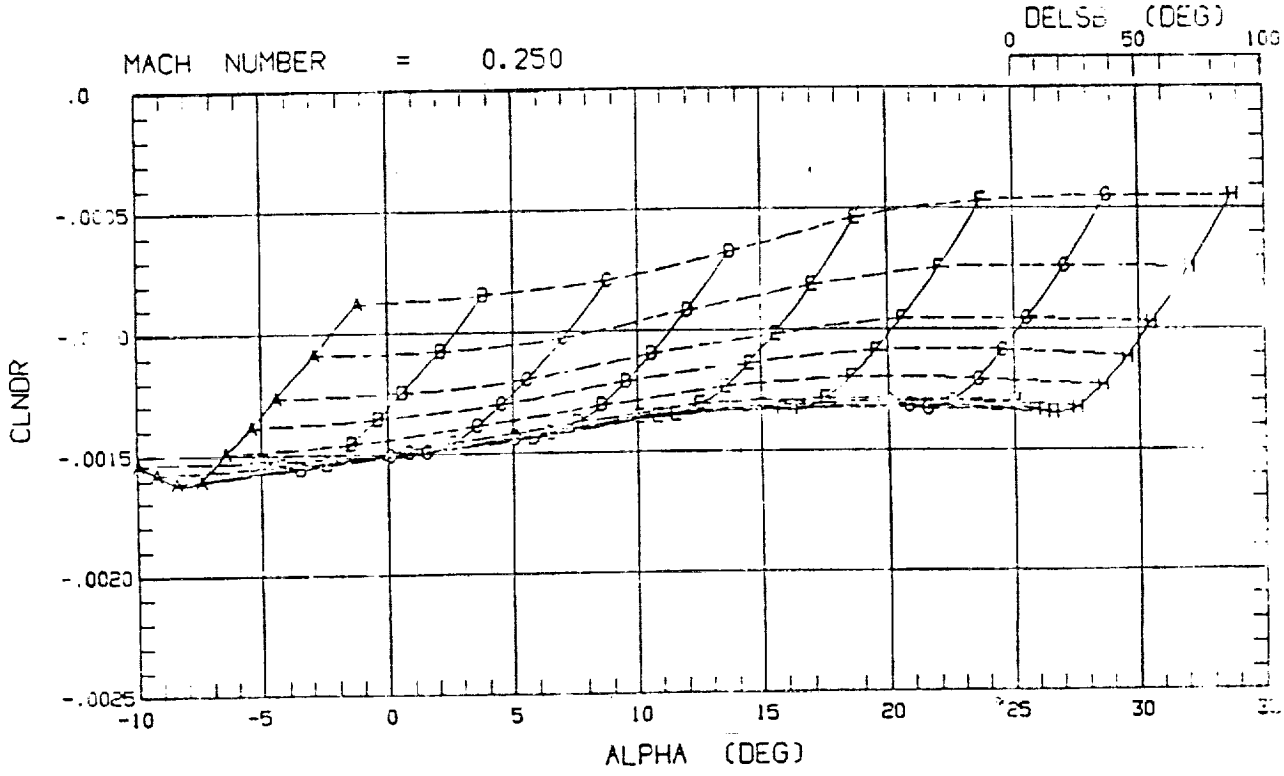
FIGURE 4.2.1.2-84
ELEVON PARTIAL SPAN FACTOR



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00154	-0.00153	-0.00151	-0.00144	-0.00136	-0.00132	-0.00130	-0.00130
7.500	-0.00158	-0.00155	-0.00150	-0.00144	-0.00136	-0.00133	-0.00132	-0.00134
15.000	-0.00162	-0.00156	-0.00150	-0.00142	-0.00135	-0.00133	-0.00133	-0.00135
25.000	-0.00161	-0.00154	-0.00146	-0.00138	-0.00131	-0.00129	-0.00130	-0.00133
35.000	-0.00150	-0.00146	-0.00139	-0.00131	-0.00124	-0.00120	-0.00121	-0.00124
45.000	-0.00139	-0.00136	-0.00130	-0.00121	-0.00114	-0.00109	-0.00109	-0.00112
55.000	-0.00127	-0.00125	-0.00120	-0.00110	-0.00102	-0.00096	-0.00096	-0.00098
70.000	-0.00109	-0.00108	-0.00103	-0.00092	-0.00082	-0.00075	-0.00074	-0.00075
87.200	-0.00088	-0.00085	-0.00079	-0.00069	-0.00054	-0.00047	-0.00045	-0.00045

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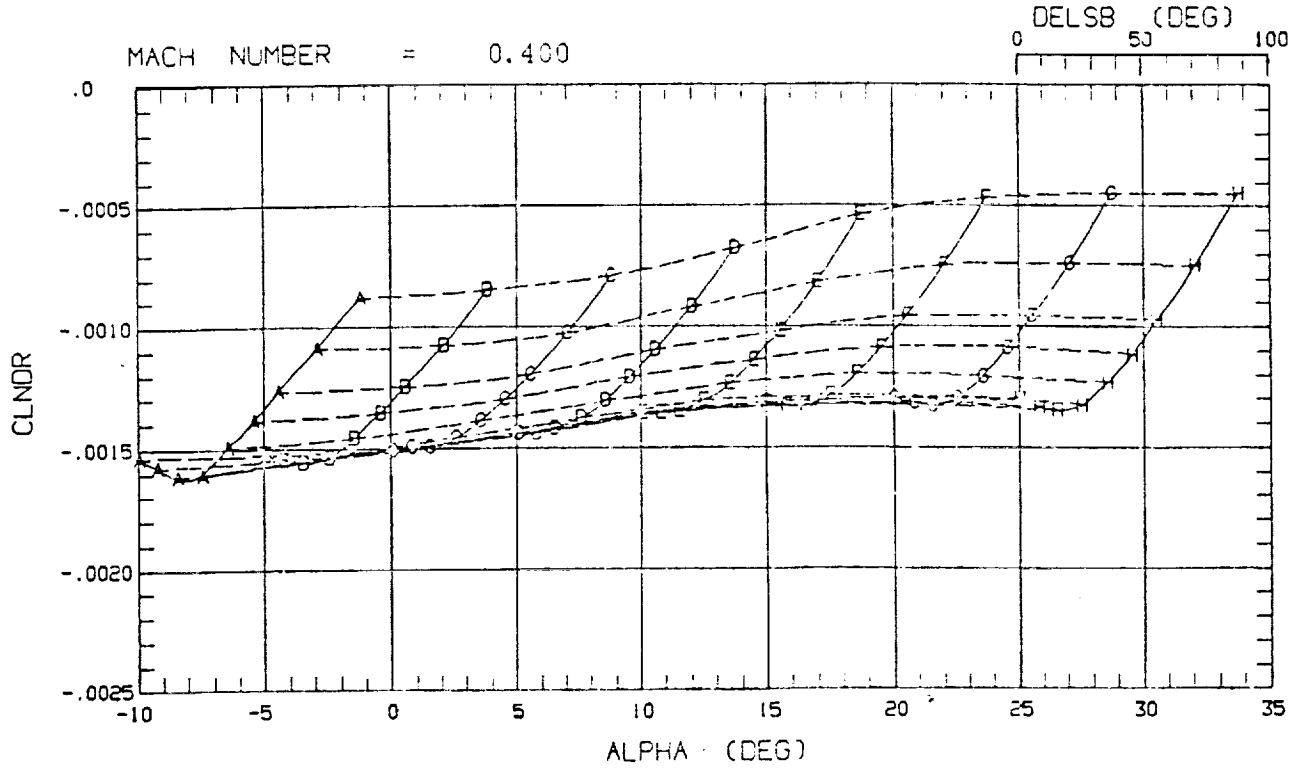
FIGURE 4.2.1.2- 35
EFFECT OF RUDDER



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1339.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00154	-0.00153	-0.00151	-0.00144	-0.00136	-0.00132	-0.00130	-0.00130
7.500	-0.00158	-0.00155	-0.00150	-0.00144	-0.00136	-0.00133	-0.00132	-0.00134
15.000	-0.00162	-0.00156	-0.00150	-0.00142	-0.00135	-0.00133	-0.00133	-0.00135
25.000	-0.00161	-0.00154	-0.00146	-0.00138	-0.00131	-0.00129	-0.00130	-0.00133
35.000	-0.00150	-0.00146	-0.00139	-0.00131	-0.00124	-0.00120	-0.00121	-0.00124
45.000	-0.00139	-0.00136	-0.00130	-0.00121	-0.00114	-0.00109	-0.00109	-0.00112
55.000	-0.00127	-0.00125	-0.00120	-0.00110	-0.00102	-0.00096	-0.00096	-0.00098
70.000	-0.00109	-0.00108	-0.00103	-0.00092	-0.00082	-0.00075	-0.00074	-0.00075
87.200	-0.00098	-0.00085	-0.00079	-0.00068	-0.00054	-0.00047	-0.00045	-0.00045

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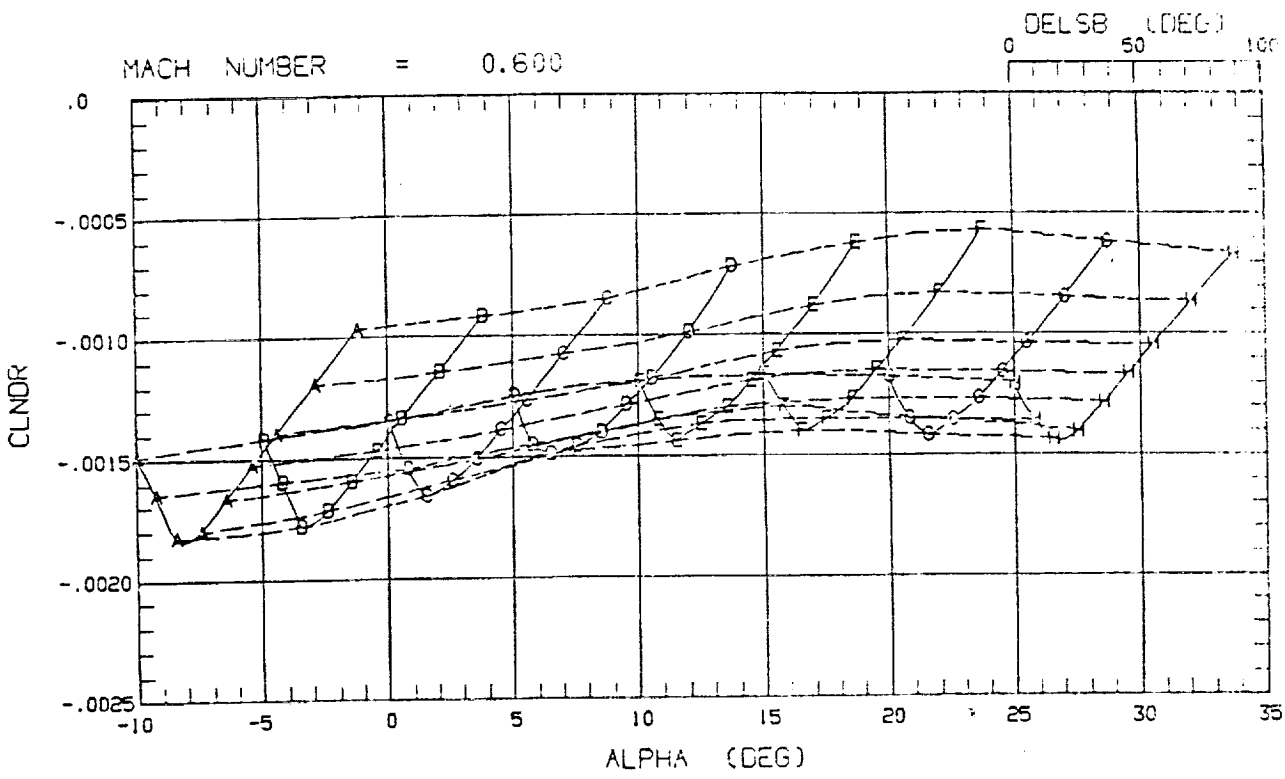
FIGURE 4.2.1.2-86
EFFECT OF RUDDER



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00149	-0.00142	-0.00135	-0.00125	-0.00119	-0.00117	-0.00118	-0.00121
7.500	-0.00165	-0.00160	-0.00155	-0.00145	-0.00135	-0.00130	-0.00135	-0.00136
15.000	-0.00183	-0.00178	-0.00166	-0.00149	-0.00144	-0.00140	-0.00142	-0.00144
25.000	-0.00180	-0.00172	-0.00160	-0.00146	-0.00137	-0.00135	-0.00136	-0.00141
35.000	-0.00167	-0.00160	-0.00151	-0.00140	-0.00130	-0.00127	-0.00127	-0.00129
45.000	-0.00153	-0.00147	-0.00139	-0.00129	-0.00119	-0.00115	-0.00116	-0.00117
55.000	-0.00140	-0.00134	-0.00127	-0.00118	-0.00107	-0.00103	-0.00104	-0.00105
70.000	-0.00120	-0.00115	-0.00108	-0.00099	-0.00088	-0.00083	-0.00085	-0.00087
87.200	-0.00097	-0.00092	-0.00085	-0.00072	-0.00062	-0.00057	-0.00062	-0.00057

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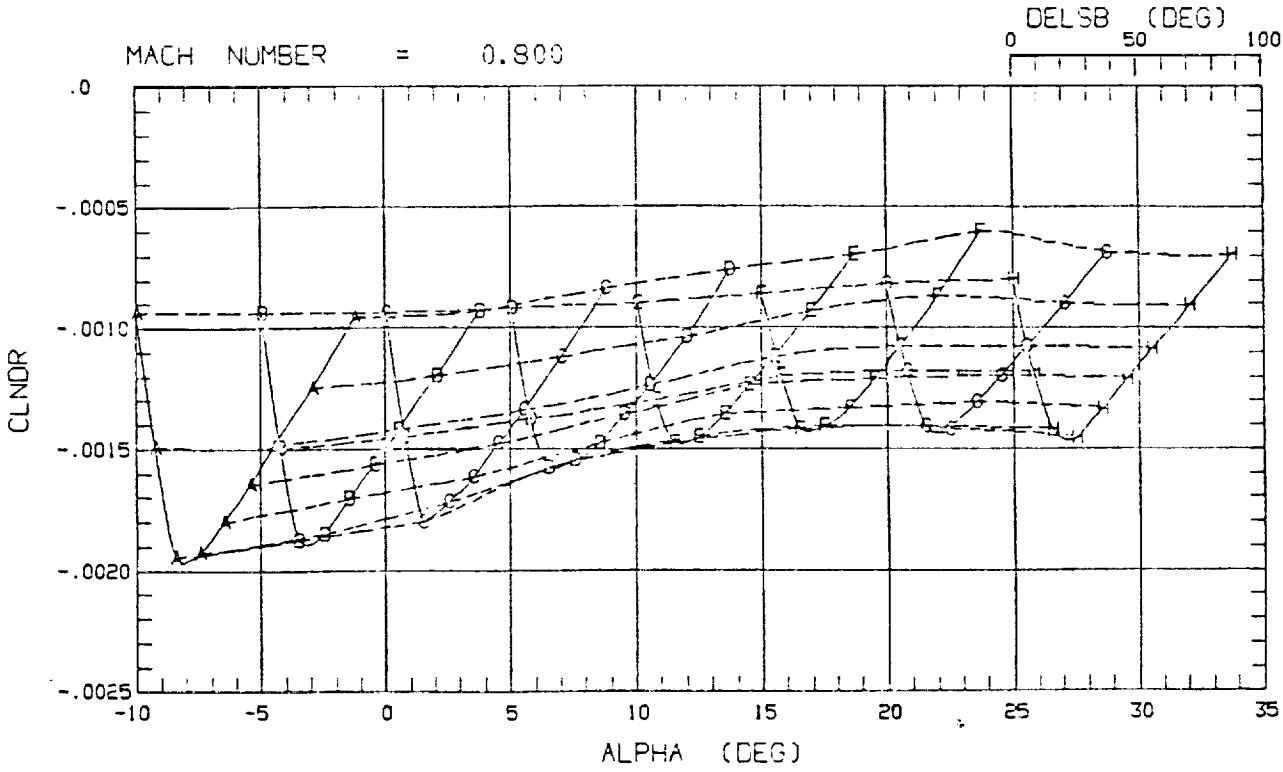
FIGURE 4.2.1.2-87
EFFECT OF RUDDER



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00094	-0.00094	-0.00094	-0.00092	-0.00090	-0.00086	-0.00082	-0.00080
7.500	-0.00150	-0.00150	-0.00145	-0.00138	-0.00130	-0.00120	-0.00118	-0.00118
15.000	-0.00195	-0.00188	-0.00180	-0.00168	-0.00148	-0.00142	-0.00141	-0.00142
25.000	-0.00193	-0.00185	-0.00172	-0.00155	-0.00145	-0.00141	-0.00142	-0.00146
35.000	-0.00180	-0.00171	-0.00162	-0.00148	-0.00136	-0.00133	-0.00131	-0.00134
45.000	-0.00165	-0.00157	-0.00148	-0.00136	-0.00124	-0.00121	-0.00120	-0.00121
55.000	-0.00149	-0.00142	-0.00134	-0.00124	-0.00112	-0.00108	-0.00108	-0.00109
70.000	-0.00125	-0.00120	-0.00112	-0.00104	-0.00093	-0.00087	-0.00090	-0.00091
87.200	-0.00096	-0.00093	-0.00084	-0.00076	-0.00070	-0.00060	-0.00059	-0.00070

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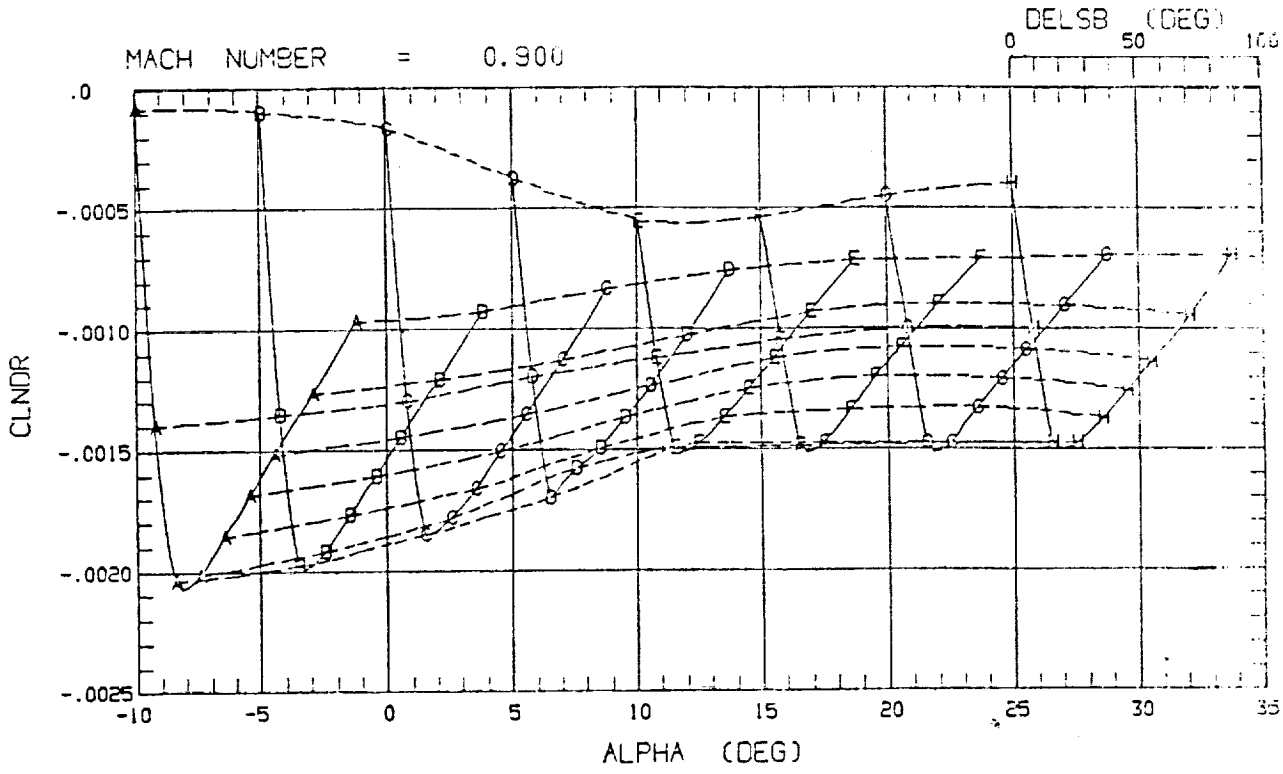
FIGURE 4.2.1.2-88
EFFECT OF RUDDER



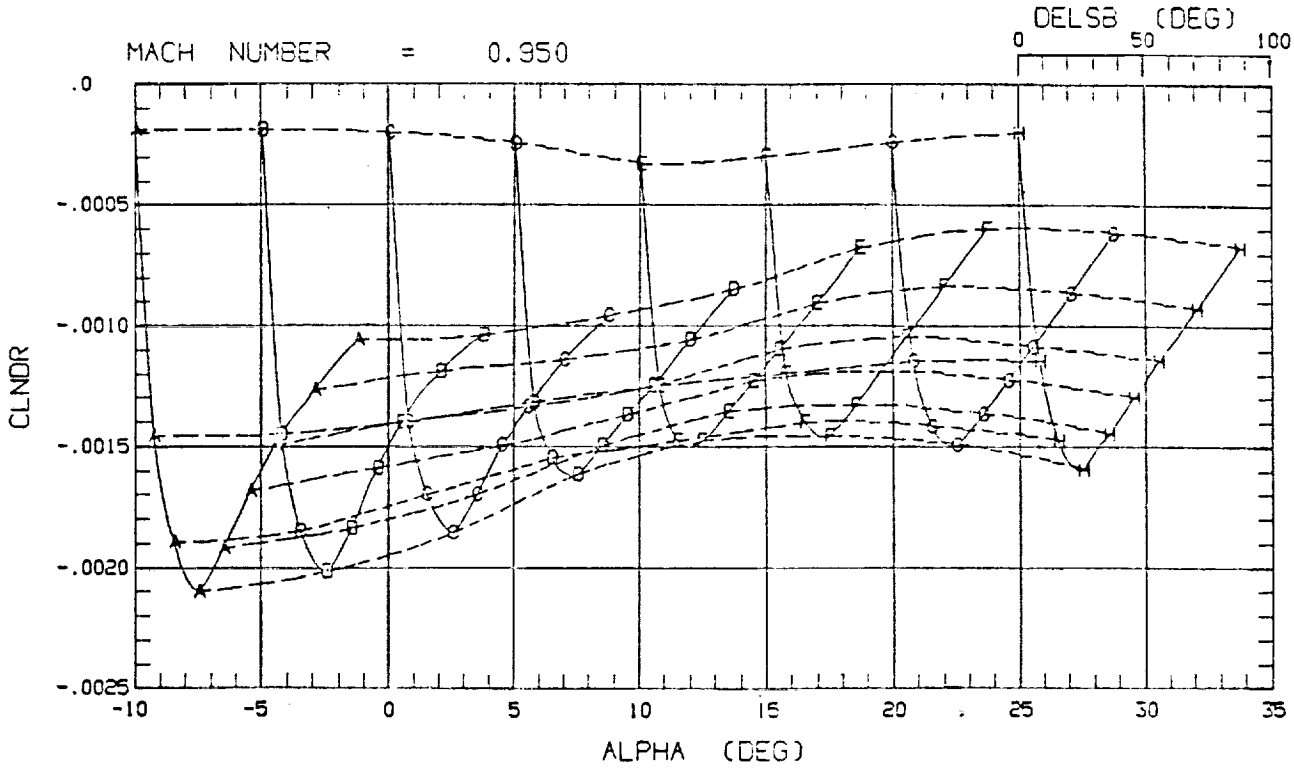
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00008	-0.00010	-0.00017	-0.00038	-0.00056	-0.00054	-0.00045	-0.00040
7.500	-0.00140	-0.00136	-0.00130	-0.00120	-0.00112	-0.00105	-0.00100	-0.00100
15.000	-0.00204	-0.00198	-0.00185	-0.00170	-0.00150	-0.00149	-0.00148	-0.00148
25.000	-0.00202	-0.00192	-0.00178	-0.00158	-0.00148	-0.00148	-0.00148	-0.00148
35.000	-0.00186	-0.00177	-0.00166	-0.00150	-0.00137	-0.00134	-0.00133	-0.00138
45.000	-0.00169	-0.00161	-0.00151	-0.00137	-0.00125	-0.00120	-0.00121	-0.00125
55.000	-0.00152	-0.00145	-0.00136	-0.00124	-0.00112	-0.00108	-0.00109	-0.00114
70.000	-0.00127	-0.00121	-0.00113	-0.00103	-0.00093	-0.00090	-0.00091	-0.00095
87.200	-0.00097	-0.00093	-0.00084	-0.00076	-0.00072	-0.00071	-0.00070	-0.00070

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.2-89
EFFECT OF RUDDER



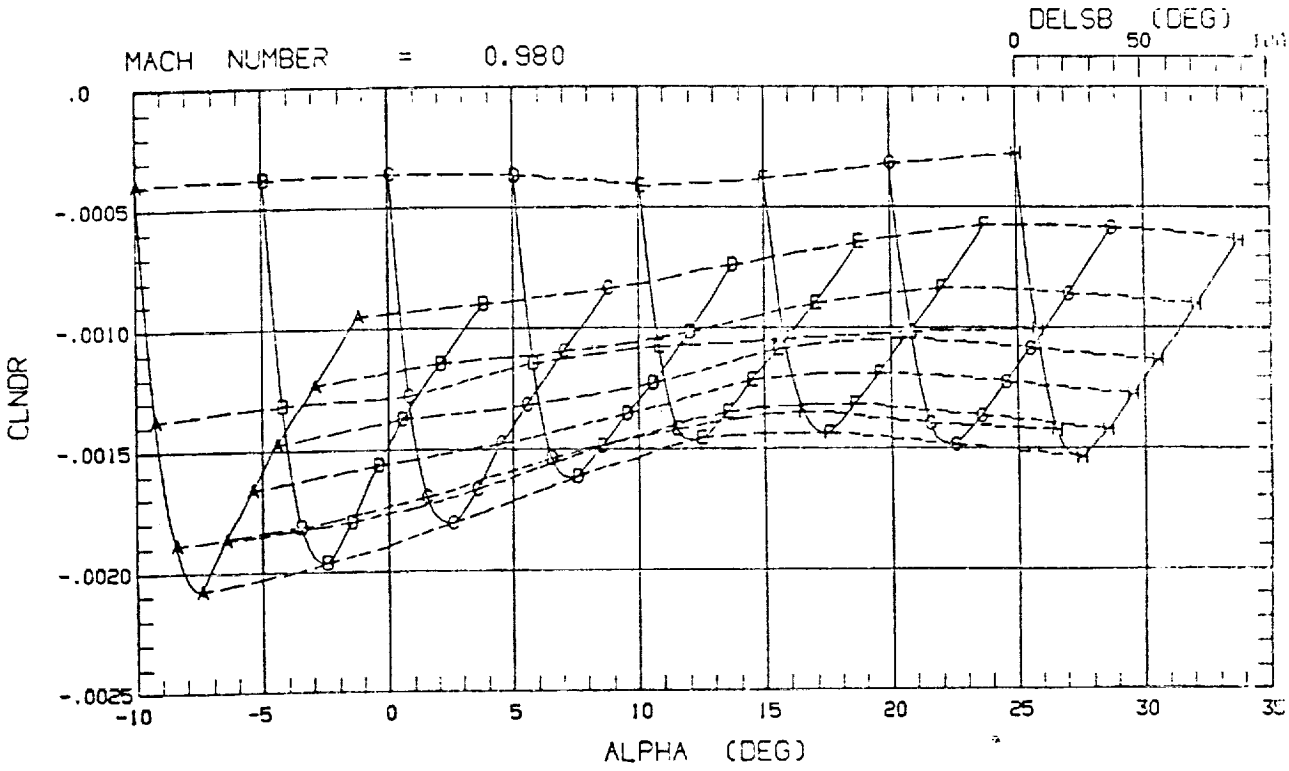
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00019	-0.00019	-0.00020	-0.00025	-0.00033	-0.00030	-0.00024	-0.00020
7.500	-0.00146	-0.00145	-0.00140	-0.00132	-0.00125	-0.00120	-0.00115	-0.00115
15.000	-0.00190	-0.00185	-0.00170	-0.00155	-0.00148	-0.00140	-0.00142	-0.00148
25.000	-0.00210	-0.00202	-0.00186	-0.00162	-0.00148	-0.00146	-0.00150	-0.00160
35.000	-0.00192	-0.00184	-0.00170	-0.00150	-0.00136	-0.00133	-0.00137	-0.00145
45.000	-0.00169	-0.00159	-0.00150	-0.00137	-0.00123	-0.00119	-0.00123	-0.00130
55.000	-0.00150	-0.00140	-0.00134	-0.00125	-0.00110	-0.00105	-0.00109	-0.00115
70.000	-0.00127	-0.00119	-0.00114	-0.00106	-0.00091	-0.00084	-0.00087	-0.00093
87.200	-0.00105	-0.00104	-0.00096	-0.00085	-0.00088	-0.00080	-0.00082	-0.00088

ENGINEER
DATE

FIGURE 4.2.1.2-90
EFFECT OF RUDDER



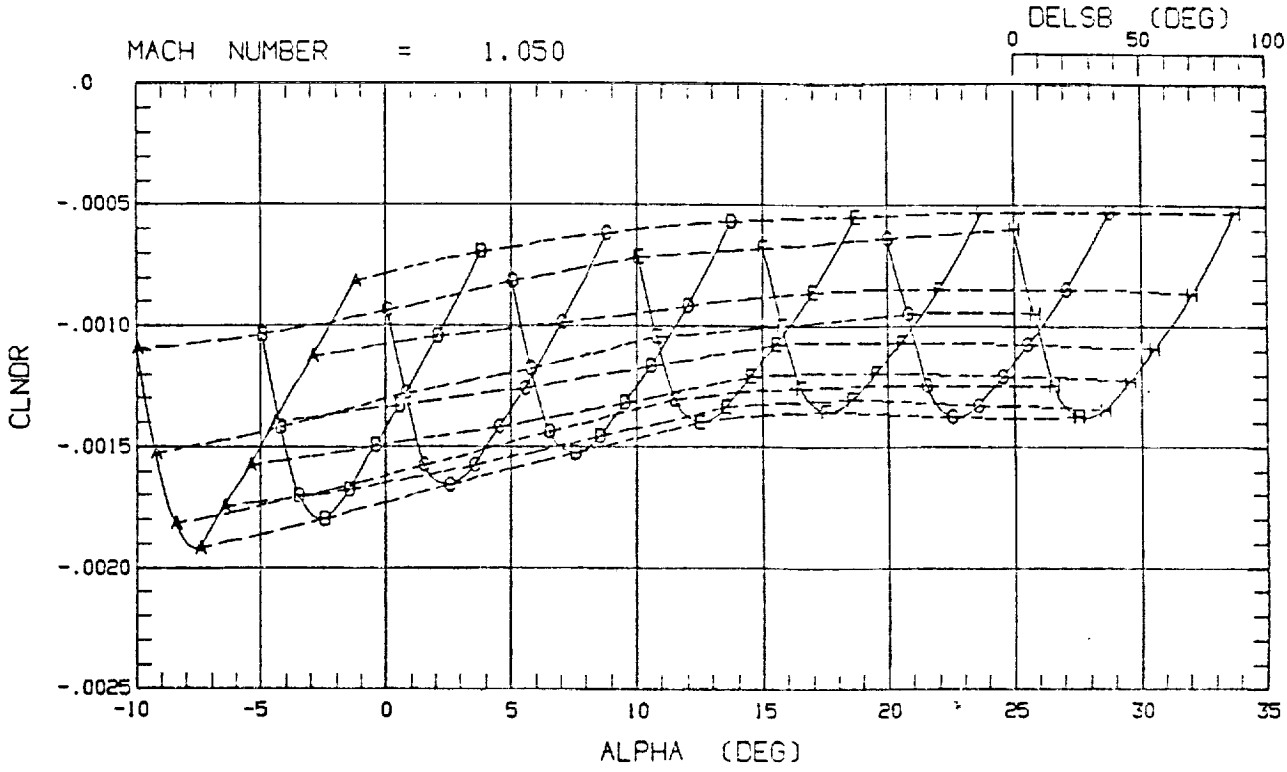
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00040	-0.00038	-0.00036	-0.00037	-0.00041	-0.00038	-0.00032	-0.00028
7.500	-0.00138	-0.00132	-0.00128	-0.00115	-0.00108	-0.00105	-0.00102	-0.00101
15.000	-0.00189	-0.00182	-0.00170	-0.00154	-0.00142	-0.00135	-0.00140	-0.00143
25.000	-0.00208	-0.00197	-0.00181	-0.00162	-0.00146	-0.00144	-0.00149	-0.00154
35.000	-0.00187	-0.00180	-0.00167	-0.00149	-0.00135	-0.00132	-0.00137	-0.00143
45.000	-0.00167	-0.00157	-0.00148	-0.00136	-0.00122	-0.00119	-0.00123	-0.00128
55.000	-0.00148	-0.00138	-0.00132	-0.00123	-0.00109	-0.00105	-0.00109	-0.00114
70.000	-0.00124	-0.00115	-0.00110	-0.00102	-0.00090	-0.00084	-0.00085	-0.00091
87.200	-0.00095	-0.00090	-0.00084	-0.00074	-0.00065	-0.00058	-0.00059	-0.00064

ENGINEER
DATE

FIGURE 4.2.1.2-91
EFFECT OF RUDDER



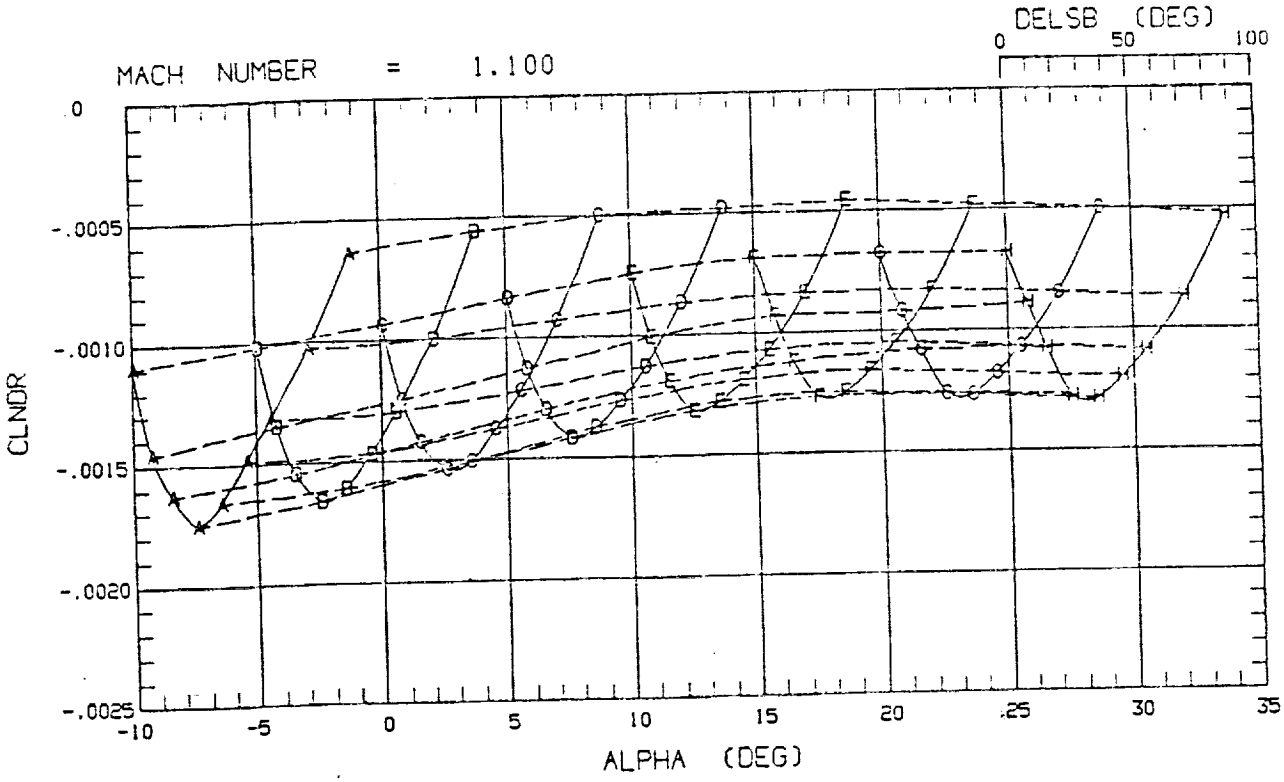
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00110	-0.00104	-0.00094	-0.00082	-0.00072	-0.00068	-0.00064	-0.00060
7.500	-0.00153	-0.00142	-0.00128	-0.00118	-0.00105	-0.00100	-0.00095	-0.00095
15.000	-0.00182	-0.00171	-0.00158	-0.00144	-0.00131	-0.00126	-0.00125	-0.00125
25.000	-0.00192	-0.00180	-0.00166	-0.00153	-0.00140	-0.00136	-0.00138	-0.00139
35.000	-0.00175	-0.00168	-0.00158	-0.00146	-0.00134	-0.00131	-0.00133	-0.00135
45.000	-0.00158	-0.00150	-0.00142	-0.00132	-0.00121	-0.00120	-0.00121	-0.00123
55.000	-0.00140	-0.00133	-0.00126	-0.00117	-0.00108	-0.00107	-0.00108	-0.00110
70.000	-0.00113	-0.00105	-0.00099	-0.00092	-0.00086	-0.00085	-0.00085	-0.00087
87.200	-0.00082	-0.00070	-0.00062	-0.00057	-0.00055	-0.00053	-0.00053	-0.00053

ENGINEER [illegible]
DATE 10-2-72

FIGURE 4.2.1.2-92
EFFECT OF RUDDER



CONFIGURATION

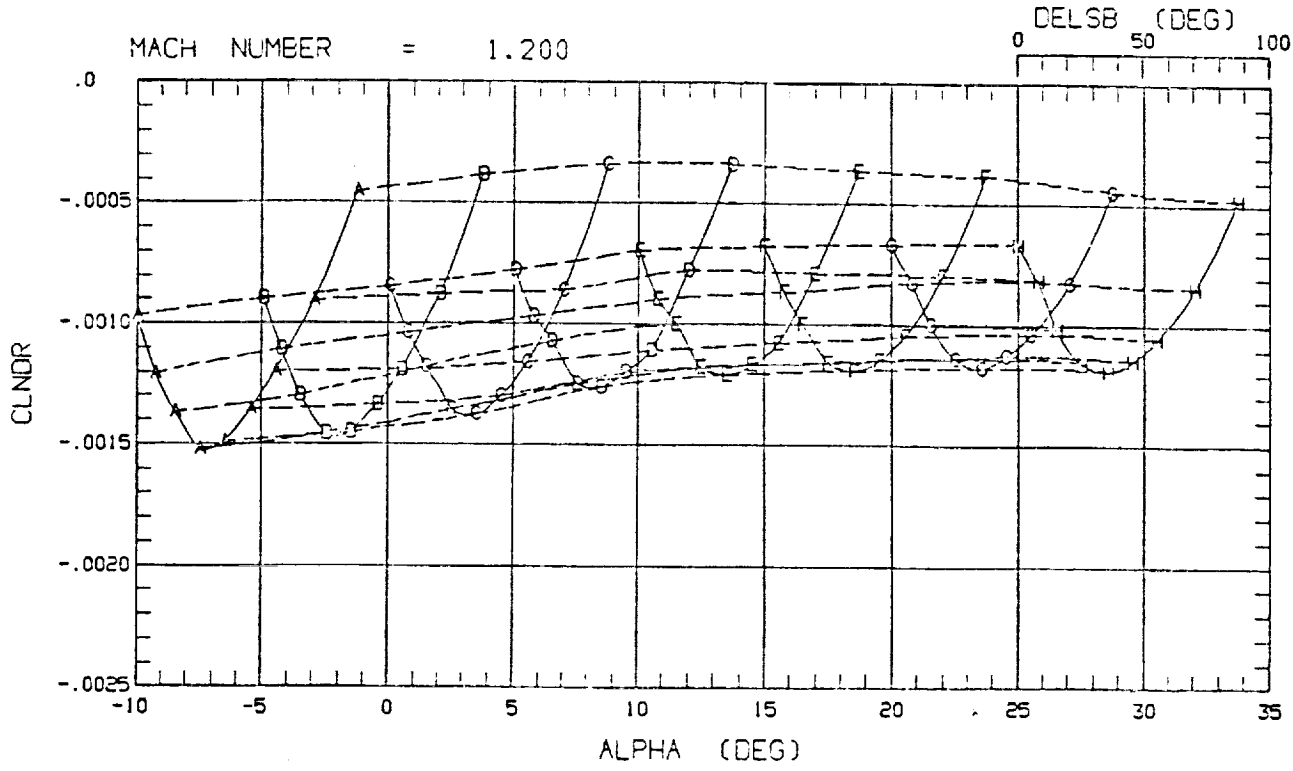
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00110	-0.00102	-0.00094	-0.00084	-0.00074	-0.00069	-0.00068	-0.00068
7.500	-0.00146	-0.00135	-0.00125	-0.00113	-0.00101	-0.00093	-0.00092	-0.00089
15.000	-0.00163	-0.00155	-0.00143	-0.00130	-0.00119	-0.00112	-0.00108	-0.00108
25.000	-0.00175	-0.00166	-0.00154	-0.00142	-0.00132	-0.00127	-0.00126	-0.00128
35.000	-0.00166	-0.00151	-0.00151	-0.00138	-0.00128	-0.00125	-0.00127	-0.00129
45.000	-0.00149	-0.00147	-0.00138	-0.00127	-0.00119	-0.00116	-0.00118	-0.00120
55.000	-0.00132	-0.00130	-0.00122	-0.00113	-0.00107	-0.00105	-0.00107	-0.00109
70.000	-0.00103	-0.00100	-0.00093	-0.00087	-0.00084	-0.00083	-0.00085	-0.00087
87.200	-0.00064	-0.00056	-0.00050	-0.00048	-0.00046	-0.00049	-0.00050	-0.00053

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.2-93
EFFECT OF RUDDER

[illegible] CCCO IM



CONFIGURATION

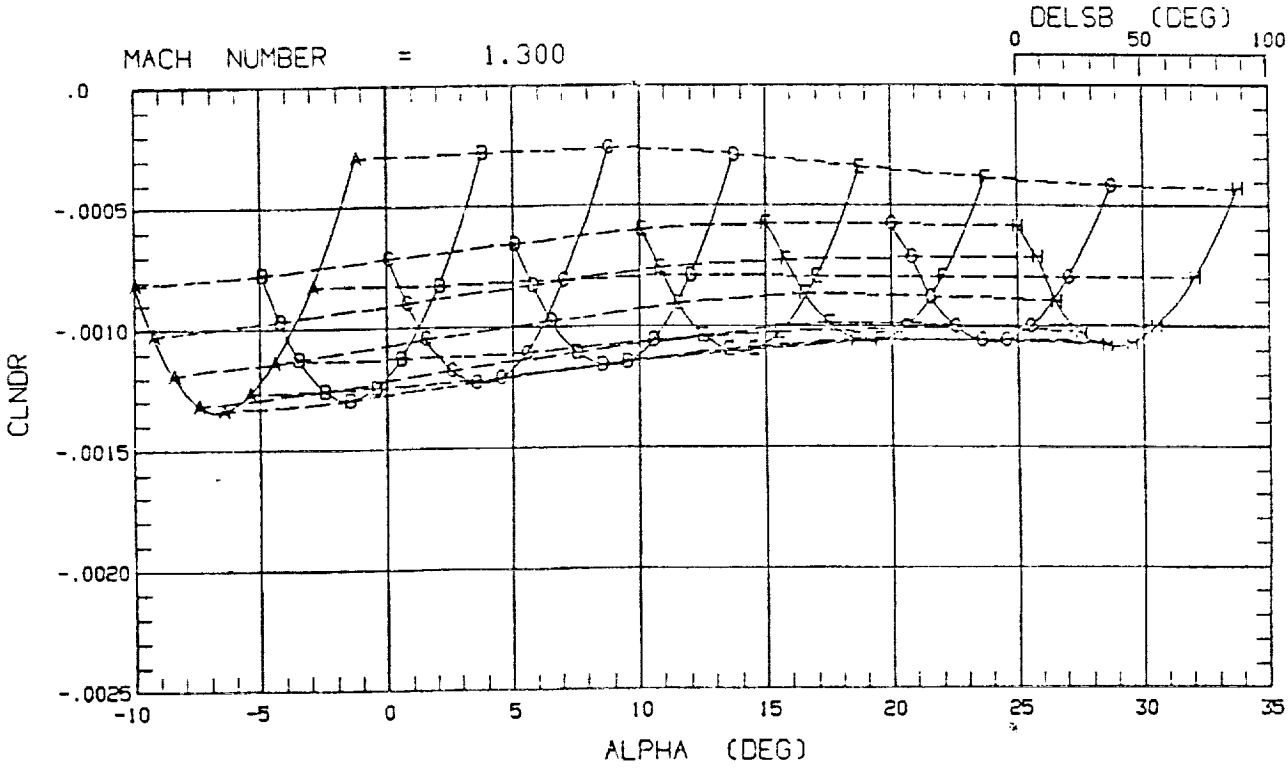
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.0 IN.	

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00097	-0.00090	-0.00085	-0.00078	-0.00070	-0.00068	-0.00067	-0.00067
7.500	-0.00121	-0.00111	-0.00104	-0.00097	-0.00090	-0.00087	-0.00083	-0.00082
15.000	-0.00137	-0.00130	-0.00118	-0.00107	-0.00100	-0.00100	-0.00100	-0.00102
25.000	-0.00152	-0.00146	-0.00136	-0.00125	-0.00113	-0.00116	-0.00114	-0.00116
35.000	-0.00149	-0.00145	-0.00138	-0.00125	-0.00121	-0.00119	-0.00118	-0.00119
45.000	-0.00136	-0.00134	-0.00130	-0.00120	-0.00117	-0.00115	-0.00113	-0.00115
55.000	-0.00120	-0.00119	-0.00116	-0.00111	-0.00108	-0.00105	-0.00104	-0.00106
70.000	-0.00091	-0.00088	-0.00086	-0.00078	-0.00079	-0.00080	-0.00083	-0.00085
87.200	-0.00046	-0.00039	-0.00034	-0.00034	-0.00037	-0.00039	-0.00045	-0.00048

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.2-94
EFFECT OF RUDDER

[illegible] 0000 IM



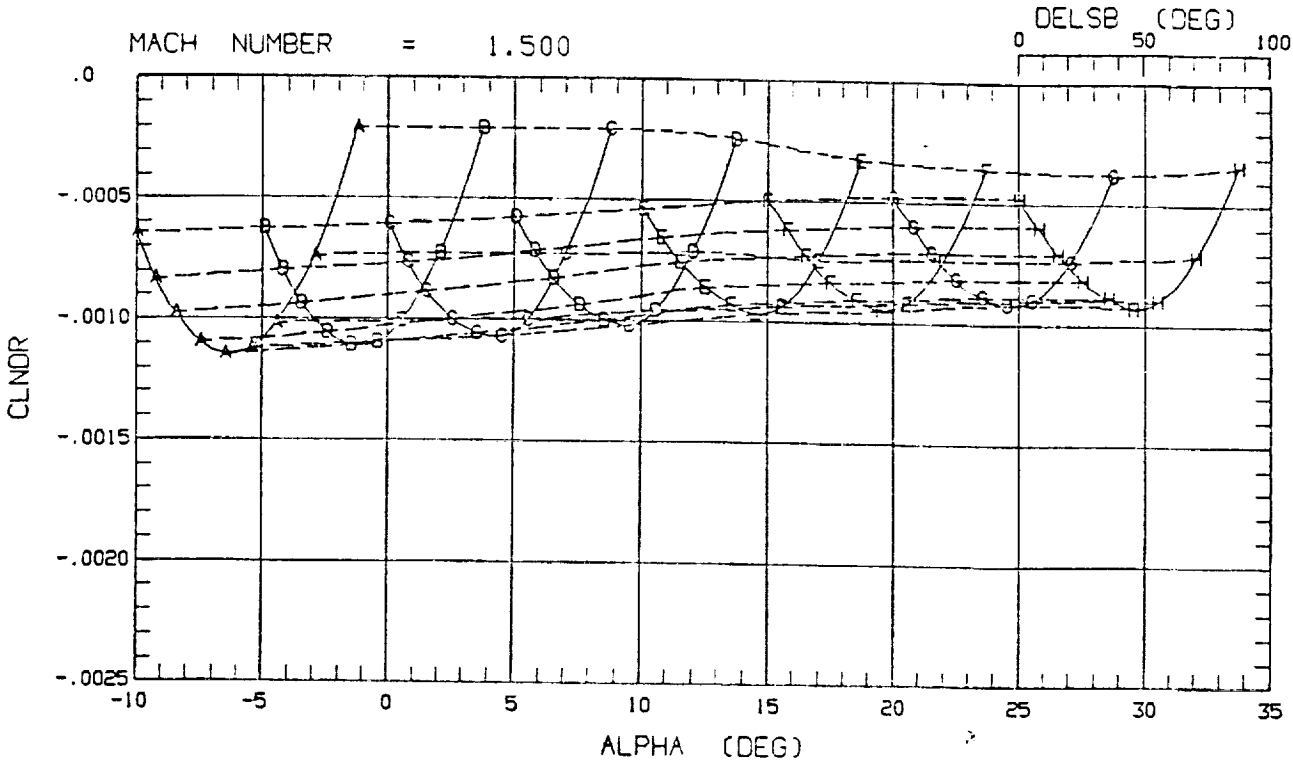
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00082	-0.00078	-0.00072	-0.00066	-0.00060	-0.00058	-0.00058	-0.00059
7.500	-0.00103	-0.00097	-0.00090	-0.00083	-0.00076	-0.00073	-0.00072	-0.00072
15.000	-0.00119	-0.00113	-0.00105	-0.00098	-0.00091	-0.00087	-0.00088	-0.00090
25.000	-0.00132	-0.00126	-0.00118	-0.00111	-0.00104	-0.00099	-0.00100	-0.00103
35.000	-0.00134	-0.00130	-0.00123	-0.00116	-0.00110	-0.00106	-0.00106	-0.00108
45.000	-0.00127	-0.00125	-0.00121	-0.00115	-0.00110	-0.00106	-0.00106	-0.00107
55.000	-0.00114	-0.00113	-0.00111	-0.00106	-0.00103	-0.00101	-0.00100	-0.00100
70.000	-0.00083	-0.00083	-0.00081	-0.00079	-0.00080	-0.00080	-0.00080	-0.00080
87.200	-0.00030	-0.00029	-0.00026	-0.00029	-0.00034	-0.00039	-0.00042	-0.00043

ENGINEER WMT
DATE 10-21-78

FIGURE 4.2.1.2- 95
EFFECT OF RUDDER



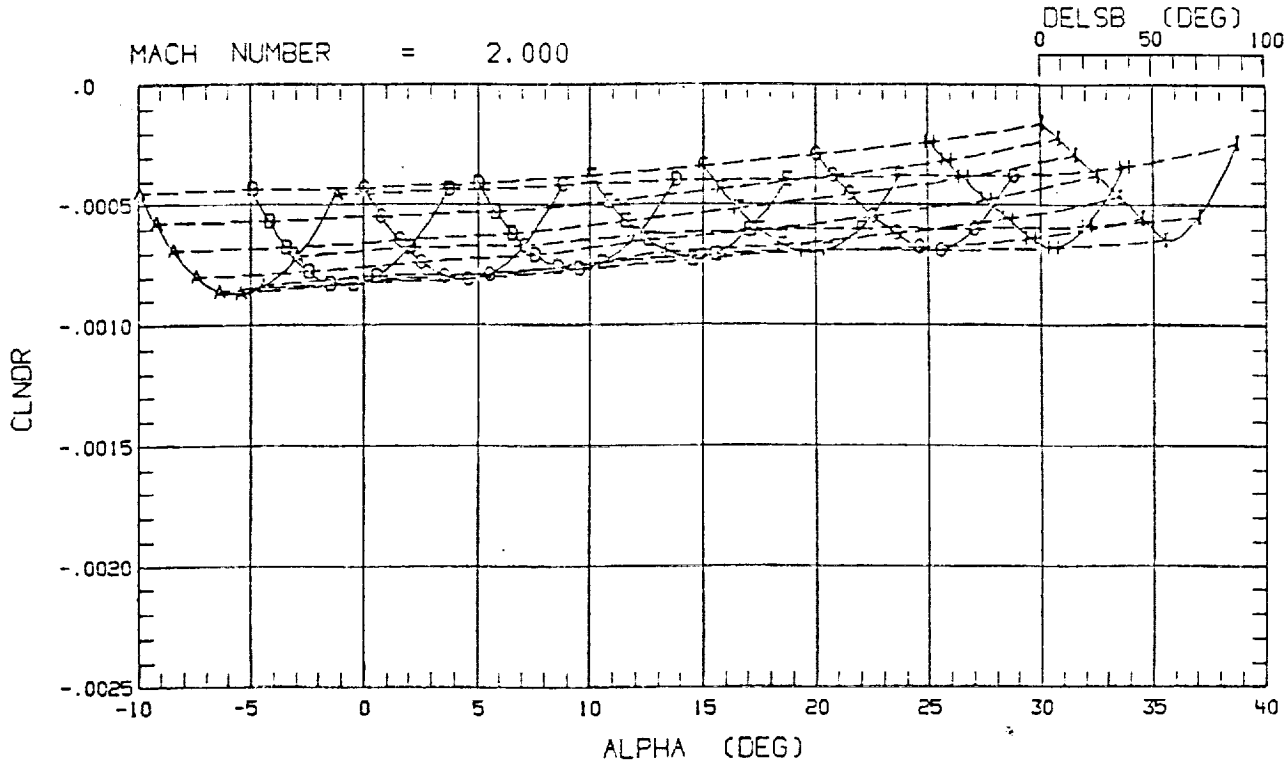
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB	= 1290.0 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00065	-0.00063	-0.00061	-0.00058	-0.00054	-0.00050	-0.00048	-0.00048
7.500	-0.00084	-0.00080	-0.00077	-0.00072	-0.00066	-0.00062	-0.00060	-0.00060
15.000	-0.00098	-0.00094	-0.00089	-0.00083	-0.00076	-0.00073	-0.00071	-0.00071
25.000	-0.00110	-0.00106	-0.00100	-0.00094	-0.00086	-0.00084	-0.00082	-0.00082
35.000	-0.00115	-0.00111	-0.00106	-0.00100	-0.00093	-0.00091	-0.00089	-0.00089
45.000	-0.00112	-0.00110	-0.00107	-0.00102	-0.00097	-0.00095	-0.00092	-0.00093
55.000	-0.00102	-0.00101	-0.00100	-0.00096	-0.00094	-0.00092	-0.00090	-0.00090
70.000	-0.00074	-0.00073	-0.00073	-0.00072	-0.00075	-0.00074	-0.00074	-0.00072
87.200	-0.00021	-0.00021	-0.00021	-0.00025	-0.00033	-0.00036	-0.00038	-0.00034

ENGINEER [illegible]
DATE 12-3-78

FIGURE 4.2.1.2-96
EFFECT OF RUDDER



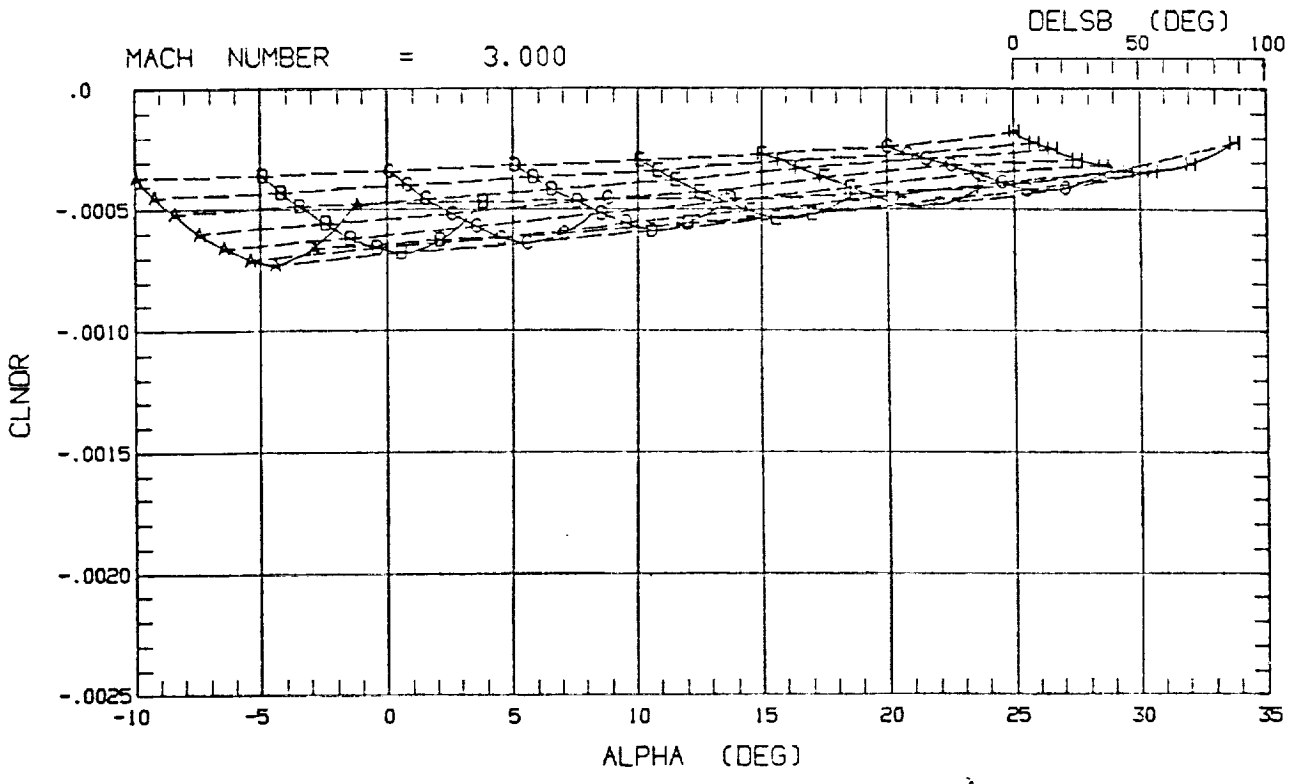
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE								
0.0	-0.00045	-0.00044	-0.00043	-0.00041	-0.00038	-0.00034	-0.00029	-0.00024	-0.00016
7.500	-0.00058	-0.00057	-0.00055	-0.00053	-0.00049	-0.00044	-0.00038	-0.00032	-0.00022
15.000	-0.00069	-0.00068	-0.00065	-0.00062	-0.00057	-0.00052	-0.00046	-0.00039	-0.00029
25.000	-0.00080	-0.00078	-0.00074	-0.00071	-0.00065	-0.00061	-0.00055	-0.00048	-0.00038
35.000	-0.00086	-0.00083	-0.00080	-0.00076	-0.00070	-0.00067	-0.00062	-0.00056	-0.00047
45.000	-0.00087	-0.00083	-0.00081	-0.00077	-0.00073	-0.00070	-0.00068	-0.00064	-0.00056
55.000	-0.00084	-0.00080	-0.00079	-0.00074	-0.00071	-0.00069	-0.00069	-0.00068	-0.00065
70.000	-0.00072	-0.00068	-0.00067	-0.00063	-0.00061	-0.00060	-0.00060	-0.00059	-0.00055
87.200	-0.00046	-0.00044	-0.00042	-0.00040	-0.00040	-0.00039	-0.00038	-0.00034	-0.00024

ENGINEER wmz
DATE 12-1-78

FIGURE 4.2.1.2-97
EFFECT OF RUDDER



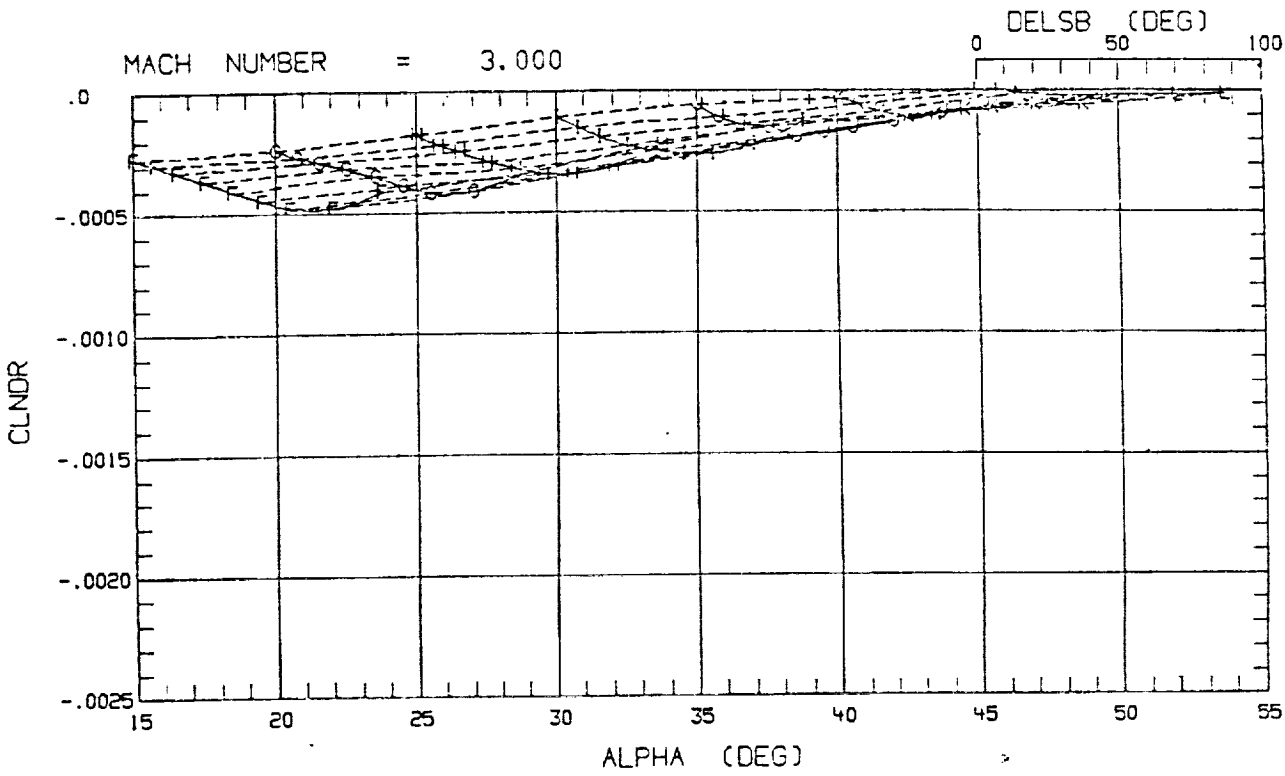
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00037	-0.00036	-0.00034	-0.00032	-0.00030	-0.00027	-0.00024	-0.00018
7.500	-0.00045	-0.00043	-0.00040	-0.00037	-0.00034	-0.00030	-0.00027	-0.00022
15.000	-0.00052	-0.00049	-0.00046	-0.00042	-0.00038	-0.00033	-0.00029	-0.00025
25.000	-0.00060	-0.00056	-0.00052	-0.00047	-0.00043	-0.00037	-0.00032	-0.00029
35.000	-0.00066	-0.00062	-0.00057	-0.00052	-0.00047	-0.00041	-0.00035	-0.00032
45.000	-0.00071	-0.00066	-0.00062	-0.00056	-0.00051	-0.00045	-0.00039	-0.00034
55.000	-0.00073	-0.00068	-0.00064	-0.00059	-0.00054	-0.00048	-0.00042	-0.00034
70.000	-0.00066	-0.00063	-0.00060	-0.00056	-0.00052	-0.00048	-0.00041	-0.00031
87.200	-0.00048	-0.00047	-0.00046	-0.00046	-0.00044	-0.00041	-0.00034	-0.00022

ENGINEER
DATE 2-5-78

FIGURE 4.2.1.2-98
EFFECT OF RUDDER

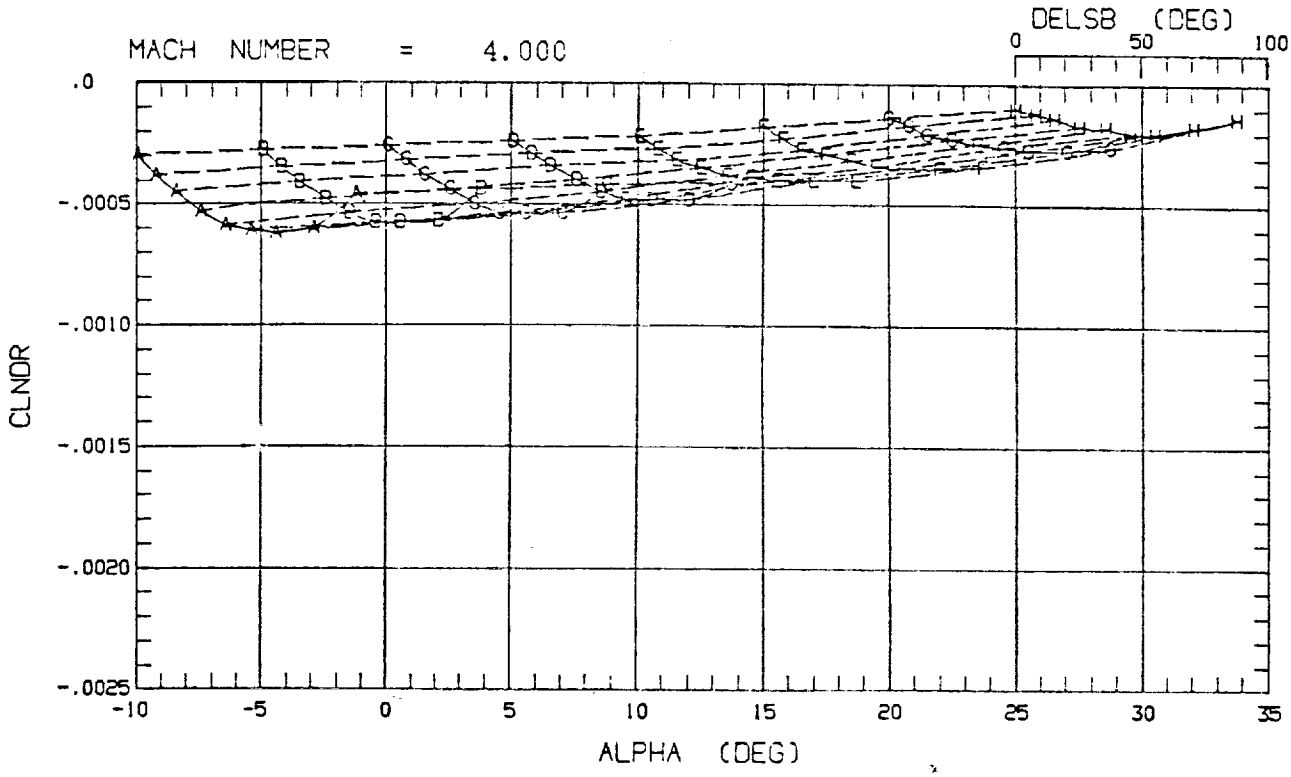


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE						
0.0	-0.00027	-0.00024	-0.00018	-0.00011	-0.00006	-0.00003	0.0
7.500	-0.00030	-0.00027	-0.00022	-0.00015	-0.00011	-0.00006	0.0
15.000	-0.00033	-0.00029	-0.00025	-0.00019	-0.00014	-0.00009	-0.00001
25.000	-0.00037	-0.00032	-0.00029	-0.00023	-0.00015	-0.00011	-0.00002
35.000	-0.00041	-0.00035	-0.00032	-0.00025	-0.00019	-0.00010	-0.00002
45.000	-0.00045	-0.00039	-0.00034	-0.00026	-0.00017	-0.00008	-0.00002
55.000	-0.00048	-0.00042	-0.00034	-0.00026	-0.00015	-0.00007	-0.00002
70.000	-0.00048	-0.00041	-0.00031	-0.00022	-0.00013	-0.00006	-0.00002
87.200	-0.00041	-0.00034	-0.00022	-0.00013	-0.00009	-0.00006	-0.00001

ENGINEER _____
DATE 10-1-[illegible]

FIGURE 4.2.1.2- 99
EFFECT OF RUDDER



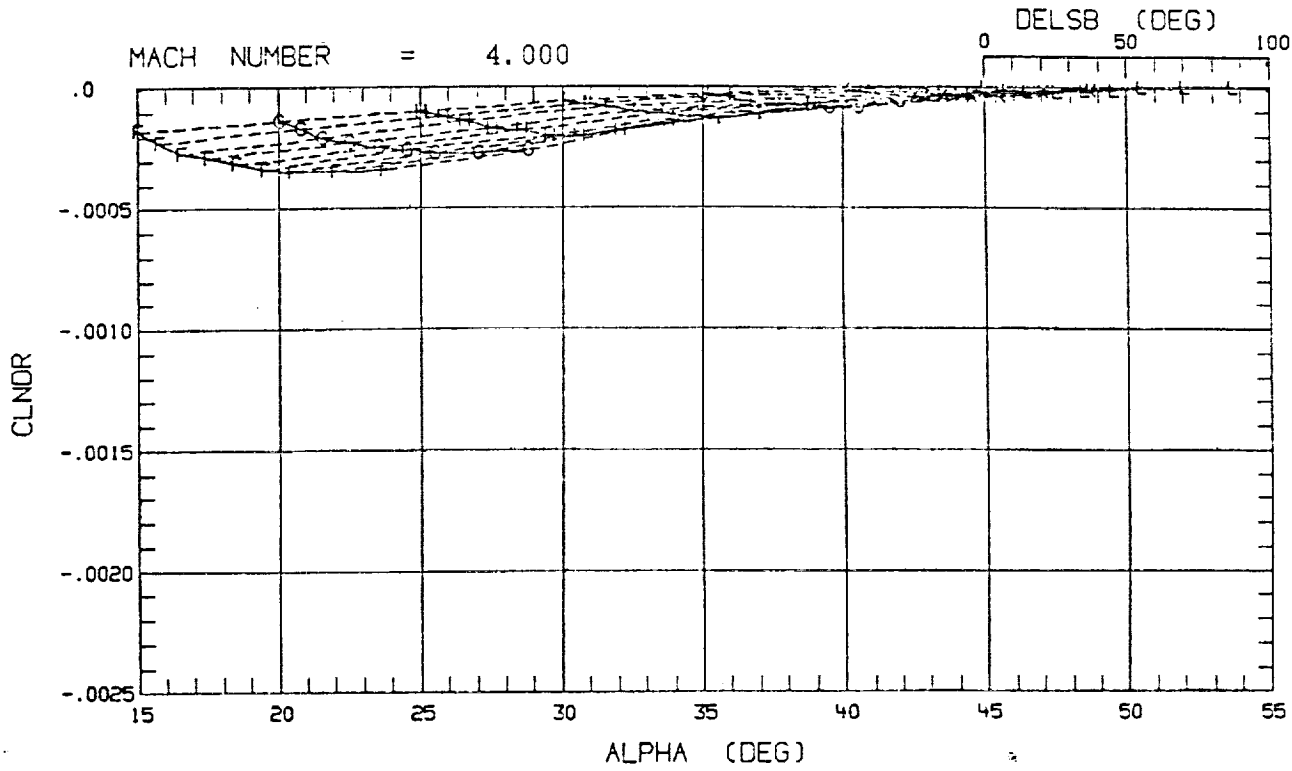
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00030	-0.00028	-0.00026	-0.00024	-0.00022	-0.00018	-0.00014	-0.00010
7.500	-0.00038	-0.00035	-0.00032	-0.00029	-0.00027	-0.00023	-0.00017	-0.00012
15.000	-0.00045	-0.00041	-0.00038	-0.00034	-0.00032	-0.00027	-0.00021	-0.00014
25.000	-0.00053	-0.00048	-0.00044	-0.00040	-0.00035	-0.00029	-0.00023	-0.00017
35.000	-0.00059	-0.00054	-0.00050	-0.00045	-0.00038	-0.00032	-0.00025	-0.00018
45.000	-0.00061	-0.00058	-0.00054	-0.00048	-0.00039	-0.00034	-0.00026	-0.00020
55.000	-0.00062	-0.00058	-0.00054	-0.00048	-0.00040	-0.00035	-0.00027	-0.00020
70.000	-0.00060	-0.00057	-0.00054	-0.00048	-0.00040	-0.00035	-0.00027	-0.00018
87.200	-0.00046	-0.00044	-0.00042	-0.00041	-0.00040	-0.00034	-0.00026	-0.00014

ENGINEER [illegible]
DATE [illegible]-78

FIGURE 4.2.1.2-100
EFFECT OF RUDDER

SI 72-SIP-CCCC IM

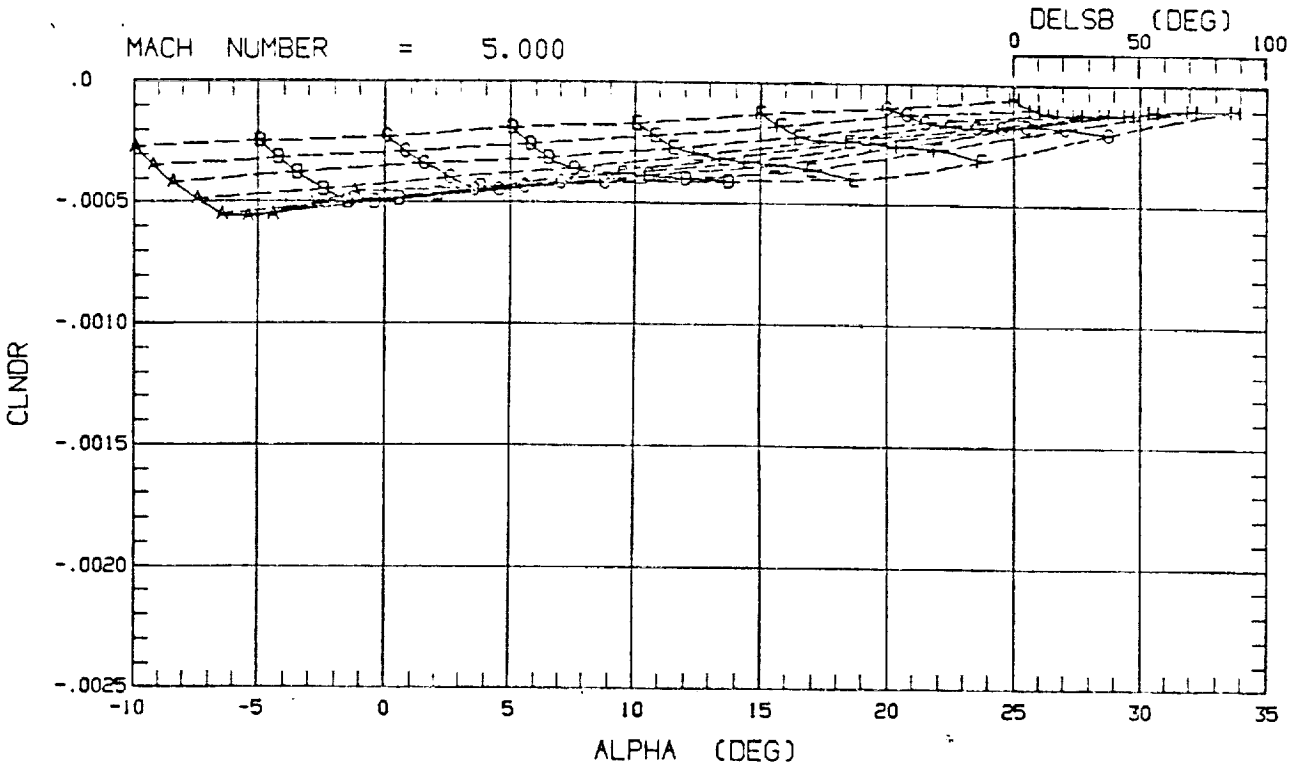


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE						
0.0	-0.00018	-0.00014	-0.00010	-0.00006	-0.00003	-0.00001	0.0
7.500	-0.00023	-0.00017	-0.00012	-0.00007	-0.00004	-0.00002	-0.00001
15.000	-0.00027	-0.00021	-0.00014	-0.00008	-0.00006	-0.00003	-0.00002
25.000	-0.00029	-0.00023	-0.00017	-0.00010	-0.00007	-0.00004	-0.00002
35.000	-0.00032	-0.00025	-0.00018	-0.00011	-0.00007	-0.00004	-0.00001
45.000	-0.00034	-0.00026	-0.00020	-0.00012	-0.00008	-0.00004	-0.00001
55.000	-0.00035	-0.00027	-0.00020	-0.00013	-0.00008	-0.00004	0.0
70.000	-0.00035	-0.00027	-0.00018	-0.00011	-0.00006	-0.00002	0.0
87.200	-0.00034	-0.00026	-0.00014	-0.00007	-0.00003	-0.00001	0.0

ENGINEER
DATE 10-7-78

FIGURE 4.2.1.2-101
EFFECT OF RUDDER



CONFIGURATION

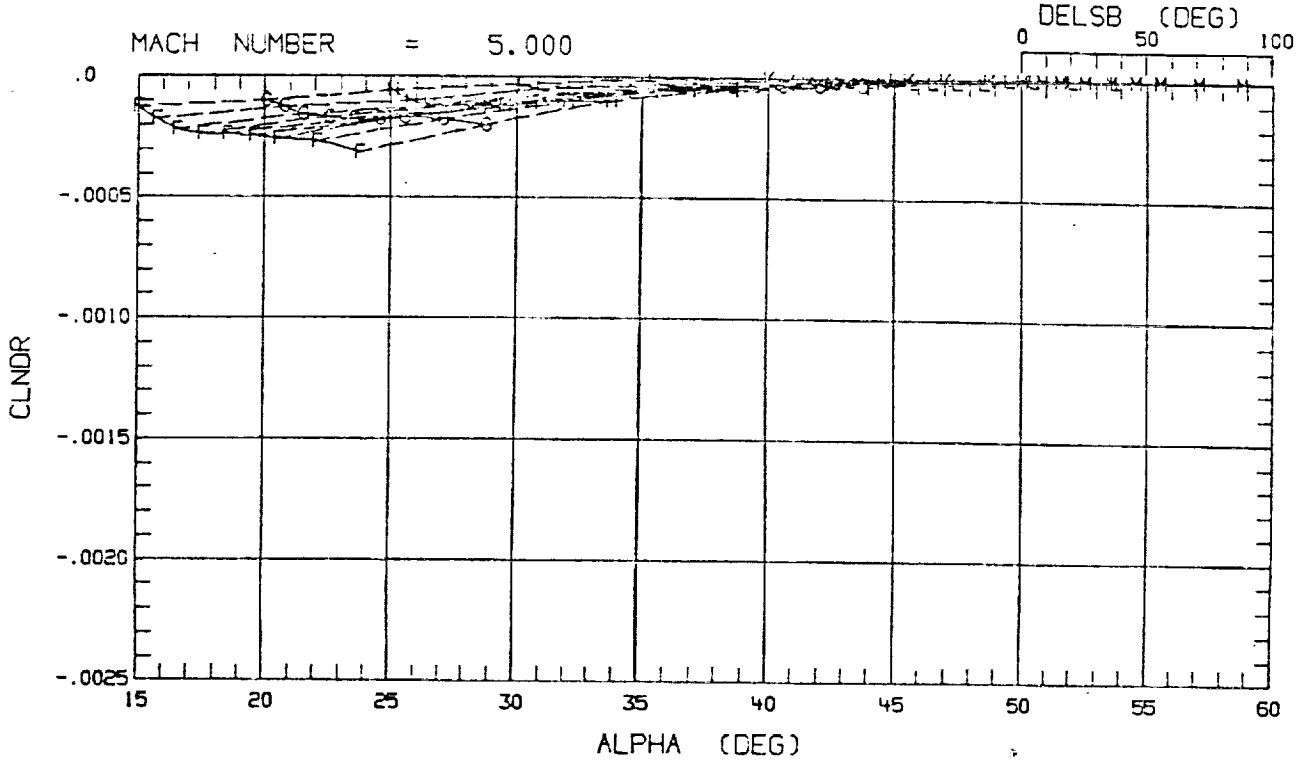
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00027	-0.00025	-0.00023	-0.00019	-0.00017	-0.00013	-0.00010	-0.00006
7.500	-0.00035	-0.00032	-0.00029	-0.00026	-0.00022	-0.00018	-0.00013	-0.00010
15.000	-0.00042	-0.00038	-0.00034	-0.00032	-0.00027	-0.00022	-0.00016	-0.00012
25.000	-0.00049	-0.00045	-0.00040	-0.00036	-0.00030	-0.00024	-0.00017	-0.00012
35.000	-0.00055	-0.00050	-0.00045	-0.00038	-0.00032	-0.00024	-0.00018	-0.00012
45.000	-0.00056	-0.00050	-0.00045	-0.00038	-0.00033	-0.00025	-0.00018	-0.00012
55.000	-0.00055	-0.00049	-0.00044	-0.00039	-0.00034	-0.00026	-0.00017	-0.00011
70.000	-0.00051	-0.00047	-0.00042	-0.00040	-0.00036	-0.00027	-0.00018	-0.00010
87.200	-0.00046	-0.00044	-0.00042	-0.00041	-0.00040	-0.00032	-0.00020	-0.00010

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.2-102
EFFECT OF RUDDER

ST 7L-SH-0000 IM



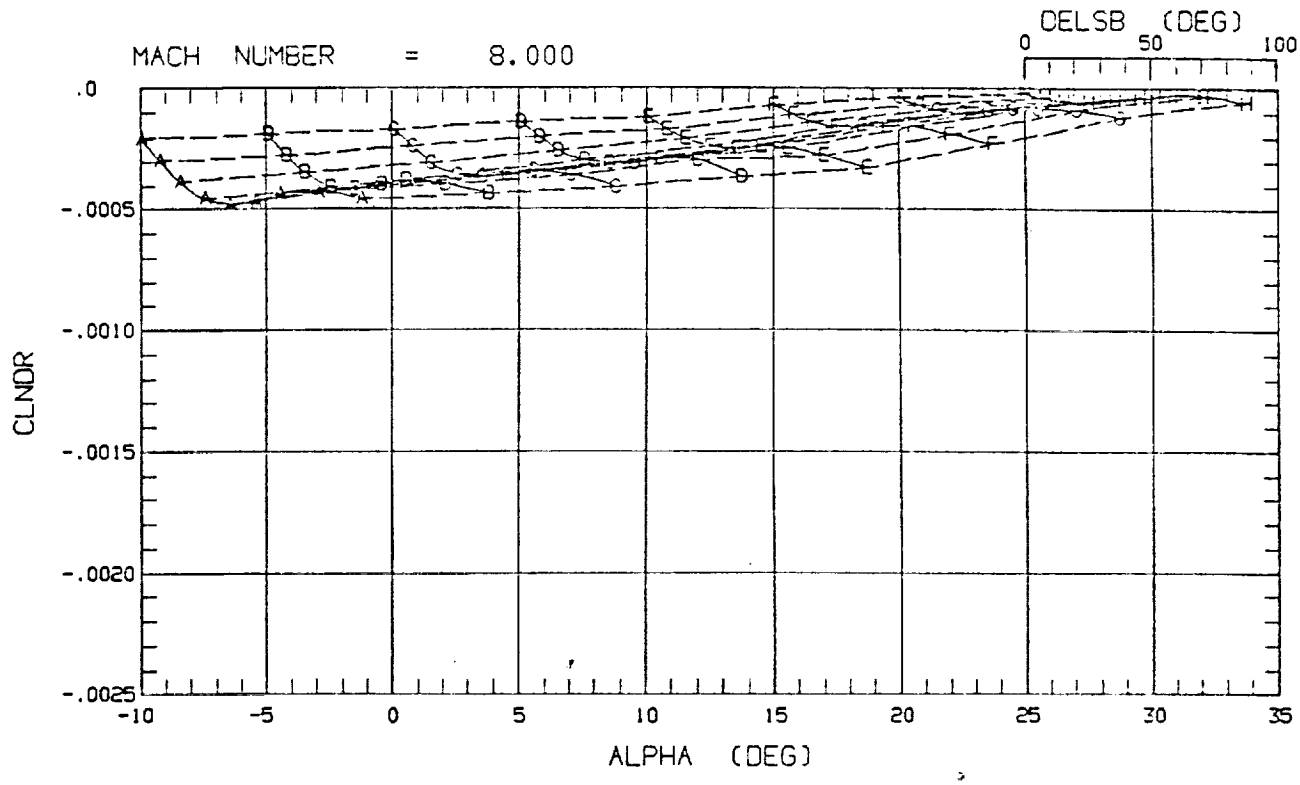
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00013	-0.00010	-0.00006	-0.00003	-0.00001	0.0	0.0	0.0
7.500	-0.00018	-0.00013	-0.00010	-0.00005	-0.00003	-0.00001	-0.00001	0.0
15.000	-0.00022	-0.00016	-0.00012	-0.00007	-0.00004	-0.00002	-0.00001	0.0
25.000	-0.00024	-0.00017	-0.00012	-0.00007	-0.00004	-0.00002	-0.00001	0.0
35.000	-0.00024	-0.00018	-0.00012	-0.00007	-0.00004	-0.00002	-0.00001	0.0
45.000	-0.00025	-0.00018	-0.00012	-0.00006	-0.00003	-0.00001	0.0	0.0
55.000	-0.00026	-0.00017	-0.00011	-0.00006	-0.00003	0.0	0.0	0.0
70.000	-0.00027	-0.00018	-0.00010	-0.00005	-0.00003	0.0	0.0	0.0
87.200	-0.00032	-0.00020	-0.00010	-0.00005	-0.00003	0.0	0.0	0.0

ENGINEER [illegible]
DATE 10-2-78

FIGURE 4.2.1.2-103
EFFECT OF RUDDER



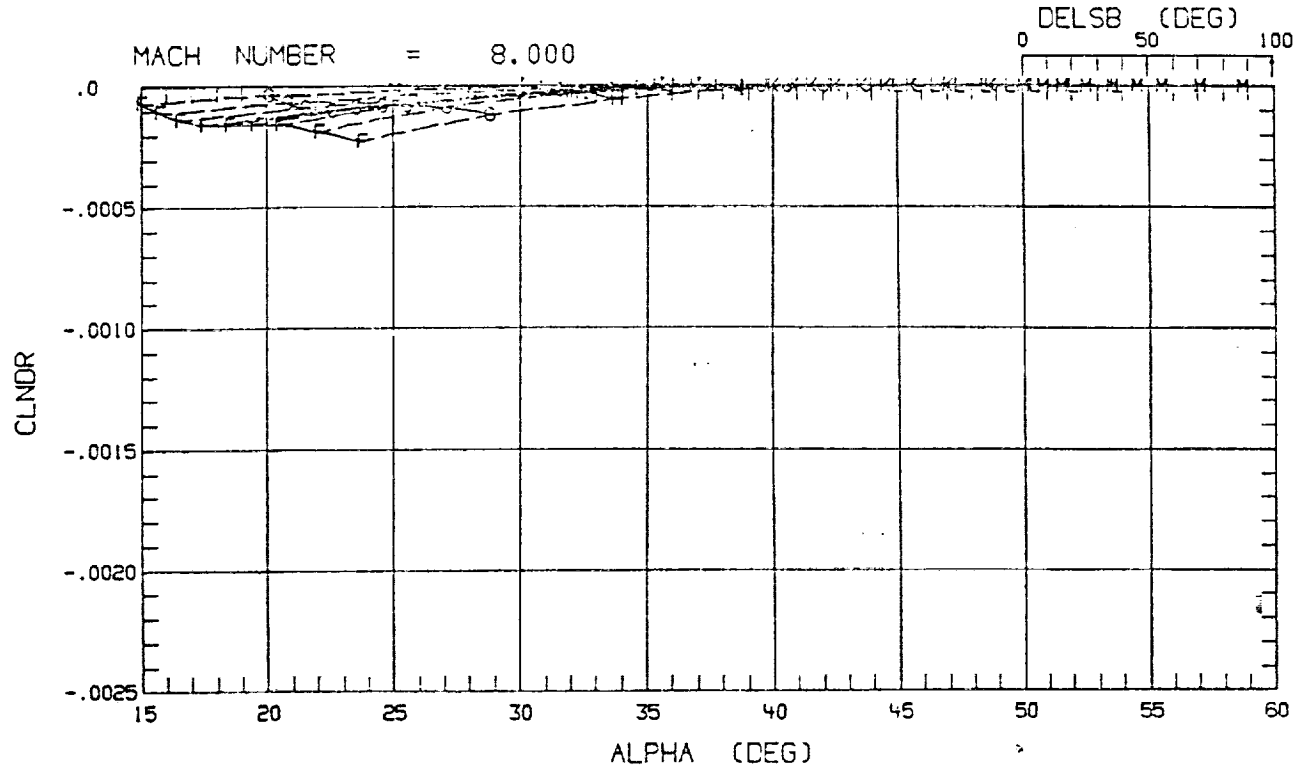
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00021	-0.00019	-0.00017	-0.00014	-0.00012	-0.00007	-0.00004	-0.00002
7.500	-0.00030	-0.00028	-0.00024	-0.00020	-0.00017	-0.00011	-0.00007	-0.00004
15.000	-0.00039	-0.00035	-0.00031	-0.00026	-0.00021	-0.00014	-0.00009	-0.00005
25.000	-0.00046	-0.00041	-0.00036	-0.00030	-0.00024	-0.00016	-0.00010	-0.00006
35.000	-0.00048	-0.00042	-0.00037	-0.00031	-0.00025	-0.00016	-0.00009	-0.00005
45.000	-0.00047	-0.00040	-0.00036	-0.00031	-0.00024	-0.00016	-0.00008	-0.00004
55.000	-0.00044	-0.00038	-0.00034	-0.00029	-0.00025	-0.00016	-0.00008	-0.00003
70.000	-0.00043	-0.00040	-0.00036	-0.00030	-0.00028	-0.00019	-0.00009	-0.00003
87.200	-0.00046	-0.00044	-0.00041	-0.00037	-0.00033	-0.00023	-0.00012	-0.00006

ENGINEER
DATE

FIGURE 4.2.1.2-104
EFFECT OF RUDDER



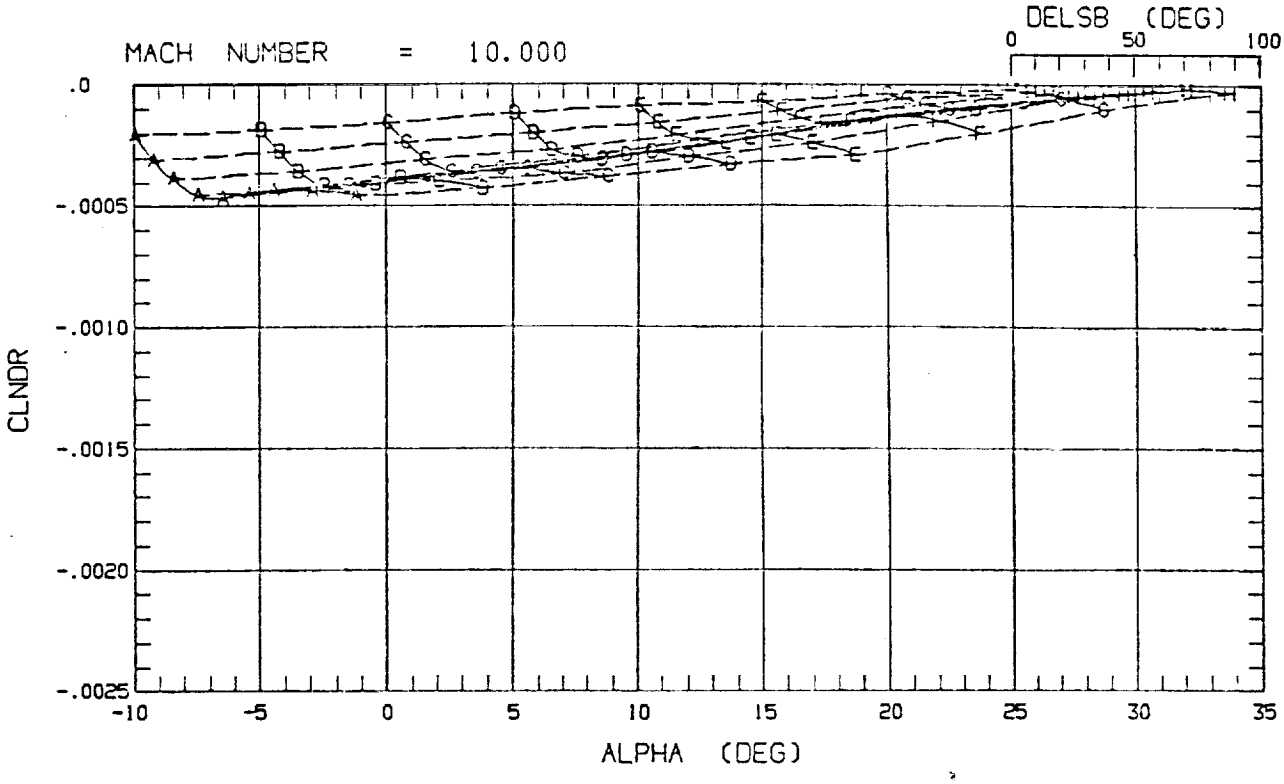
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00007	-0.00004	-0.00002	0.0	0.0	0.0	0.0	0.0
7.500	-0.00011	-0.00007	-0.00004	-0.00001	0.0	0.0	0.0	0.0
15.000	-0.00014	-0.00009	-0.00005	-0.00002	0.0	0.0	0.0	0.0
25.000	-0.00016	-0.00010	-0.00006	-0.00003	0.0	0.0	0.0	0.0
35.000	-0.00016	-0.00009	-0.00005	-0.00002	0.0	0.0	0.0	0.0
45.000	-0.00016	-0.00008	-0.00004	-0.00001	0.0	0.0	0.0	0.0
55.000	-0.00016	-0.00008	-0.00003	0.0	0.0	0.0	0.0	0.0
70.000	-0.00019	-0.00009	-0.00003	0.0	0.0	0.0	0.0	0.0
87.200	-0.00023	-0.00012	-0.00006	-0.00001	0.0	0.0	0.0	0.0

ENGINEER
DATE

FIGURE 4.2.1.2-105
EFFECT OF RUDDER

CI 71-SH-0060 IM



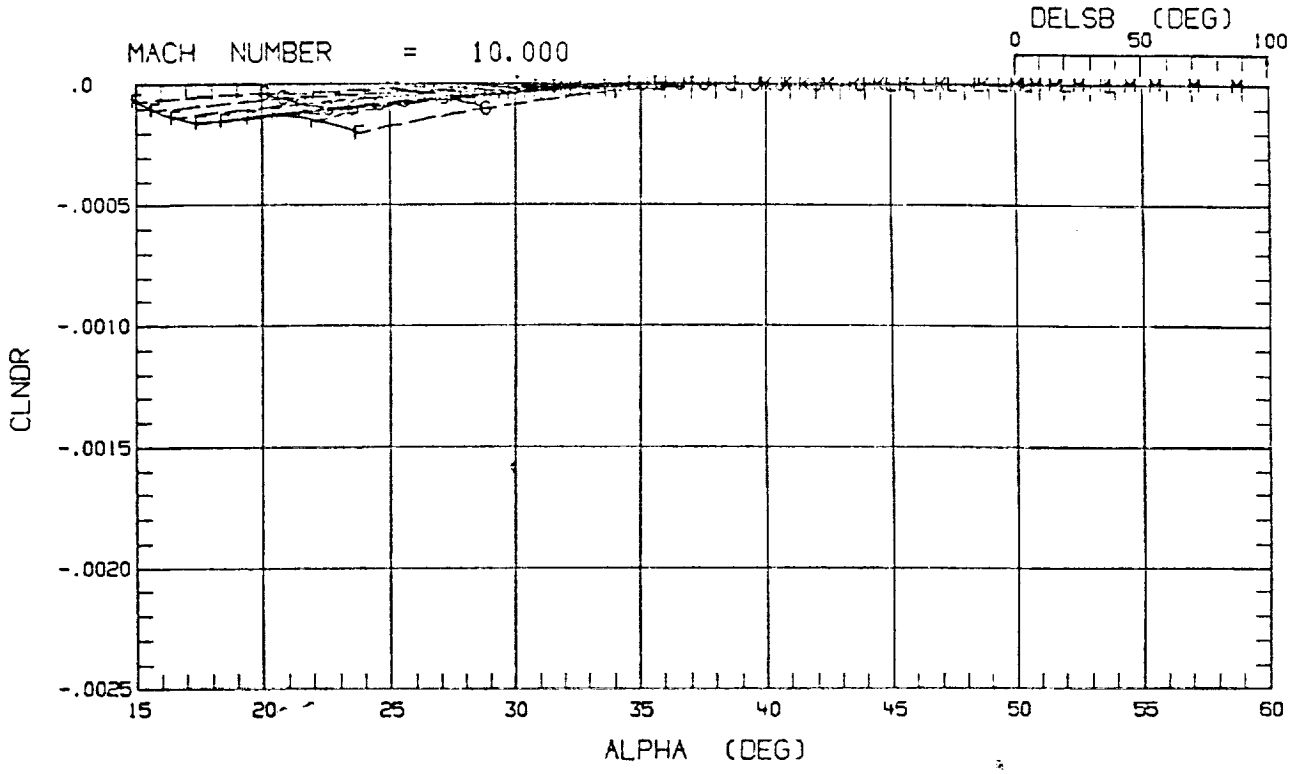
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00021	-0.00019	-0.00016	-0.00012	-0.00009	-0.00007	-0.00004	-0.00002
7.500	-0.00031	-0.00028	-0.00024	-0.00020	-0.00016	-0.00011	-0.00006	-0.00003
15.000	-0.00039	-0.00036	-0.00031	-0.00027	-0.00021	-0.00014	-0.00008	-0.00004
25.000	-0.00046	-0.00042	-0.00036	-0.00030	-0.00023	-0.00016	-0.00010	-0.00005
35.000	-0.00047	-0.00042	-0.00036	-0.00031	-0.00024	-0.00015	-0.00010	-0.00005
45.000	-0.00045	-0.00041	-0.00035	-0.00029	-0.00022	-0.00014	-0.00008	-0.00004
55.000	-0.00044	-0.00039	-0.00035	-0.00028	-0.00021	-0.00013	-0.00007	-0.00003
70.000	-0.00044	-0.00040	-0.00037	-0.00030	-0.00024	-0.00015	-0.00006	-0.00002
87.200	-0.00046	-0.00043	-0.00038	-0.00033	-0.00029	-0.00020	-0.00010	-0.00003

ENGINEER
DATE 10-3-78

FIGURE 4.2.1.2-106
EFFECT OF RUDDER



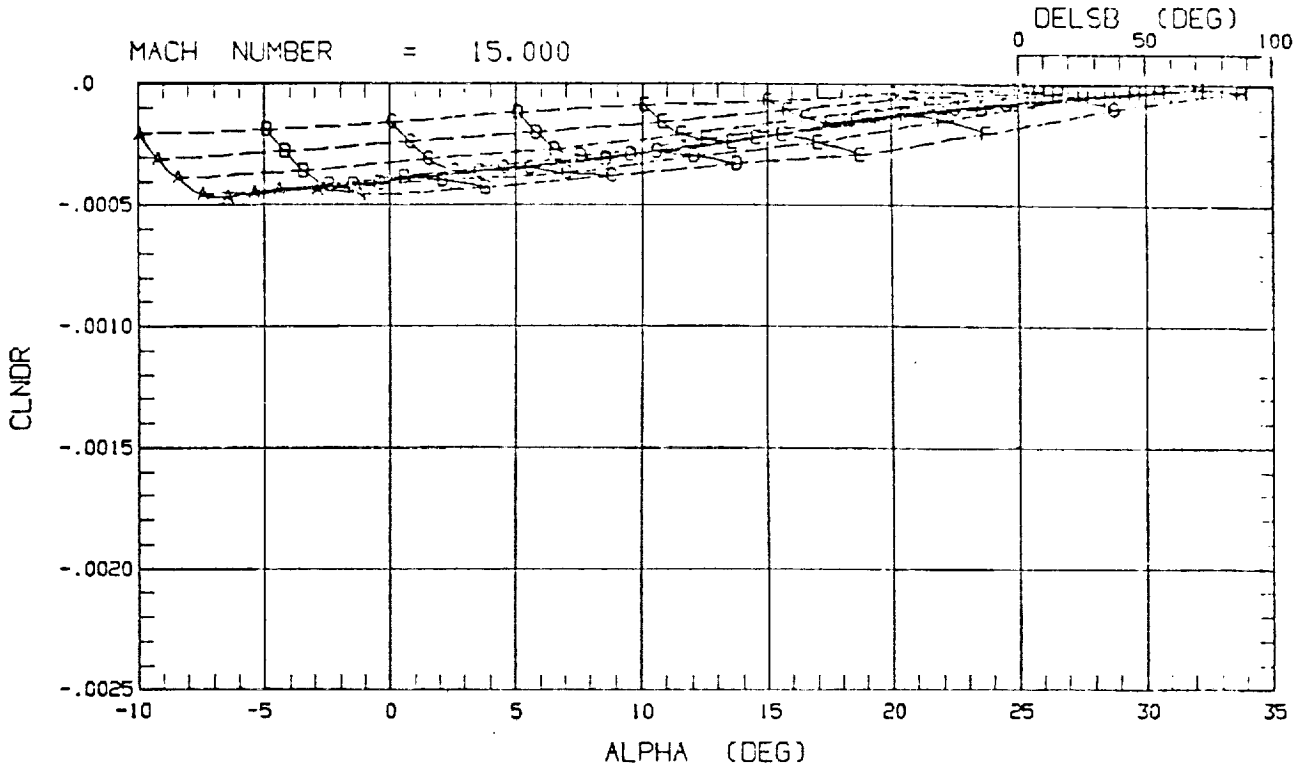
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00007	-0.00004	-0.00002	0.0	0.0	0.0	0.0	0.0
7.500	-0.00011	-0.00006	-0.00003	-0.00001	0.0	0.0	0.0	0.0
15.000	-0.00014	-0.00008	-0.00004	-0.00001	0.0	0.0	0.0	0.0
25.000	-0.00016	-0.00010	-0.00005	-0.00002	0.0	0.0	0.0	0.0
35.000	-0.00015	-0.00010	-0.00005	-0.00001	0.0	0.0	0.0	0.0
45.000	-0.00014	-0.00008	-0.00004	0.0	0.0	0.0	0.0	0.0
55.000	-0.00013	-0.00007	-0.00003	0.0	0.0	0.0	0.0	0.0
70.000	-0.00015	-0.00006	-0.00002	0.0	0.0	0.0	0.0	0.0
87.200	-0.00020	-0.00010	-0.00003	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE 10-2-78

FIGURE 4.2.1.2-107
EFFECT OF RUDDER



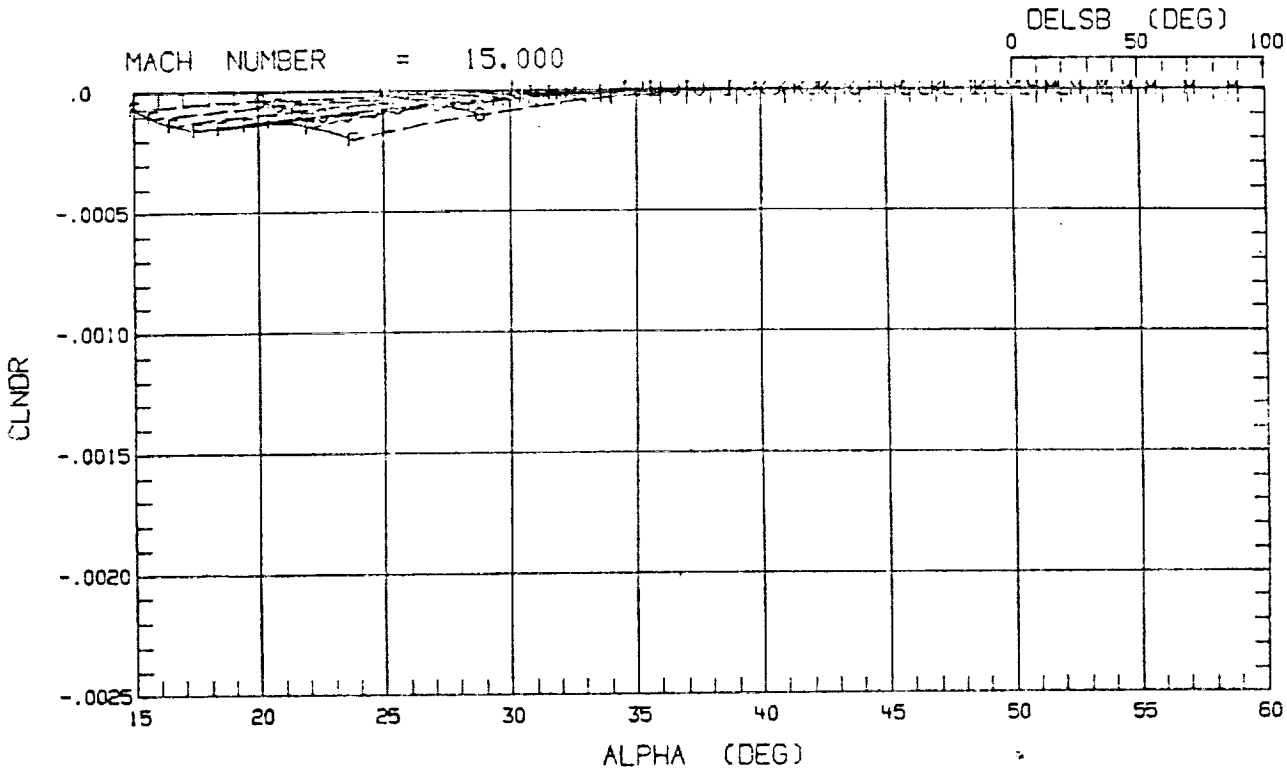
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00021	-0.00019	-0.00016	-0.00012	-0.00009	-0.00007	-0.00004	-0.00002
7.500	-0.00031	-0.00028	-0.00024	-0.00020	-0.00016	-0.00011	-0.00006	-0.00003
15.000	-0.00039	-0.00036	-0.00031	-0.00027	-0.00021	-0.00014	-0.00008	-0.00004
25.000	-0.00046	-0.00042	-0.00036	-0.00030	-0.00023	-0.00016	-0.00010	-0.00005
35.000	-0.00047	-0.00042	-0.00036	-0.00031	-0.00024	-0.00015	-0.00010	-0.00005
45.000	-0.00045	-0.00041	-0.00035	-0.00029	-0.00022	-0.00014	-0.00008	-0.00004
55.000	-0.00044	-0.00039	-0.00035	-0.00028	-0.00021	-0.00013	-0.00007	-0.00003
70.000	-0.00044	-0.00040	-0.00037	-0.00030	-0.00024	-0.00015	-0.00006	-0.00002
87.200	-0.00046	-0.00043	-0.00038	-0.00033	-0.00029	-0.00020	-0.00010	-0.00003

ENGINEER
DATE

FIGURE 4.2.1.2-108
EFFECT OF RUDDER

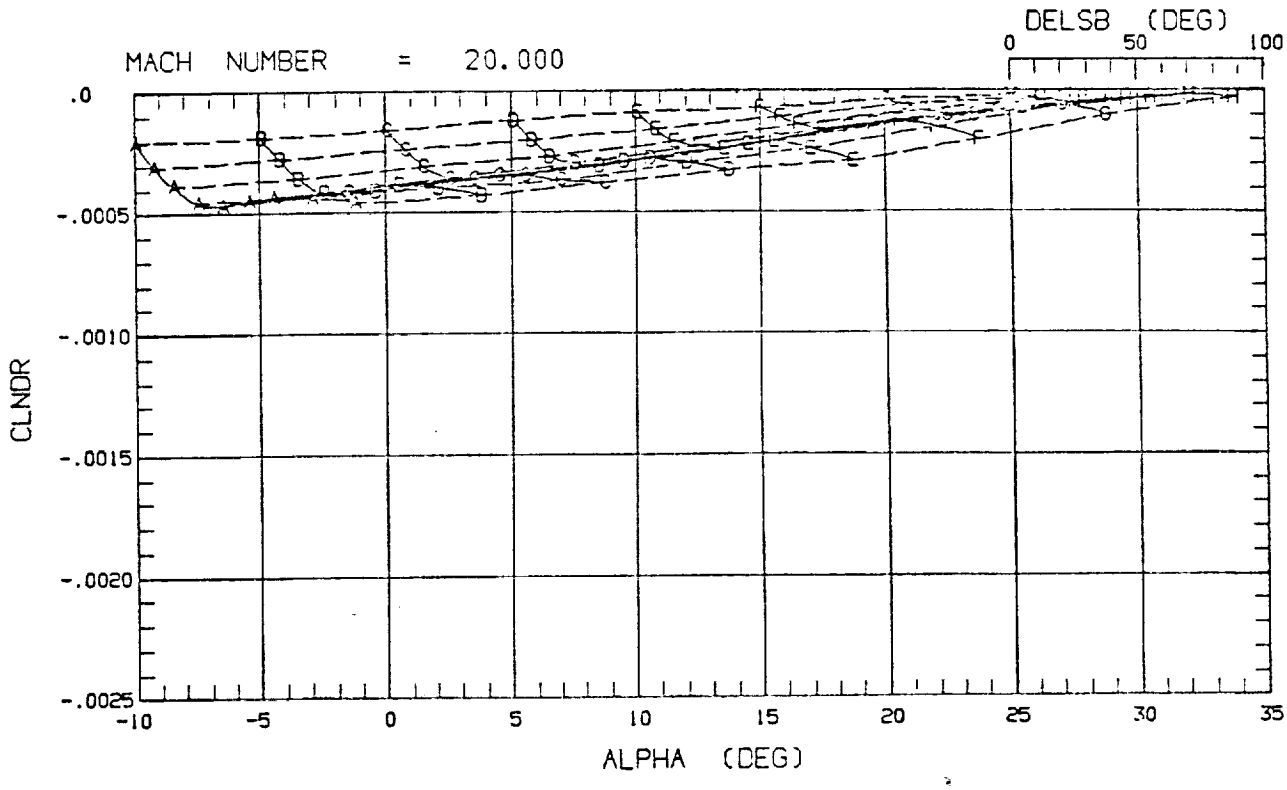


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00007	-0.00004	-0.00002	0.0	0.0	0.0	0.0	0.0
7.500	-0.00011	-0.00006	-0.00003	-0.00001	0.0	0.0	0.0	0.0
15.000	-0.00014	-0.00009	-0.00004	-0.00001	0.0	0.0	0.0	0.0
25.000	-0.00016	-0.00010	-0.00005	-0.00002	0.0	0.0	0.0	0.0
35.000	-0.00015	-0.00010	-0.00005	-0.00001	0.0	0.0	0.0	0.0
45.000	-0.00014	-0.00008	-0.00004	0.0	0.0	0.0	0.0	0.0
55.000	-0.00013	-0.00007	-0.00003	0.0	0.0	0.0	0.0	0.0
70.000	-0.00015	-0.00006	-0.00002	0.0	0.0	0.0	0.0	0.0
87.200	-0.00020	-0.00010	-0.00003	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE 12-3-78

FIGURE 4.2.1.2-109
EFFECT OF RUDDER



CONFIGURATION

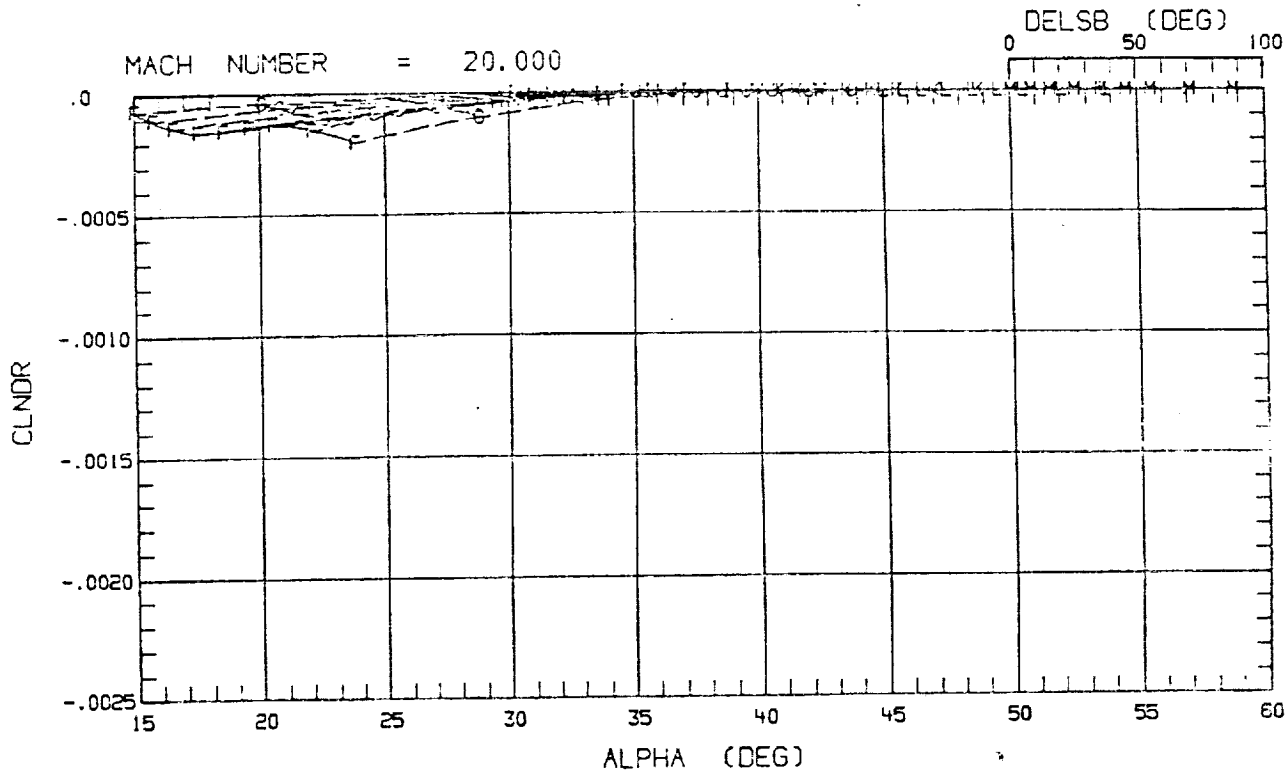
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00021	-0.00019	-0.00016	-0.00012	-0.00009	-0.00007	-0.00004	-0.00002
7.500	-0.00031	-0.00028	-0.00024	-0.00020	-0.00016	-0.00011	-0.00006	-0.00003
15.000	-0.00039	-0.00036	-0.00031	-0.00027	-0.00021	-0.00014	-0.00008	-0.00004
25.000	-0.00046	-0.00042	-0.00036	-0.00030	-0.00023	-0.00016	-0.00010	-0.00005
35.000	-0.00047	-0.00042	-0.00036	-0.00031	-0.00024	-0.00015	-0.00010	-0.00005
45.000	-0.00045	-0.00041	-0.00035	-0.00029	-0.00022	-0.00014	-0.00008	-0.00004
55.000	-0.00044	-0.00039	-0.00035	-0.00028	-0.00021	-0.00013	-0.00007	-0.00003
70.000	-0.00044	-0.00040	-0.00037	-0.00030	-0.00024	-0.00015	-0.00006	-0.00002
87.200	-0.00046	-0.00043	-0.00038	-0.00033	-0.00029	-0.00020	-0.00010	-0.00003

ENGINEER [illegible]
DATE 12-5-7F

FIGURE 4.2.1.2-110
EFFECT OF RUDDER

S1 7_ -5.1-CCEO IM



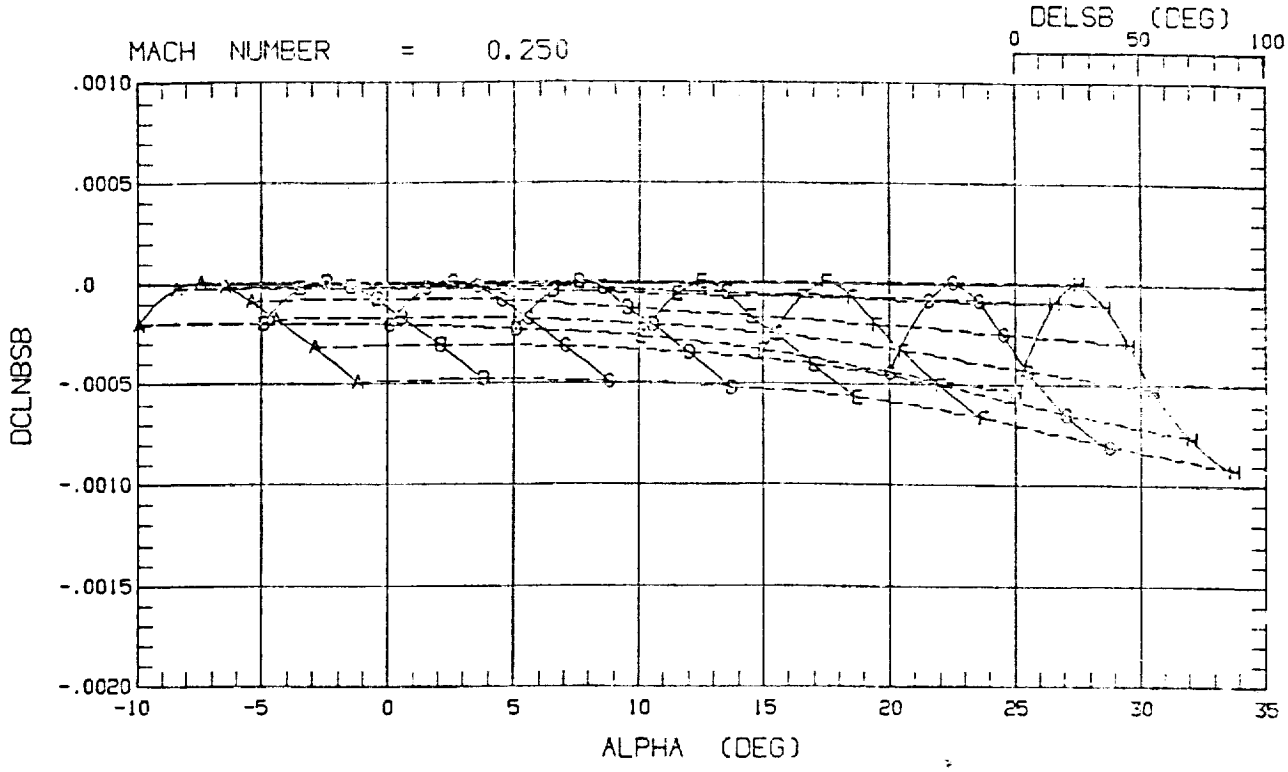
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER YAWING MOMENT DERIVATIVE							
0.0	-0.00007	-0.00004	-0.00002	0.0	0.0	0.0	0.0	0.0
7.500	-0.00011	-0.00006	-0.00003	-0.00001	0.0	0.0	0.0	0.0
15.000	-0.00014	-0.00008	-0.00004	-0.00001	0.0	0.0	0.0	0.0
25.000	-0.00016	-0.00010	-0.00005	-0.00002	0.0	0.0	0.0	0.0
35.000	-0.00015	-0.00010	-0.00005	-0.00001	0.0	0.0	0.0	0.0
45.000	-0.00014	-0.00008	-0.00004	0.0	0.0	0.0	0.0	0.0
55.000	-0.00013	-0.00007	-0.00003	0.0	0.0	0.0	0.0	0.0
70.000	-0.00015	-0.00006	-0.00002	0.0	0.0	0.0	0.0	0.0
87.200	-0.00020	-0.00010	-0.00003	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.2-111
EFFECT OF RUDDER



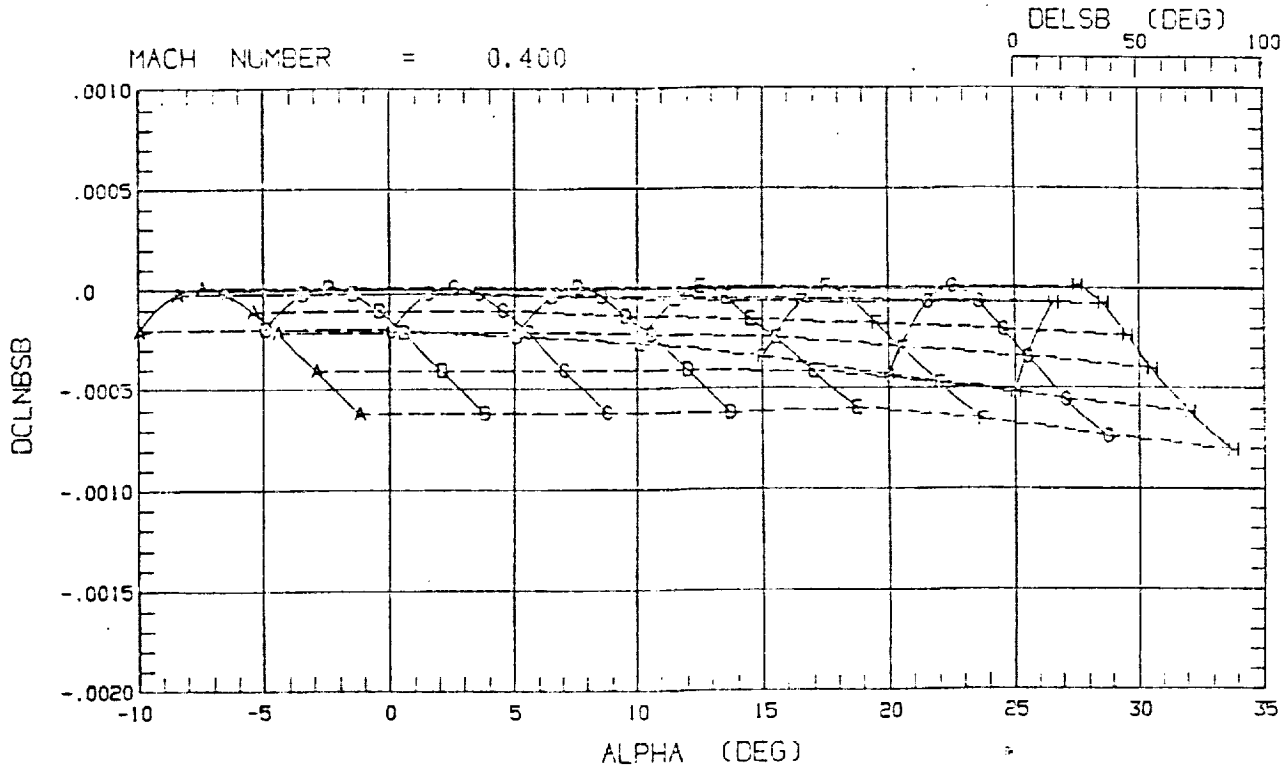
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00021	-0.00020	-0.00021	-0.00023	-0.00027	-0.00034	-0.00045	-0.00054
15.000	-0.00003	-0.00003	-0.00003	-0.00004	-0.00006	-0.00007	-0.00009	-0.00010
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00002	-0.00002	-0.00002	-0.00003	-0.00005	-0.00007	-0.00009	-0.00011
45.000	-0.00009	-0.00008	-0.00009	-0.00013	-0.00017	-0.00021	-0.00026	-0.00030
55.000	-0.00018	-0.00017	-0.00018	-0.00021	-0.00026	-0.00034	-0.00044	-0.00053
70.000	-0.00032	-0.00031	-0.00032	-0.00035	-0.00041	-0.00051	-0.00065	-0.00077
87.200	-0.00049	-0.00048	-0.00049	-0.00052	-0.00057	-0.00067	-0.00081	-0.00093

ENGINEER LL
DATE 9-18-75

FIGURE 4.2.1.2-112
EFFECT OF SPEEDBRAKE



CONFIGURATION

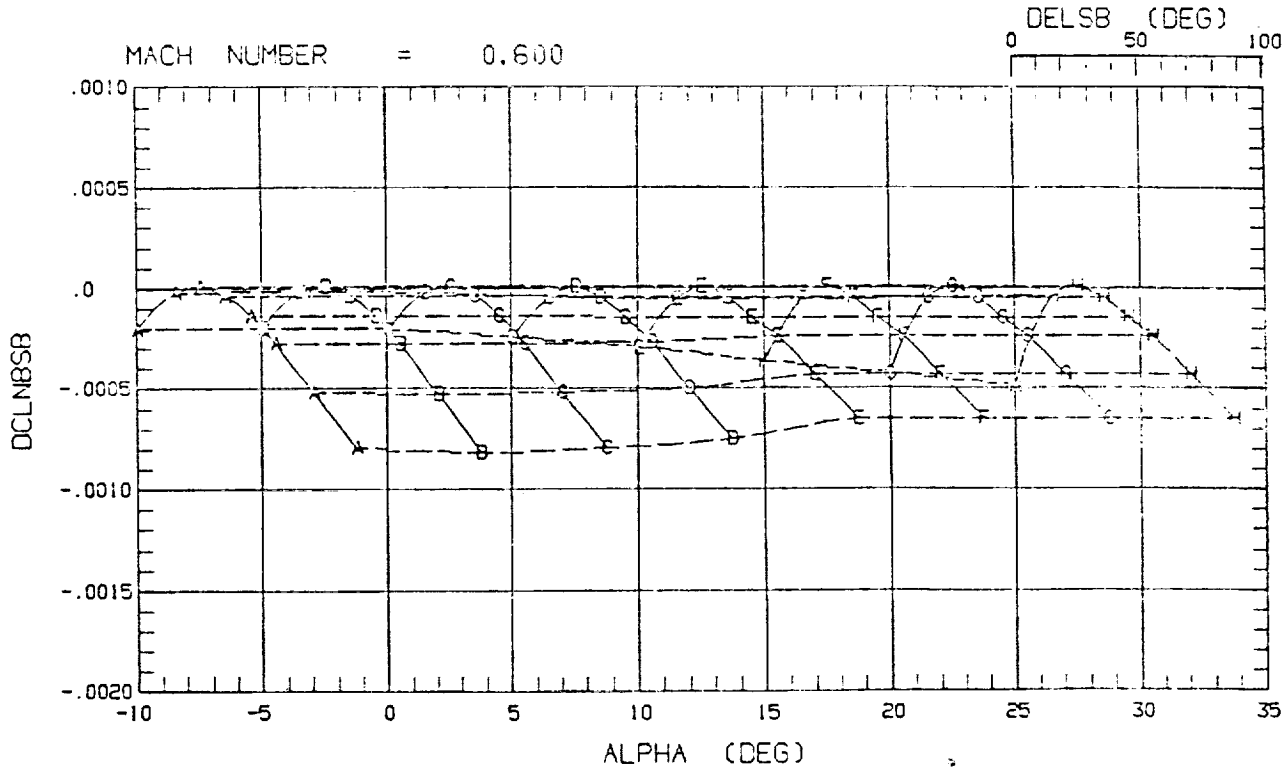
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00021	-0.00020	-0.00021	-0.00024	-0.00029	-0.00035	-0.00044	-0.00052
15.000	-0.00003	-0.00003	-0.00003	-0.00004	-0.00006	-0.00007	-0.00007	-0.00008
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00003	-0.00003	-0.00003	-0.00004	-0.00005	-0.00006	-0.00007	-0.00008
45.000	-0.00011	-0.00011	-0.00011	-0.00014	-0.00016	-0.00018	-0.00021	-0.00024
55.000	-0.00022	-0.00022	-0.00022	-0.00023	-0.00025	-0.00030	-0.00035	-0.00041
70.000	-0.00041	-0.00041	-0.00041	-0.00041	-0.00042	-0.00048	-0.00056	-0.00062
87.200	-0.00062	-0.00062	-0.00062	-0.00062	-0.00060	-0.00066	-0.00074	-0.00081

ENGINEER LL
DATE 9-15-78

FIGURE 4.2.1.2-113
EFFECT OF SPEEDBRAKE

SV-0000 IM



CONFIGURATION

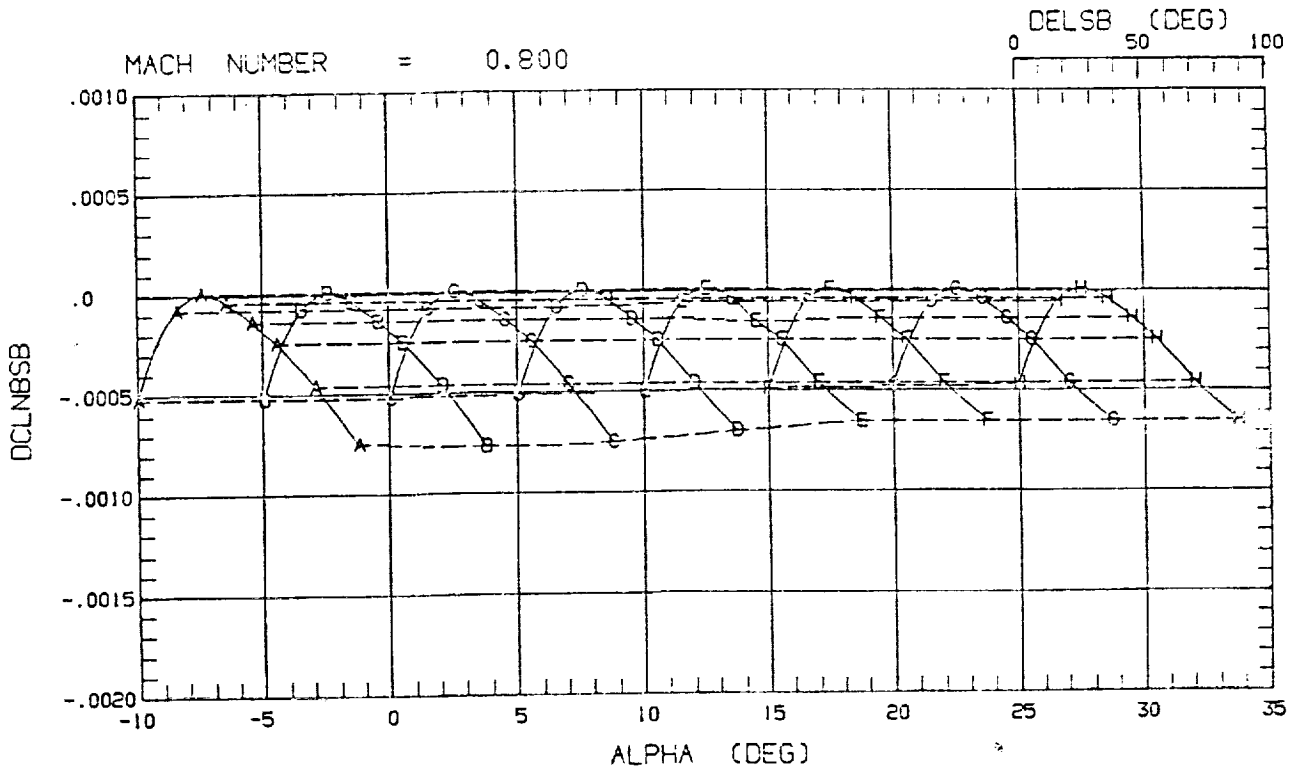
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00021	-0.00020	-0.00021	-0.00025	-0.00030	-0.00037	-0.00043	-0.00049
15.000	-0.00003	-0.00002	-0.00003	-0.00005	-0.00006	-0.00006	-0.00005	-0.00004
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00004	-0.00004	-0.00004	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005
45.000	-0.00014	-0.00014	-0.00014	-0.00015	-0.00015	-0.00015	-0.00015	-0.00015
55.000	-0.00028	-0.00028	-0.00028	-0.00027	-0.00024	-0.00024	-0.00024	-0.00024
70.000	-0.00052	-0.00053	-0.00052	-0.00050	-0.00043	-0.00043	-0.00043	-0.00043
87.200	-0.00080	-0.00082	-0.00080	-0.00075	-0.00065	-0.00065	-0.00065	-0.00065

ENGINEER LL
DATE 9-18-75

FIGURE 4.2.1.2-114
EFFECT OF SPEEDBRAKE

SI Version-CCCO IM



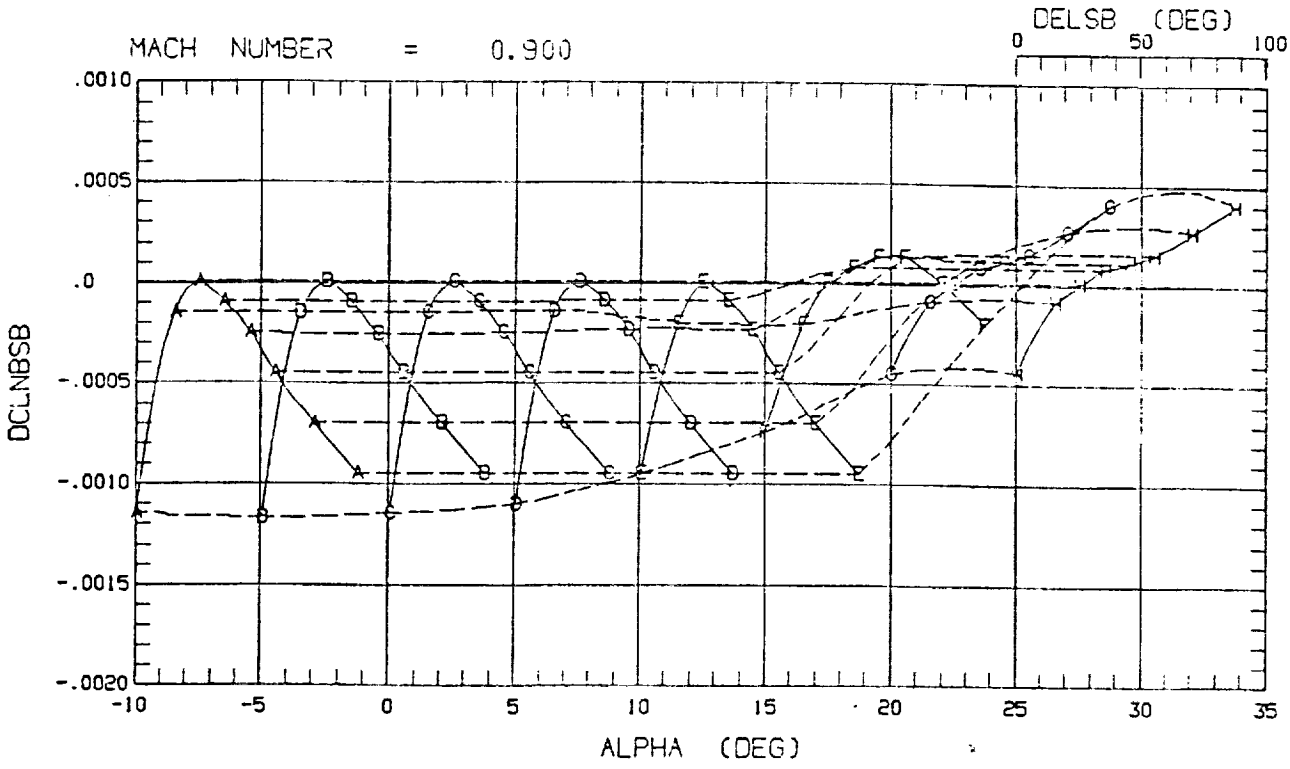
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00052	-0.00052	-0.00052	-0.00051	-0.00050	-0.00049	-0.00048	-0.00047
15.000	-0.00008	-0.00008	-0.00008	-0.00008	-0.00006	-0.00006	-0.00006	-0.00006
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00004	-0.00004	-0.00004	-0.00004	-0.00004	-0.00004	-0.00004	-0.00004
45.000	-0.00014	-0.00014	-0.00014	-0.00014	-0.00016	-0.00014	-0.00014	-0.00014
55.000	-0.00025	-0.00025	-0.00025	-0.00025	-0.00025	-0.00025	-0.00025	-0.00025
70.000	-0.00046	-0.00046	-0.00046	-0.00046	-0.00046	-0.00046	-0.00046	-0.00046
87.200	-0.00075	-0.00077	-0.00075	-0.00070	-0.00065	-0.00065	-0.00065	-0.00065

ENGINEER LL
DATE 9-18-75

FIGURE 4.2.1.2-115
EFFECT OF SPEEDBRAKE



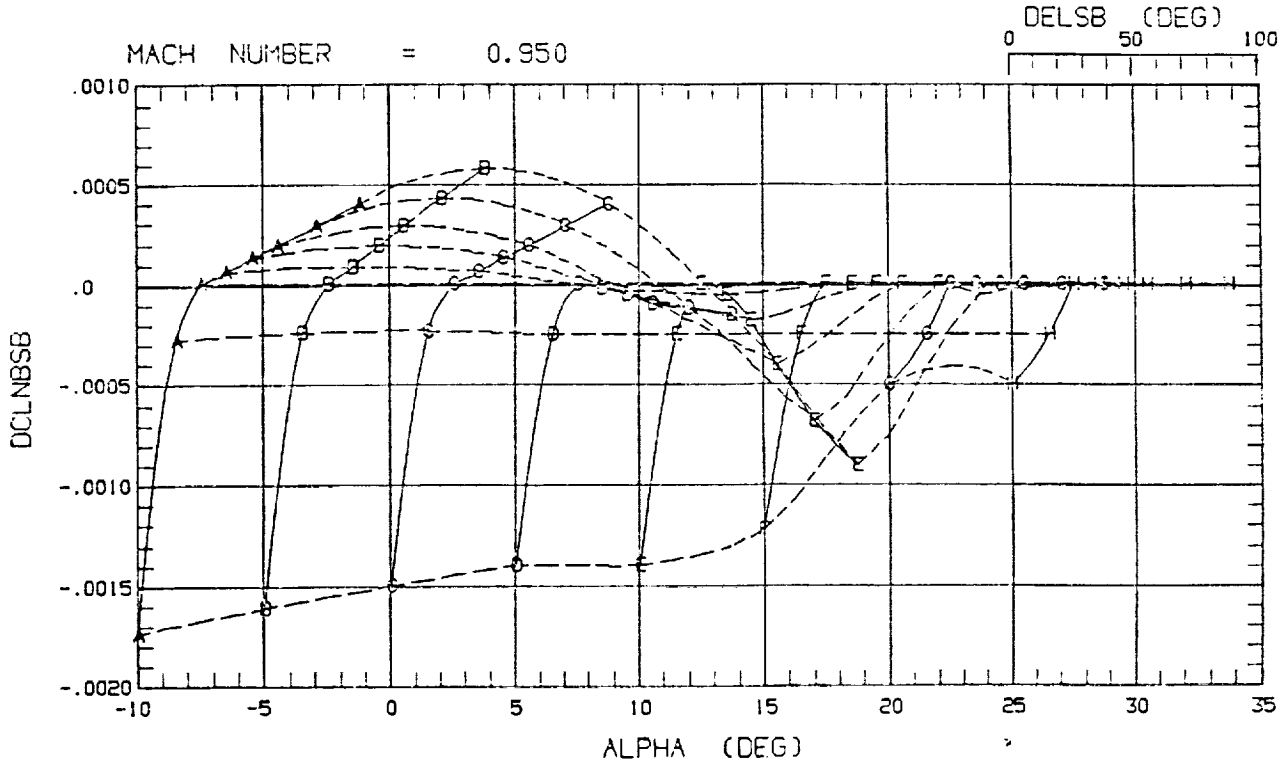
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1075.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00115	-0.00117	-0.00115	-0.00110	-0.00095	-0.00074	-0.00045	-0.00045
15.000	-0.00015	-0.00015	-0.00015	-0.00014	-0.00020	-0.00020	-0.00009	-0.00009
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00010	-0.00010	-0.00010	-0.00009	-0.00009	0.00008	0.00008	0.00008
45.000	-0.00025	-0.00026	-0.00025	-0.00023	-0.00023	0.00013	0.00011	0.00011
55.000	-0.00045	-0.00045	-0.00045	-0.00045	-0.00045	0.00013	0.00015	0.00015
70.000	-0.00070	-0.00070	-0.00070	-0.00070	-0.00070	0.0	0.00026	0.00026
87.200	-0.00095	-0.00095	-0.00095	-0.00095	-0.00095	-0.00020	0.00040	0.00040

ENGINEER ///
DATE 2-18-78

FIGURE 4.2.1.2-116
EFFECT OF SPEEDBRAKE



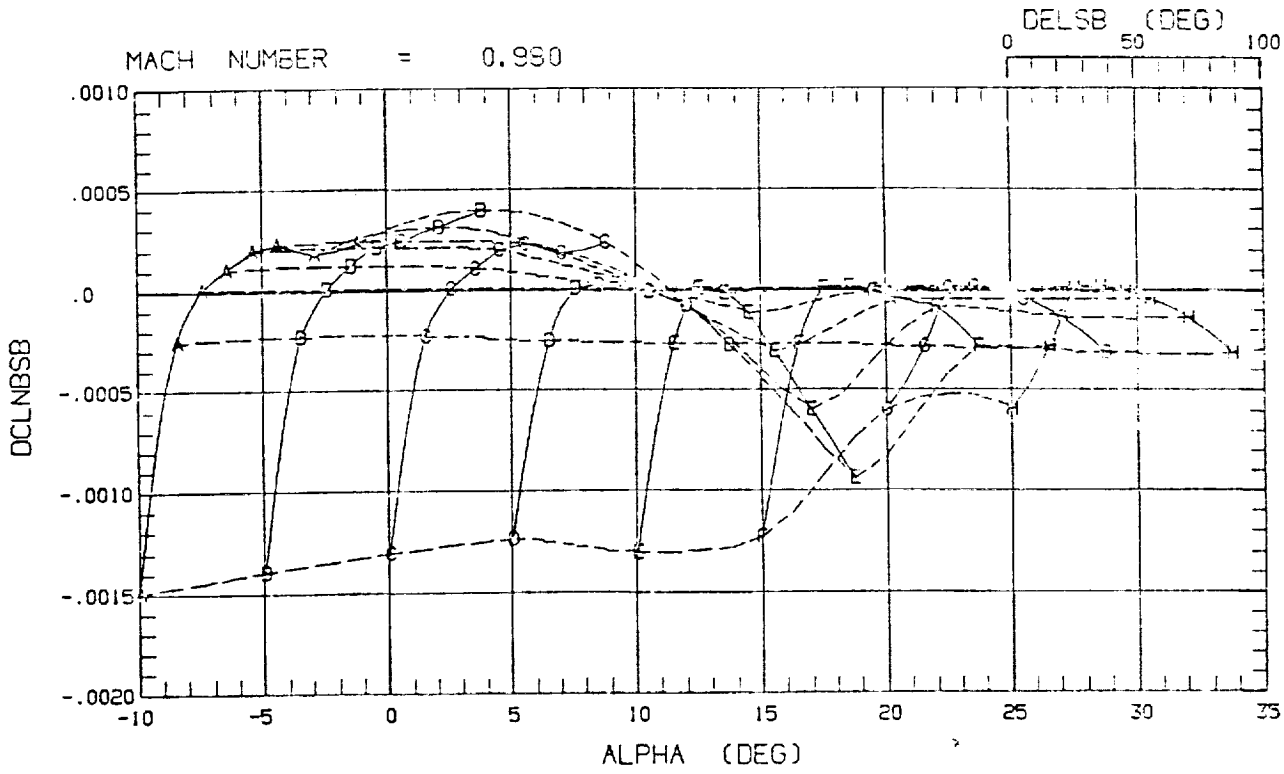
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00174	-0.00161	-0.00150	-0.00140	-0.00140	-0.00122	-0.00050	-0.00050
15.000	-0.00028	-0.00024	-0.00023	-0.00025	-0.00025	-0.00025	-0.00025	-0.00025
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00006	0.00009	0.00006	-0.00002	-0.00005	0.0	0.0	0.0
45.000	0.00013	0.00019	0.00013	-0.00005	-0.00018	0.0	0.0	0.0
55.000	0.00019	0.00029	0.00019	-0.00010	-0.00040	0.0	0.0	0.0
70.000	0.00029	0.00043	0.00029	-0.00012	-0.00068	0.0	0.0	0.0
87.200	0.00040	0.00058	0.00040	-0.00015	-0.00090	-0.00005	0.0	0.0

ENGINEER LL
DATE 9-15-78

FIGURE 4.2.1.2-117
EFFECT OF SPEEDBRAKE



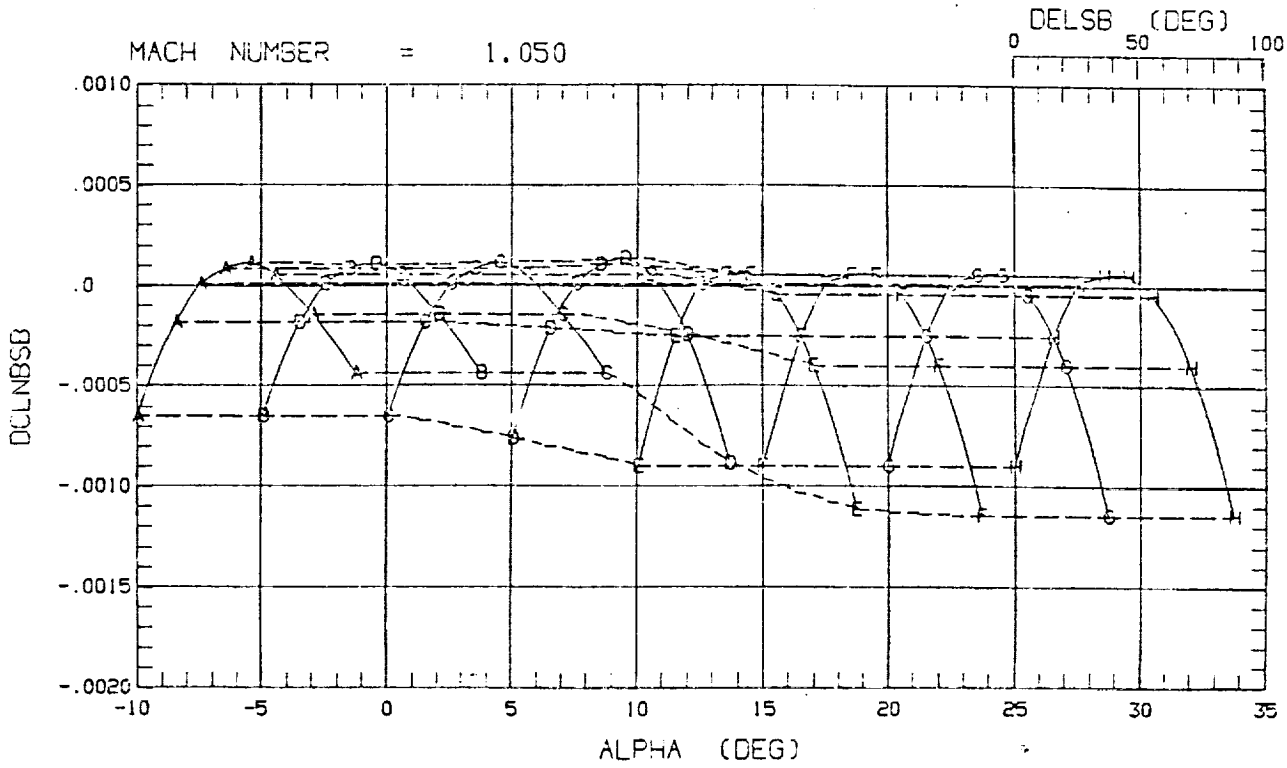
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00150	-0.00140	-0.00131	-0.00124	-0.00131	-0.00123	-0.00060	-0.00060
15.000	-0.00026	-0.00023	-0.00023	-0.00026	-0.00027	-0.00027	-0.00029	-0.00029
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00010	0.00012	0.00010	0.00002	-0.00002	0.00001	0.00001	0.00001
45.000	0.00019	0.00021	0.00019	0.00004	-0.00012	-0.00001	-0.00001	-0.00001
55.000	0.00022	0.00024	0.00022	-0.00001	-0.00031	-0.00005	-0.00005	-0.00005
70.000	0.00018	0.00031	0.00018	-0.00008	-0.00060	-0.00009	-0.00014	-0.00014
87.200	0.00023	0.00039	0.00023	-0.00028	-0.00094	-0.00029	-0.00032	-0.00032

ENGINEER LLL
DATE 7-15-28

FIGURE 4.2.1.2-118
EFFECT OF SPEEDBRAKE



CONFIGURATION

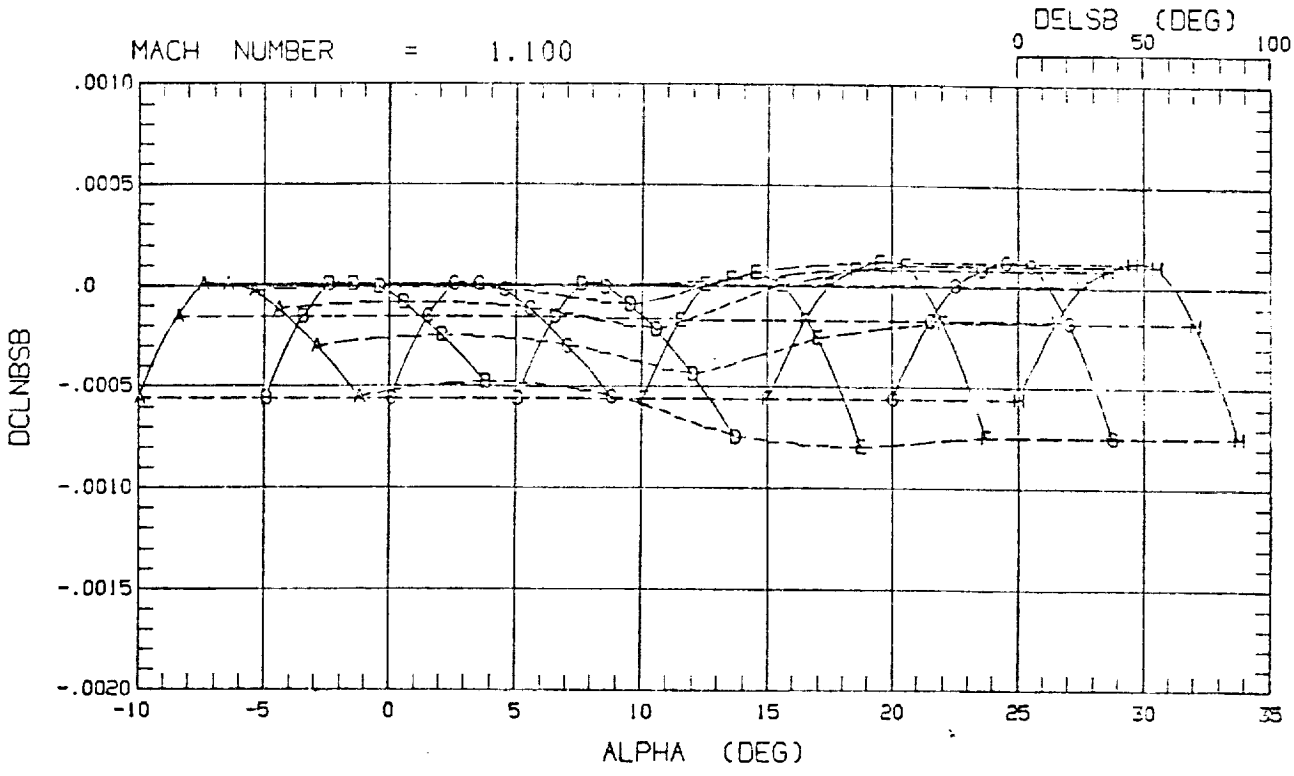
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00065	-0.00065	-0.00065	-0.00077	-0.00090	-0.00090	-0.00090	-0.00090
15.000	-0.00019	-0.00019	-0.00019	-0.00022	-0.00026	-0.00026	-0.00026	-0.00026
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00008	0.00008	0.00008	0.00010	0.00005	0.00005	0.00005	0.00005
45.000	0.00011	0.00010	0.00011	0.00013	0.00005	0.00005	0.00005	0.00005
55.000	0.00005	0.00005	0.00005	0.00005	-0.00005	-0.00005	-0.00005	-0.00005
70.000	-0.00015	-0.00015	-0.00015	-0.00025	-0.00040	-0.00040	-0.00040	-0.00040
87.200	-0.00044	-0.00044	-0.00044	-0.00089	-0.00112	-0.00115	-0.00115	-0.00115

ENGINEER [illegible]
DATE 7-18-78

FIGURE 4.2.1.2-119
EFFECT OF SPEEDBRAKE

[illegible] 0000 IM



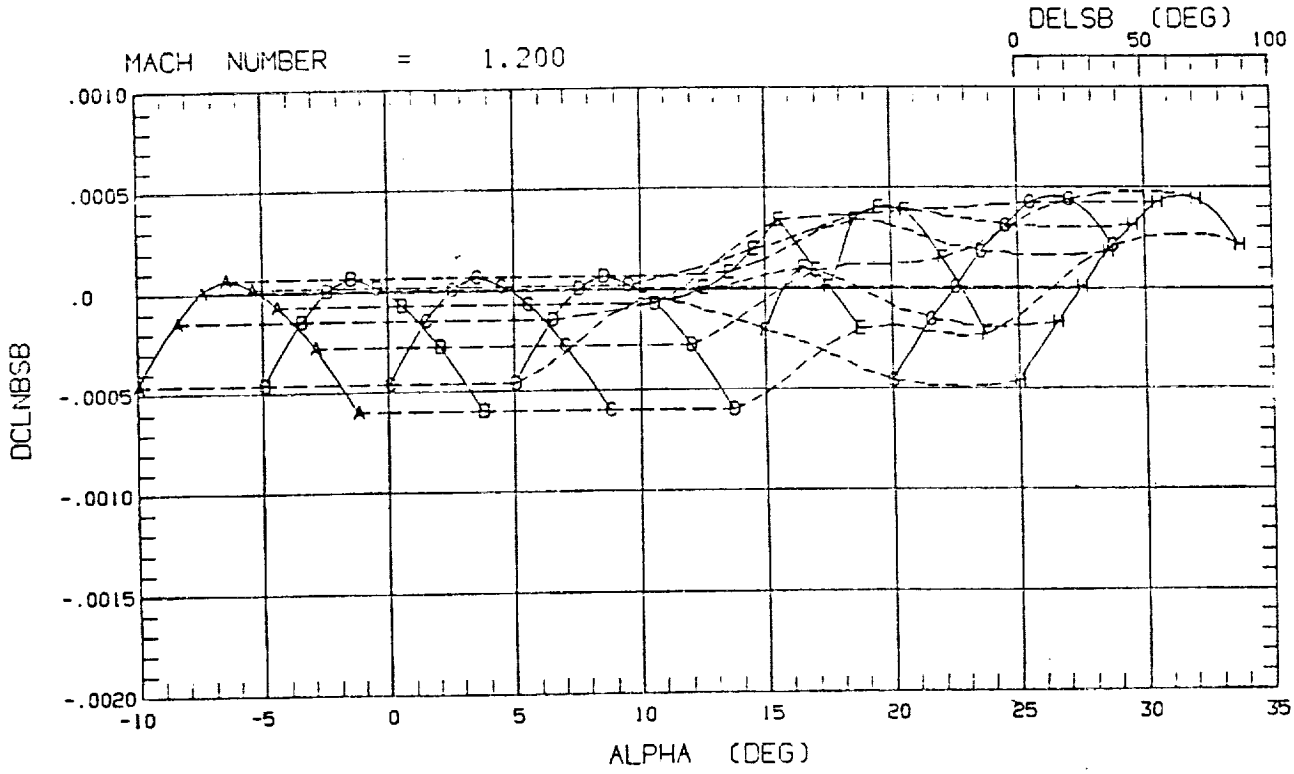
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00056	-0.00056	-0.00056	-0.00056	-0.00056	-0.00056	-0.00056	-0.00056
15.000	-0.00016	-0.00016	-0.00016	-0.00016	-0.00017	-0.00017	-0.00017	-0.00017
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	-0.00001	0.00003	0.00008	0.00008	0.00008
45.000	-0.00003	-0.00001	-0.00003	-0.00010	0.00006	0.00012	0.00012	0.00012
55.000	-0.00012	-0.00009	-0.00012	-0.00022	0.0	0.00010	0.00010	0.00010
70.000	-0.00030	-0.00025	-0.00030	-0.00044	-0.00026	-0.00018	-0.00018	-0.00018
87.200	-0.00055	-0.00048	-0.00055	-0.00075	-0.00080	-0.00075	-0.00075	-0.00075

ENGINEER LLL
DATE 8-15-78

FIGURE 4.2.1.2- 120
EFFECT OF SPEEDBRAKE

SD 72-SH-0060 IM



CONFIGURATION

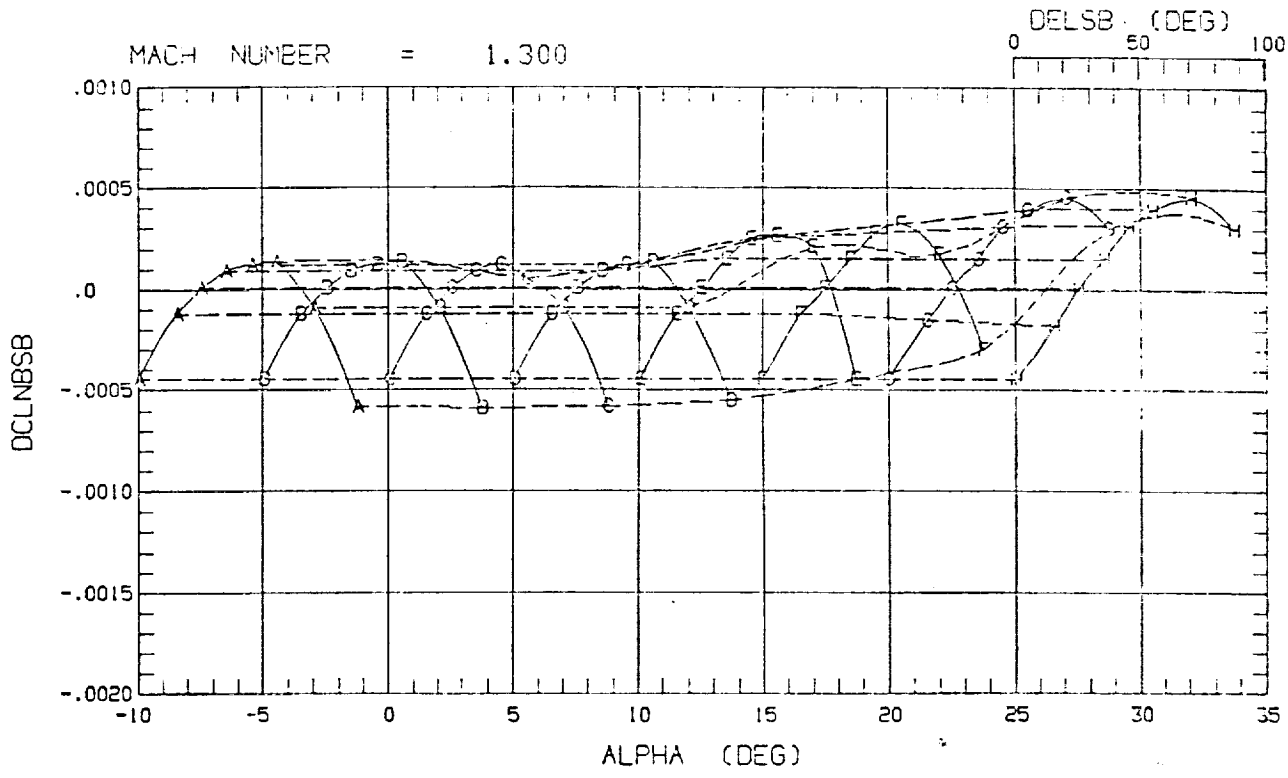
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT DERIVAT							
0.0	-0.00046	-0.00046	-0.00046	-0.00046	-0.00005	-0.00021	-0.00046	-0.00046
15.000	-0.00015	-0.00015	-0.00015	-0.00015	-0.00004	0.00010	-0.00016	-0.00017
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00006	0.00006	0.00006	0.00006	0.00008	0.00034	0.00018	0.00018
45.000	0.00002	0.00002	0.00002	0.00002	0.00013	0.00040	0.00031	0.00031
55.000	-0.00007	-0.00007	-0.00007	-0.00007	0.00034	0.00038	0.00042	0.00042
70.000	-0.00028	-0.00028	-0.00028	-0.00028	0.00009	0.00015	0.00044	0.00044
87.200	-0.00060	-0.00060	-0.00060	-0.00060	-0.00020	-0.00023	0.00021	0.00021

ENGINEER [illegible]
DATE 10-3-78

FIGURE 4.2.1.2-121
EFFECT OF SPEEDBRAKE

[illegible] CCEC IM



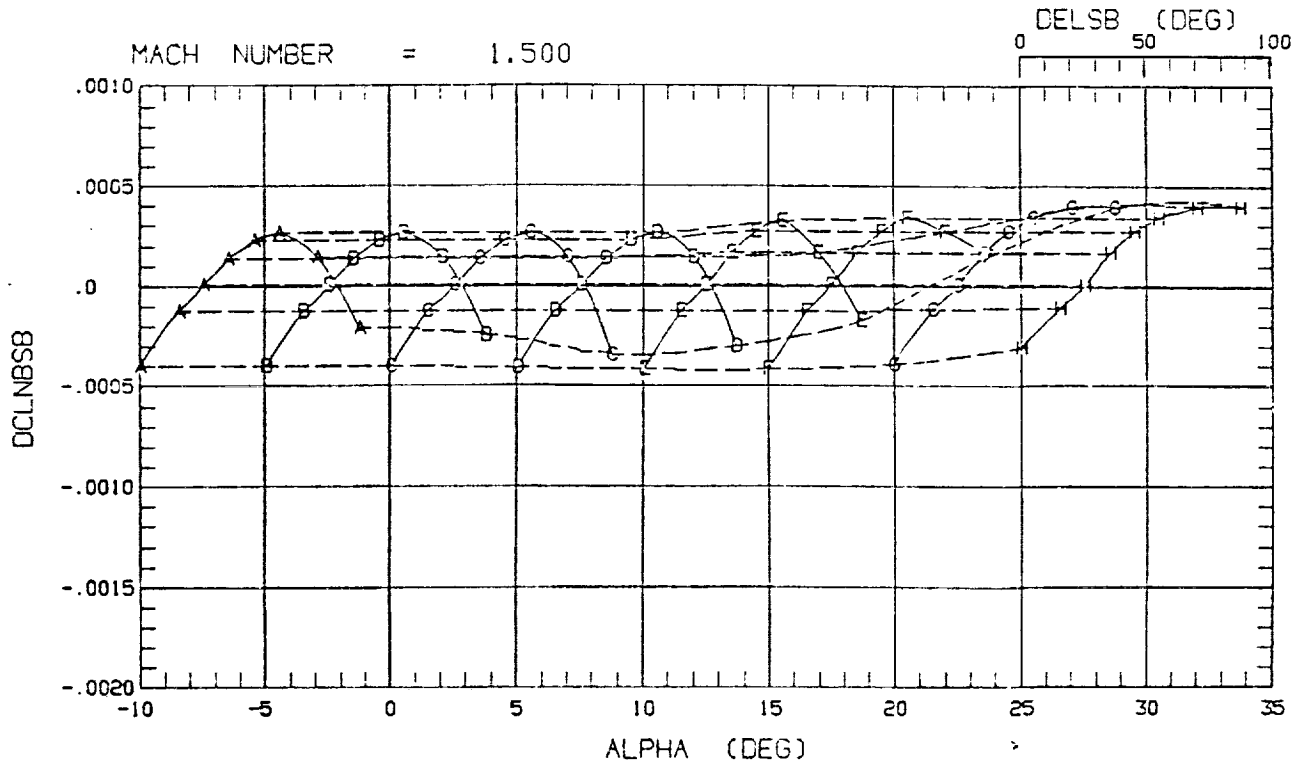
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00045	-0.00045	-0.00045	-0.00045	-0.00045	-0.00045	-0.00045	-0.00045
15.000	-0.00013	-0.00013	-0.00013	-0.00013	-0.00013	-0.00013	-0.00016	-0.00019
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00009	0.00009	0.00009	0.00009	0.00015	0.00015	0.00015	0.00015
45.000	0.00012	0.00012	0.00012	0.00012	0.00025	0.00028	0.00031	0.00031
55.000	0.00013	0.00013	0.00005	0.00013	0.00026	0.00032	0.00039	0.00039
70.000	-0.00010	-0.00010	-0.00010	-0.00010	0.00021	0.00017	0.00045	0.00045
87.200	-0.00058	-0.00059	-0.00058	-0.00055	-0.00045	-0.00030	0.00030	0.00030

ENGINEER LLL
DATE 9-18-75

FIGURE 4.2.1.2-122
EFFECT OF SPEEDBRAKE



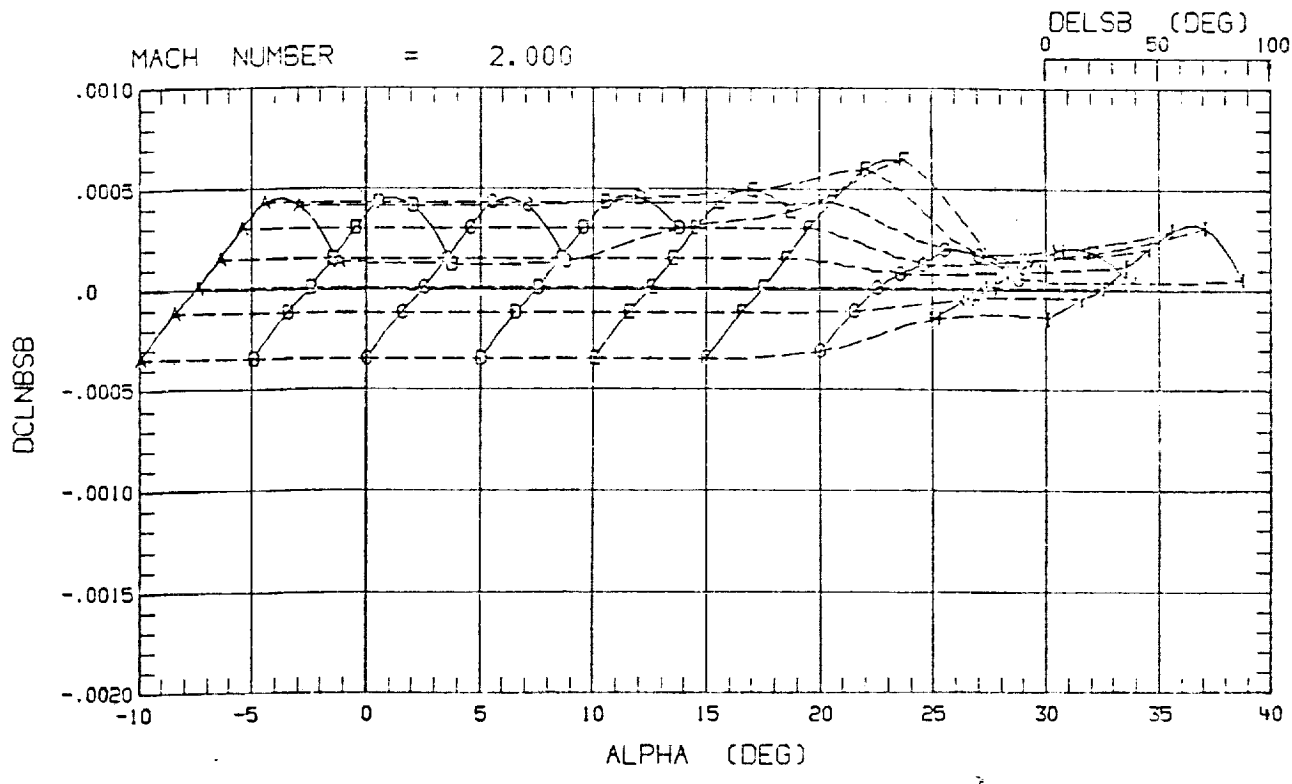
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00040	-0.00040	-0.00040	-0.00041	-0.00042	-0.00042	-0.00039	-0.00031
15.000	-0.00013	-0.00013	-0.00013	-0.00013	-0.00013	-0.00013	-0.00012	-0.00011
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00013	0.00013	0.00013	0.00013	0.00016	0.00016	0.00016	0.00016
45.000	0.00022	0.00022	0.00022	0.00022	0.00027	0.00027	0.00027	0.00027
55.000	0.00026	0.00026	0.00026	0.00026	0.00032	0.00034	0.00034	0.00034
70.000	0.00014	0.00014	0.00014	0.00014	0.00016	0.00027	0.00039	0.00039
87.200	-0.00021	-0.00025	-0.00035	-0.00030	-0.00017	0.00015	0.00039	0.00039

ENGINEER LLL
DATE 9-25-78

FIGURE 4.2.1.2-123
EFFECT OF SPEEDBRAKE



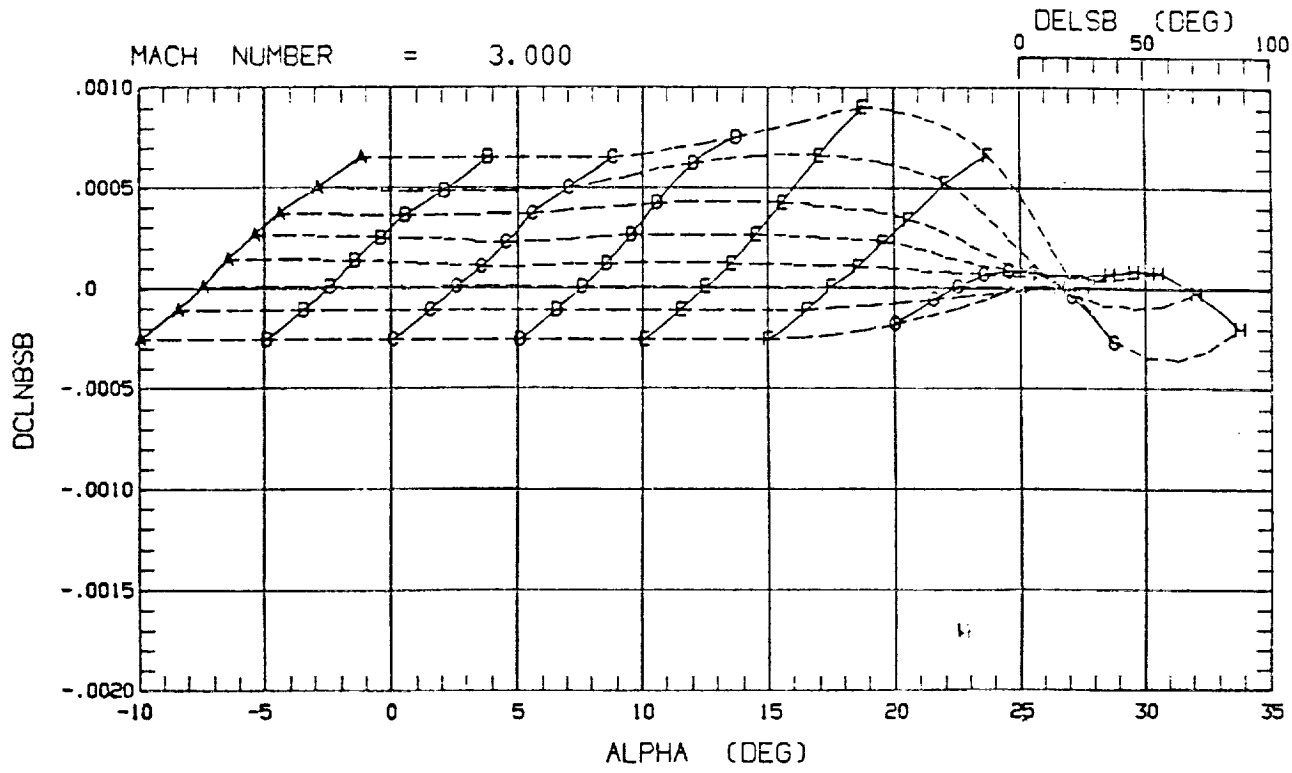
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.								
0.0	-0.00035	-0.00035	-0.00035	-0.00035	-0.00035	-0.00035	-0.00031	-0.00015	-0.00015
15.000	-0.00012	-0.00012	-0.00012	-0.00012	-0.00012	-0.00012	-0.00011	-0.00005	-0.00005
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00007	0.00008	0.00011
45.000	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00012	0.00014	0.00020
55.000	0.00043	0.00043	0.00043	0.00043	0.00043	0.00043	0.00019	0.00019	0.00029
70.000	0.00041	0.00041	0.00041	0.00045	0.00049	0.00060	0.00016	0.00018	0.00031
87.200	0.00013	0.00012	0.00013	0.00030	0.00038	0.00064	0.00005	0.00003	0.00005

ENGINEER LLL
DATE 9-15-78

FIGURE 4.2.1.2-124
EFFECT OF SPEEDBRAKE



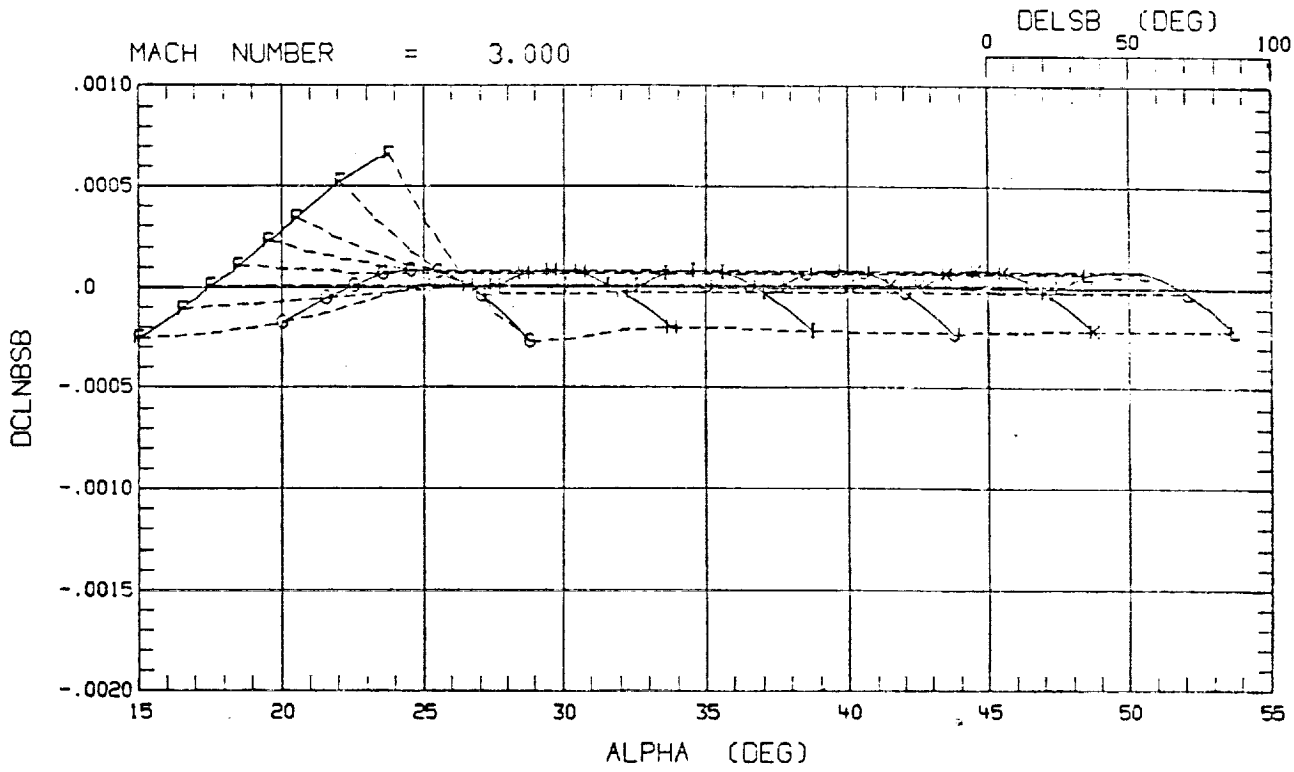
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	-0.00025	-0.00026	-0.00026	-0.00026	-0.00025	-0.00018	0.0
15.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00005	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00014	0.00013	0.00010	0.00012	0.00012	0.00010	0.00006	0.00006
45.000	0.00026	0.00025	0.00022	0.00025	0.00026	0.00022	0.00008	0.00008
55.000	0.00037	0.00036	0.00037	0.00042	0.00042	0.00034	0.00007	0.00007
70.000	0.00050	0.00048	0.00050	0.00052	0.00066	0.00052	-0.00004	-0.00003
87.200	0.00065	0.00065	0.00065	0.00075	0.00090	0.00066	-0.00027	-0.00020

ENGINEER LL
DATE 9-13-85

FIGURE 4.2.1.2-125
EFFECT OF SPEEDBRAKE



CONFIGURATION

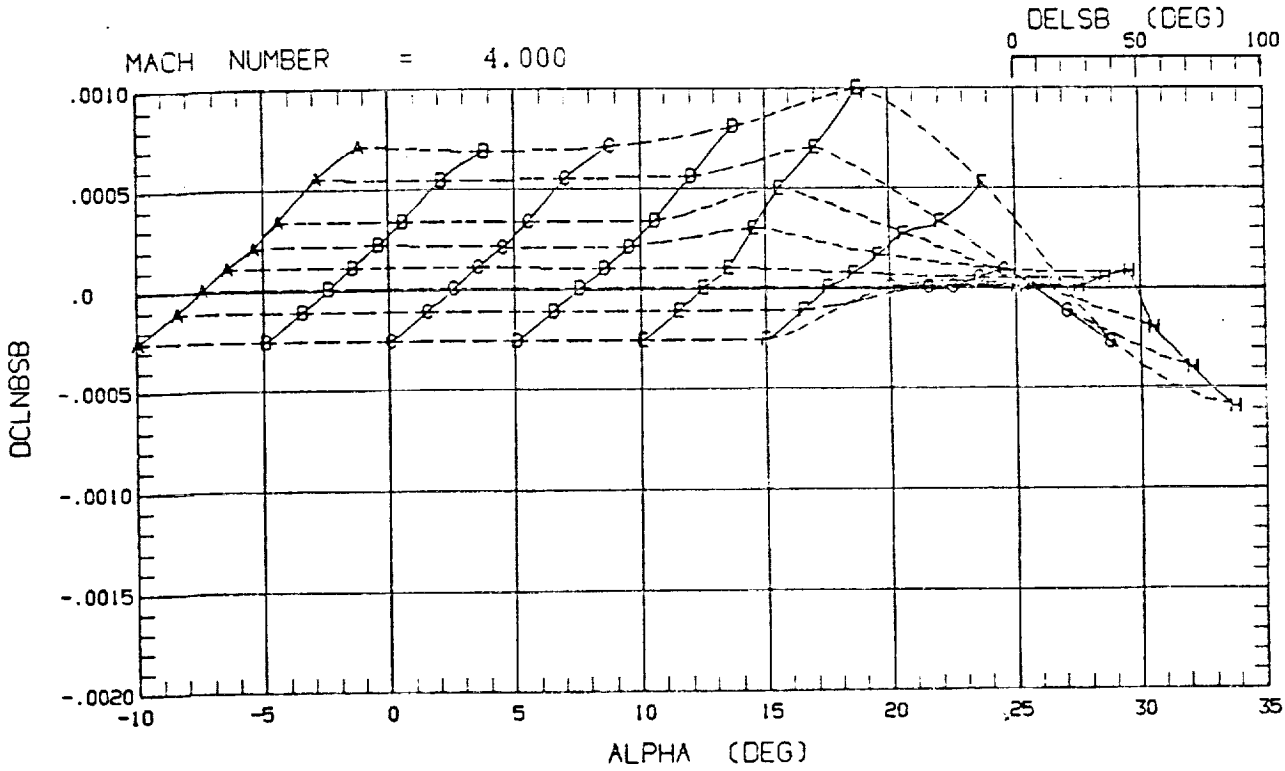
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.						
0.0	-0.00026	-0.00018	0.0	0.0	0.0	0.0	0.0
15.000	-0.00011	-0.00006	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00010	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006
45.000	0.00022	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008
55.000	0.00034	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007
70.000	0.00052	-0.00004	-0.00003	-0.00003	-0.00003	-0.00003	-0.00003
87.200	0.00066	-0.00027	-0.00020	-0.00022	-0.00023	-0.00022	-0.00022

ENGINEER [illegible]
DATE 9-13-78

FIGURE 4.2.1.2-126
EFFECT OF SPEEDBRAKE

SD [illegible]-0004-CCCC IM



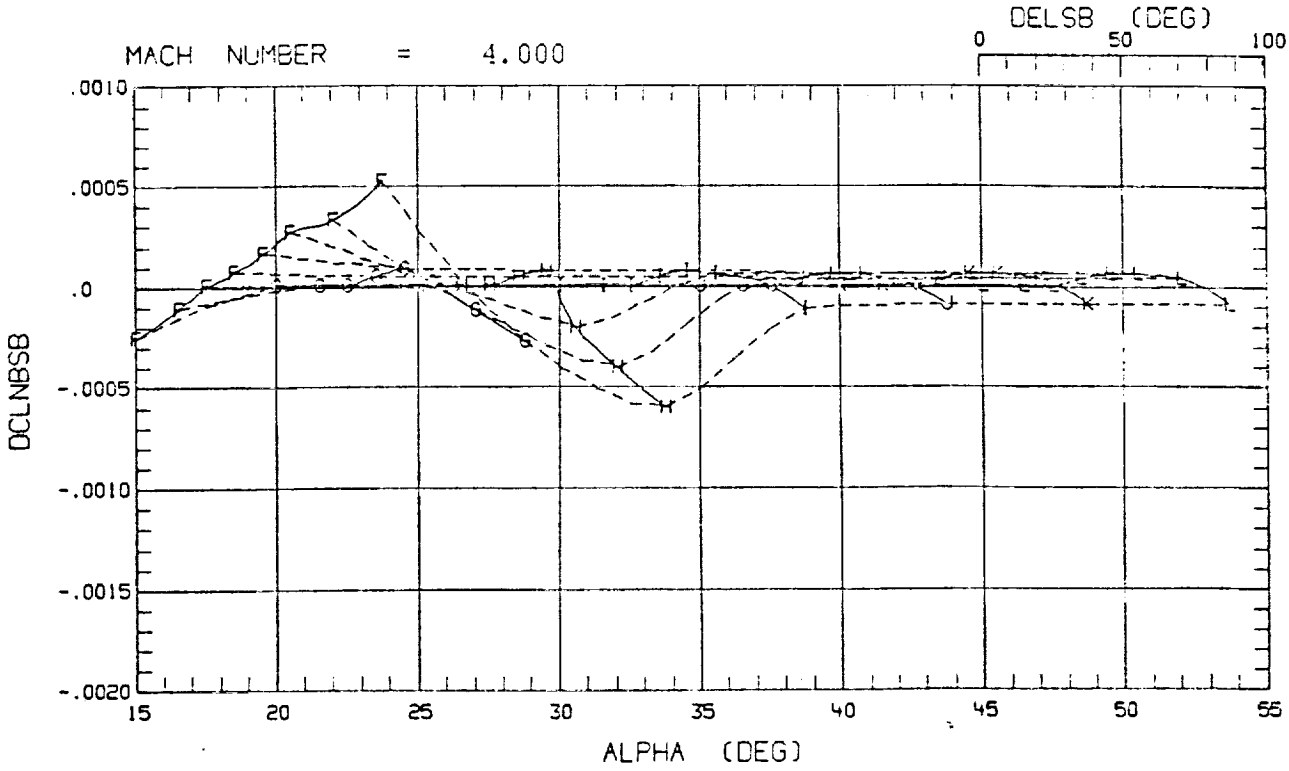
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	0.0	0.0
15.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00011	0.00011	0.00011	0.00010	0.00010	0.00007	0.00005	0.00005
45.000	0.00021	0.00022	0.00021	0.00021	0.00030	0.00016	0.00009	0.00008
55.000	0.00034	0.00034	0.00034	0.00034	0.00050	0.00027	0.00002	-0.00020
70.000	0.00055	0.00054	0.00055	0.00056	0.00070	0.00033	-0.00012	-0.00040
87.200	0.00071	0.00069	0.00071	0.00081	0.00100	0.00052	-0.00027	-0.00060

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.2-127
EFFECT OF SPEEDBRAKE



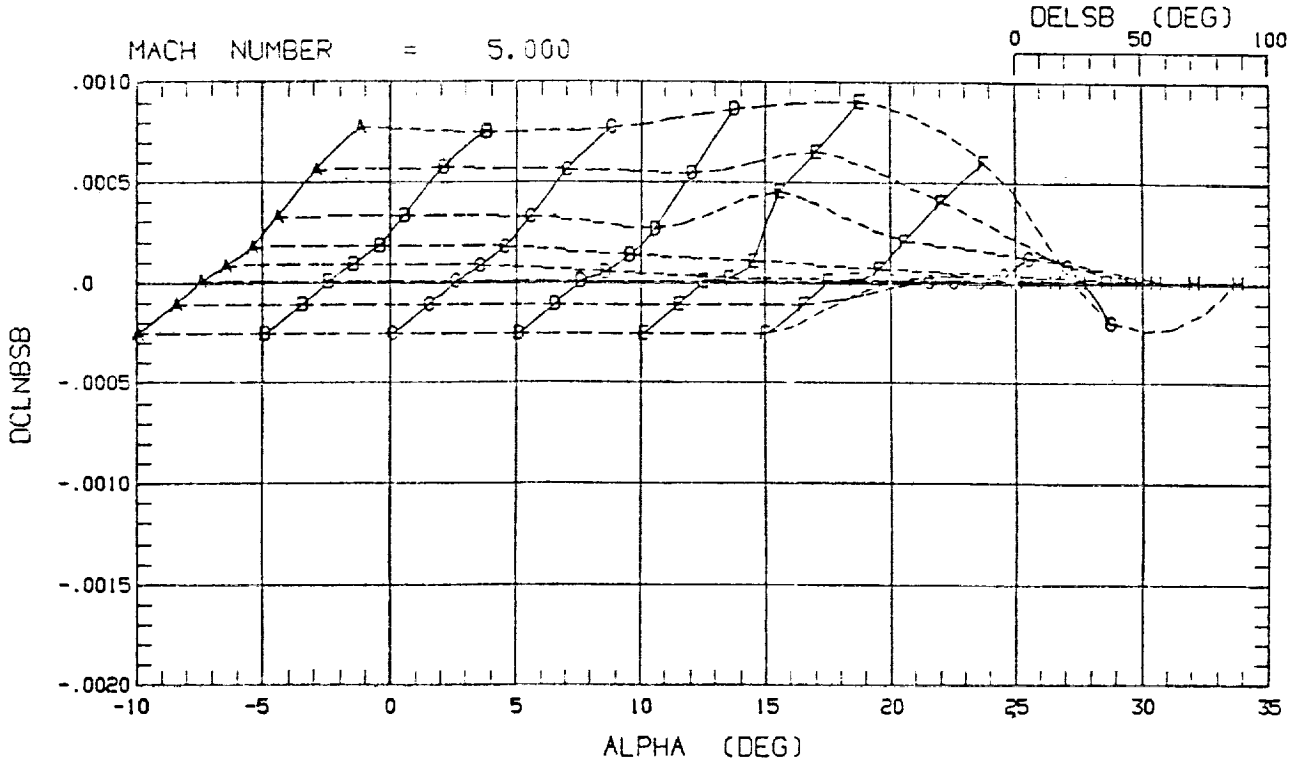
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.						
0.0	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00011	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00007	0.00005	0.00005	0.00005	0.00004	0.00004	0.00004
45.000	0.00016	0.00009	0.00008	0.00008	0.00006	0.00006	0.00006
55.000	0.00027	0.00002	-0.00020	0.00006	0.00006	0.00006	0.00006
70.000	0.00033	-0.00012	-0.00040	0.00003	0.00003	0.00004	0.00004
87.200	0.00052	-0.00027	-0.00060	-0.00011	-0.00009	-0.00009	-0.00009

ENGINEER CLL
DATE 9-13-78

FIGURE 4.2.1.2-128
EFFECT OF SPEEDBRAKE



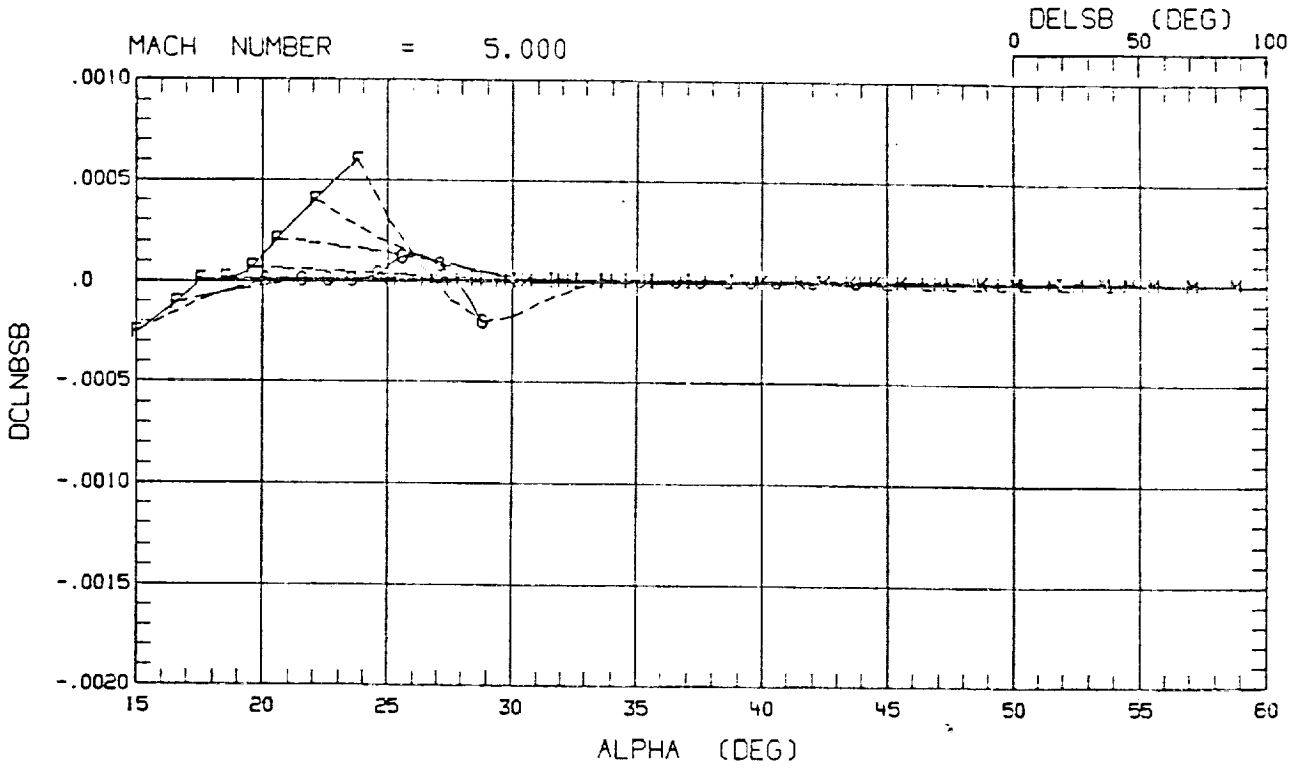
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	0.0	0.0
15.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00008	0.00009	0.00008	0.00005	0.00002	0.00001	0.0	0.0
45.000	0.00017	0.00018	0.00017	0.00013	0.00010	0.00006	0.00003	0.0
55.000	0.00032	0.00033	0.00032	0.00026	0.00045	0.00020	0.00012	0.0
70.000	0.00056	0.00057	0.00056	0.00054	0.00065	0.00040	0.00006	0.0
87.200	0.00077	0.00075	0.00077	0.00086	0.00090	0.00060	-0.00020	0.0

ENGINEER LLL
DATE 9-13-85

FIGURE 4.2.1.2-129
EFFECT OF SPEEDBRAKE



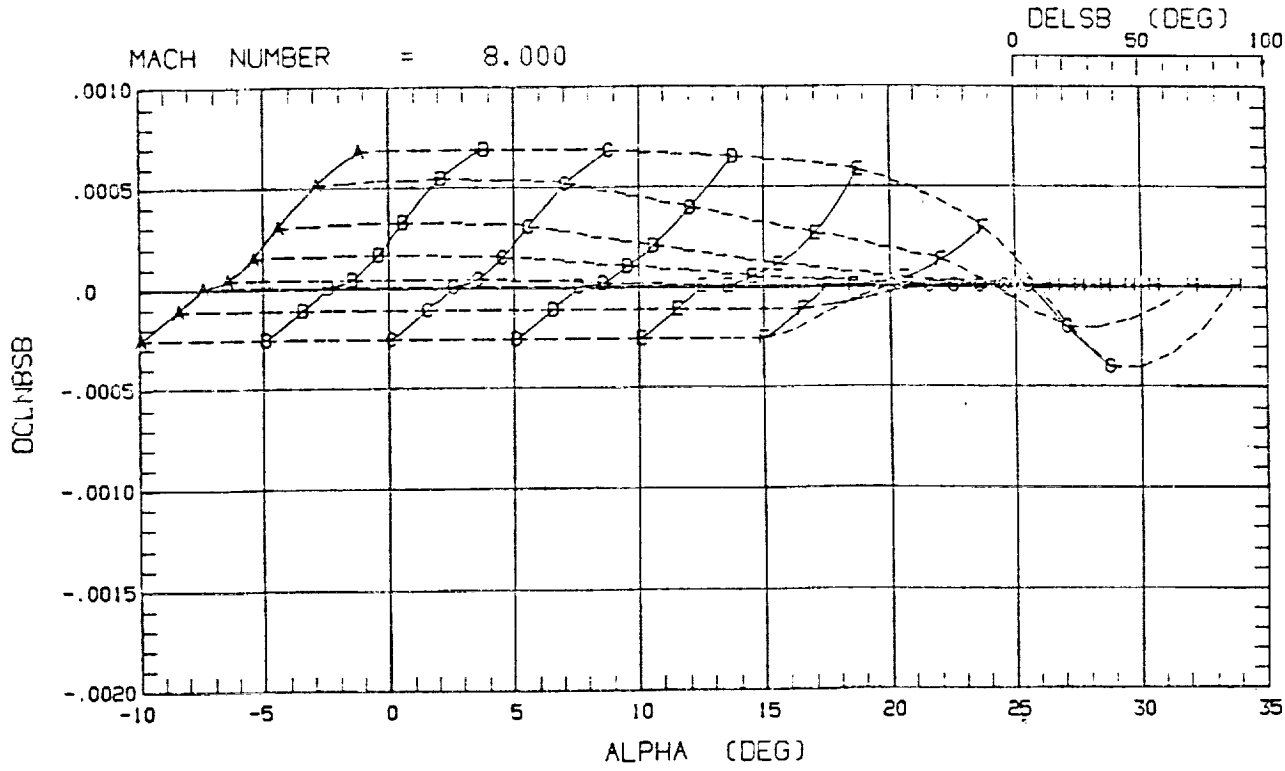
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00011	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00001	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00006	0.00003	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00020	0.00012	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00040	0.00008	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.00060	-0.00020	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER
DATE 7-13-75

FIGURE 4.2.1.2-130
EFFECT OF SPEEDBRAKE



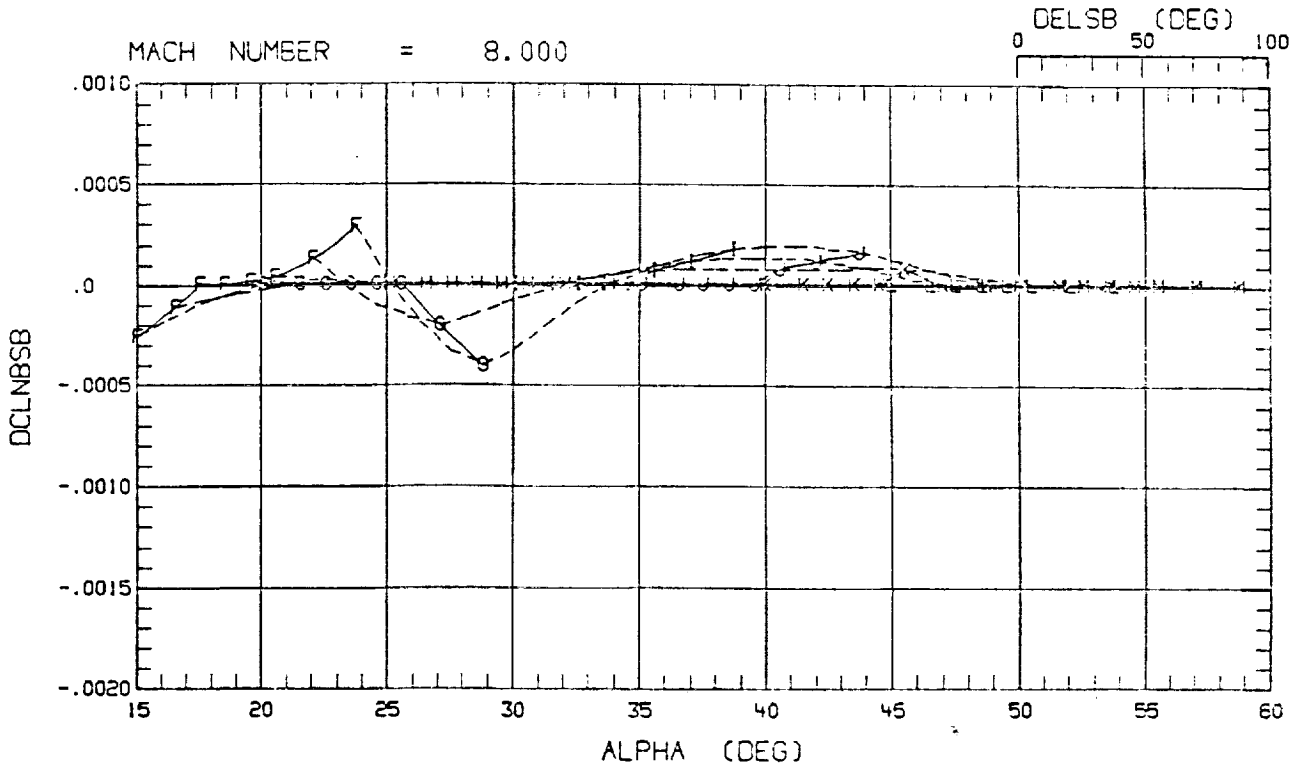
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	0.0	0.0
15.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00004	0.00004	0.00004	0.00002	0.0	0.0	0.0	0.0
45.000	0.00015	0.00016	0.00015	0.00010	0.00005	0.00002	0.0	0.0
55.000	0.00030	0.00032	0.00030	0.00020	0.00011	0.00004	0.0	0.0
70.000	0.00051	0.00054	0.00051	0.00039	0.00026	0.00013	-0.00020	0.0
87.200	0.00068	0.00069	0.00068	0.00065	0.00058	0.00029	-0.00040	0.0

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.2-131
EFFECT OF SPEEDBRAKE



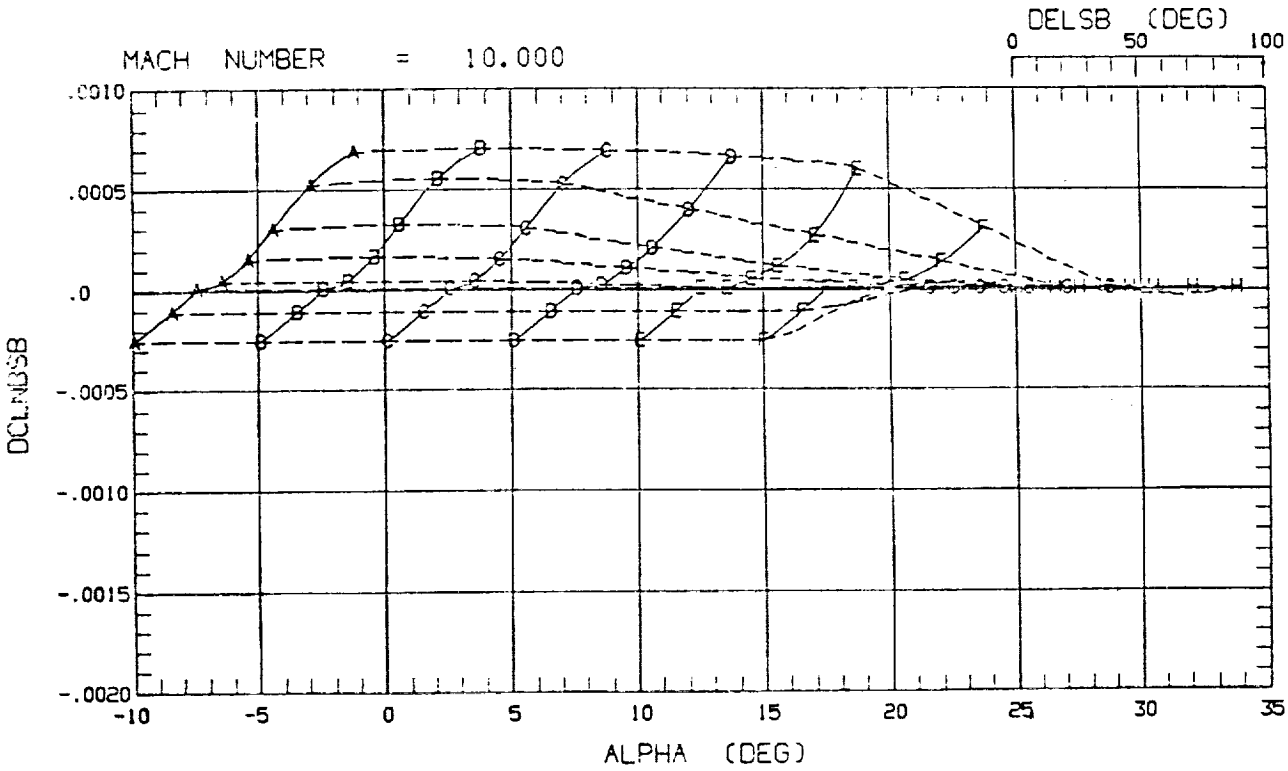
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00011	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00004	0.0	0.0	0.00007	0.00008	0.00008	0.0	0.0
70.000	0.00013	-0.00020	0.0	0.00012	0.00012	0.0	0.0	0.0
87.200	0.00029	-0.00040	0.0	0.00018	0.00016	0.0	0.0	0.0

ENGINEER LL
DATE 9-13-78

FIGURE 4.2.1.2-132
EFFECT OF SPEEDBRAKE

SD 72-SH-0000 IM



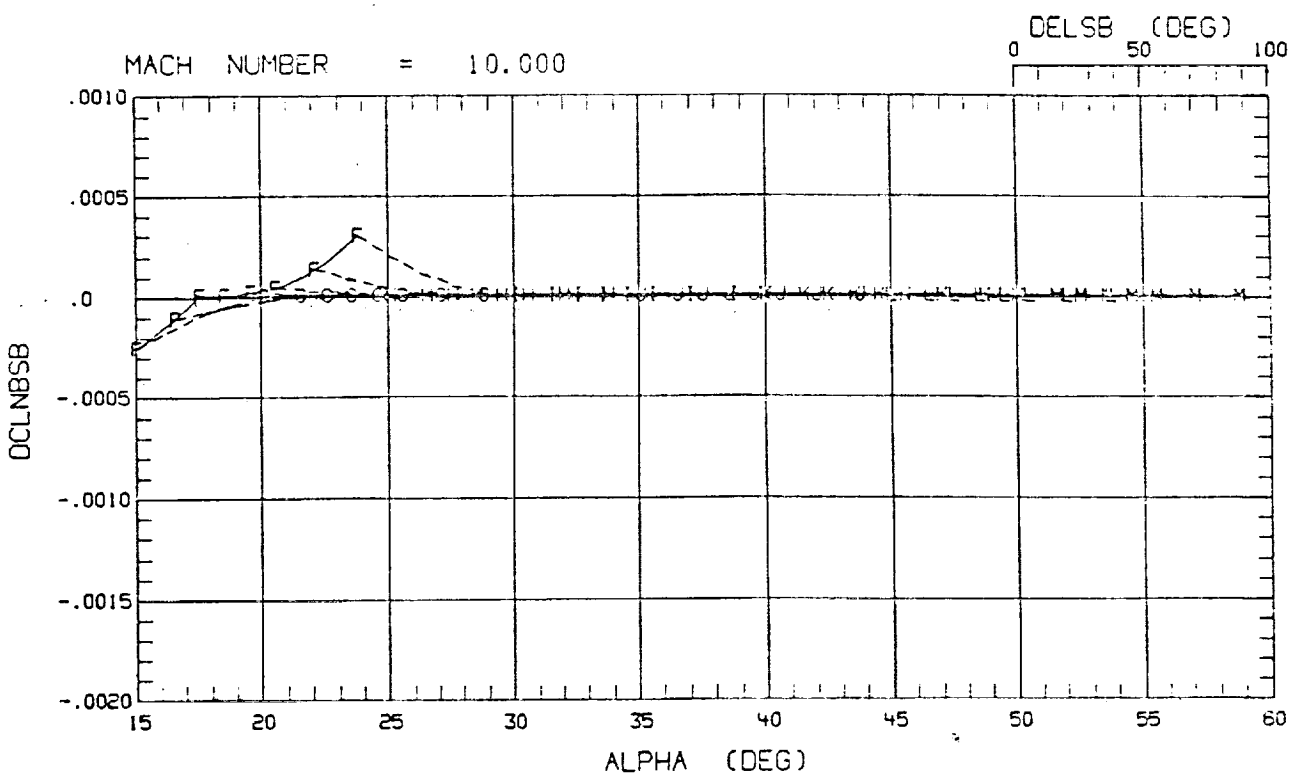
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	0.0	0.0
15.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00004	0.00004	0.00004	0.00002	0.0	0.0	0.0	0.0
45.000	0.00015	0.00016	0.00015	0.00010	0.00005	0.00002	0.0	0.0
55.000	0.00030	0.00032	0.00030	0.00020	0.00011	0.00004	0.0	0.0
70.000	0.00052	0.00055	0.00052	0.00039	0.00026	0.00013	0.0	0.0
87.200	0.00069	0.00070	0.00069	0.00066	0.00060	0.00030	0.0	0.0

ENGINEER LH
DATE 9-13-78

FIGURE 4.2.1.2-133
EFFECT OF SPEEDBRAKE



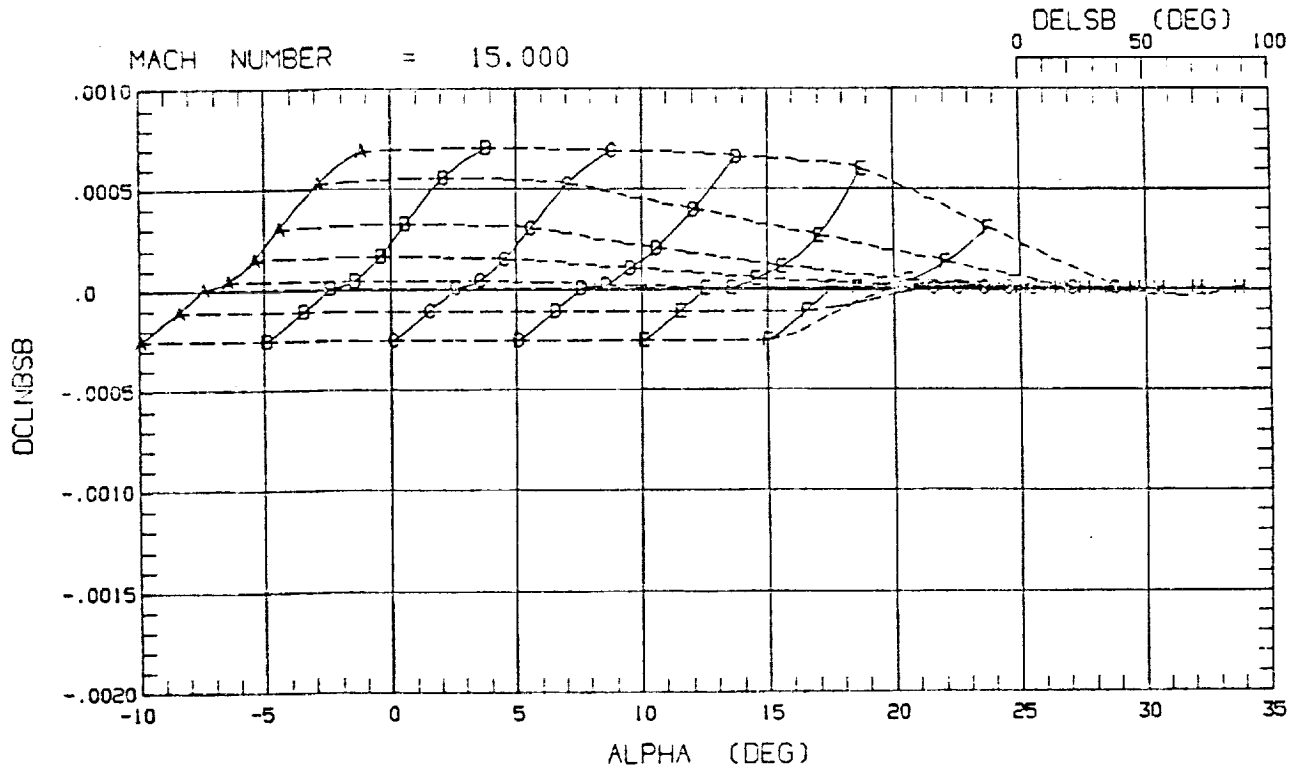
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00011	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00004	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.00030	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER LLL
DATE 9-13-78

FIGURE 4.2.1.2-134
EFFECT OF SPEEDBRAKE



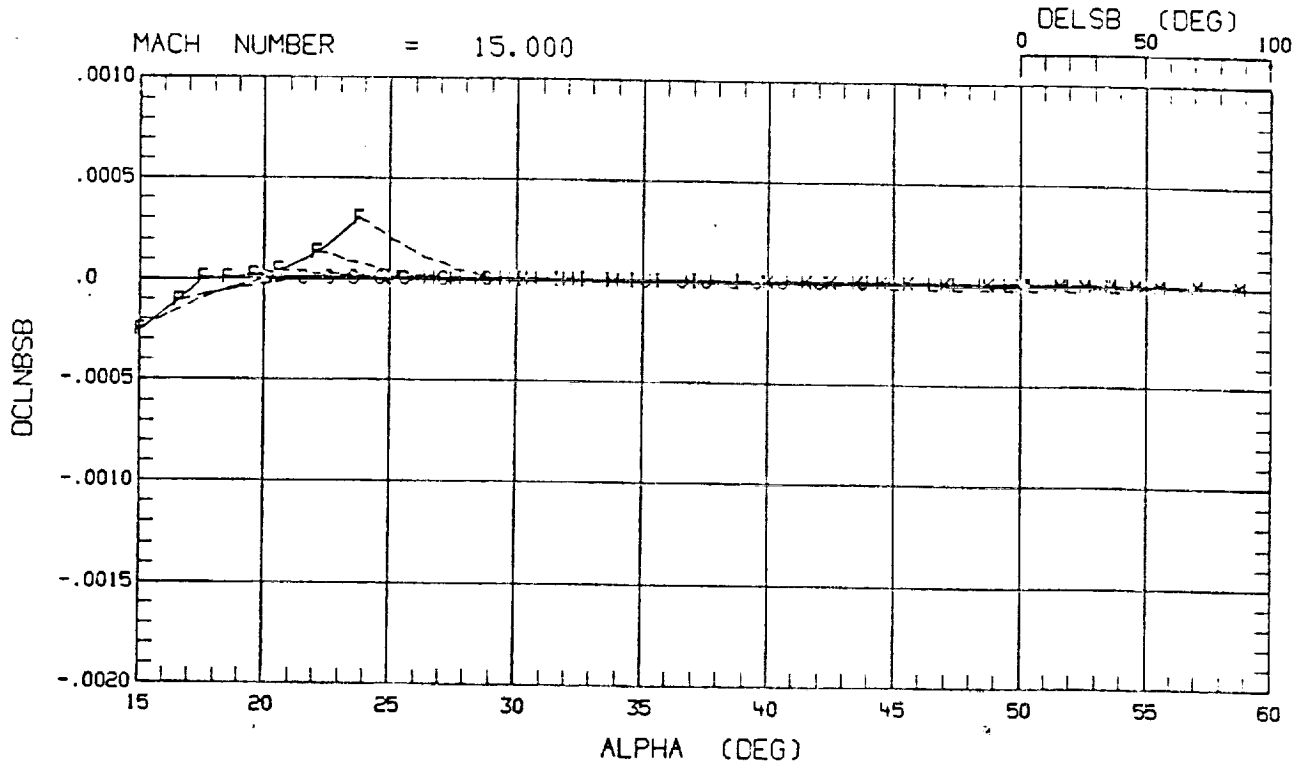
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	0.0	0.0
15.300	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00004	0.00004	0.00004	0.00002	0.0	0.0	0.0	0.0
45.000	0.00015	0.00016	0.00015	0.00010	0.00005	0.00002	0.0	0.0
55.000	0.00030	0.00032	0.00030	0.00020	0.00011	0.00004	0.0	0.0
70.000	0.00052	0.00055	0.00052	0.00039	0.00026	0.00013	0.0	0.0
87.200	0.00069	0.00070	0.00069	0.00066	0.00060	0.00030	0.0	0.0

ENGINEER [illegible]
DATE 9-13-85

FIGURE 4.2.1.2-135
EFFECT OF SPEEDBRAKE



CONFIGURATION

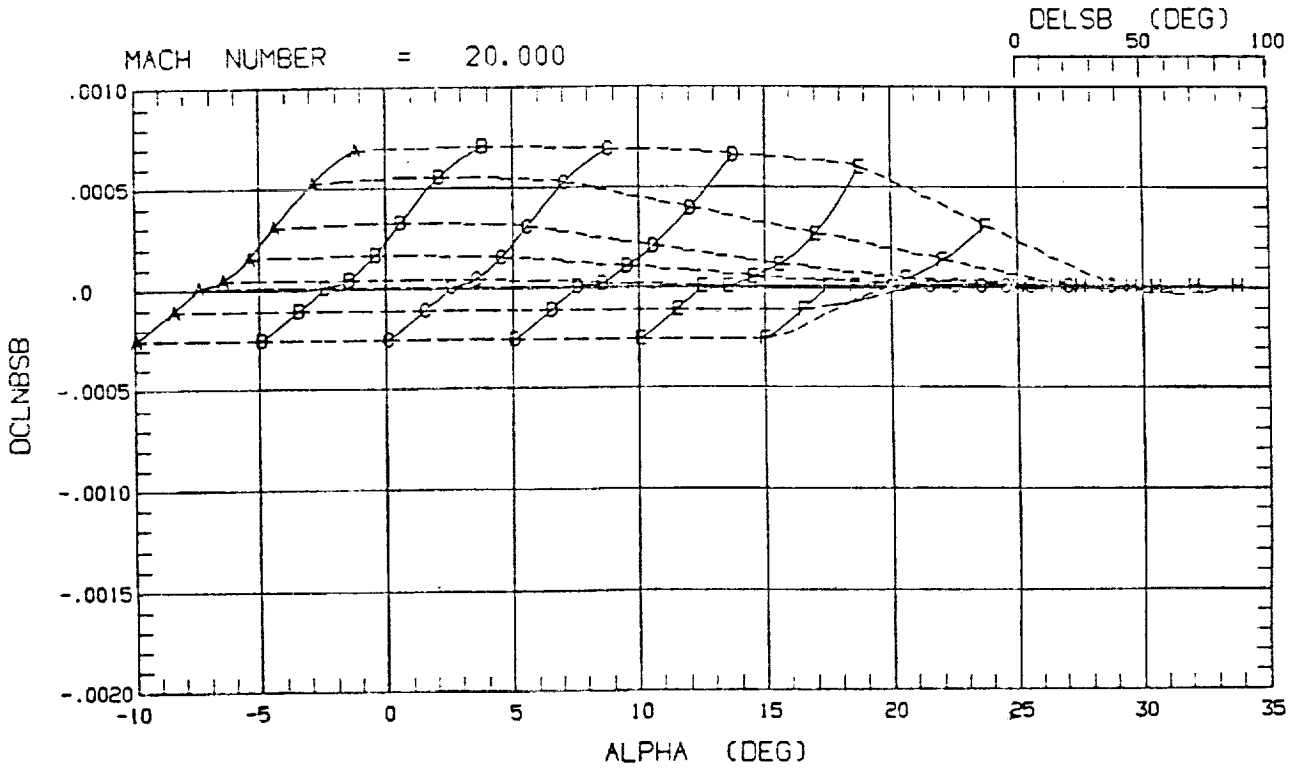
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00011	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00004	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.00030	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER LLL
DATE 7-13-78

FIGURE 4.2.1.2-136
EFFECT OF SPEEDBRAKE

SI [illegible] -0000 IM



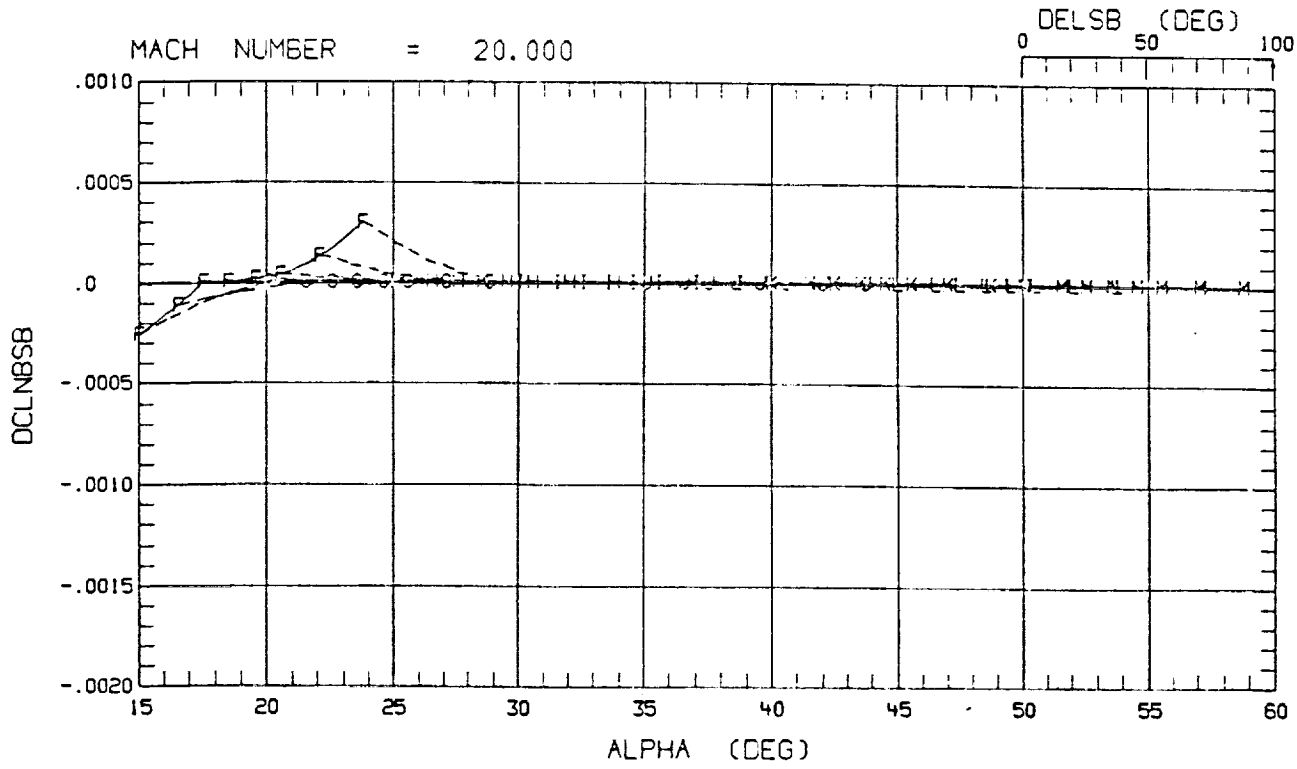
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	-0.00026	0.0	0.0
15.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00004	0.00004	0.00004	0.00002	0.0	0.0	0.0	0.0
45.000	0.00015	0.00016	0.00015	0.00010	0.00005	0.00002	0.0	0.0
55.000	0.00030	0.00032	0.00030	0.00020	0.00011	0.00004	0.0	0.0
70.000	0.00052	0.00055	0.00052	0.00039	0.00026	0.00013	0.0	0.0
87.200	0.00069	0.00070	0.00069	0.00066	0.00060	0.00030	0.0	0.0

ENGINEER LL
DATE 9-13-88

FIGURE 4.2.1.2-137
EFFECT OF SPEEDBRAKE



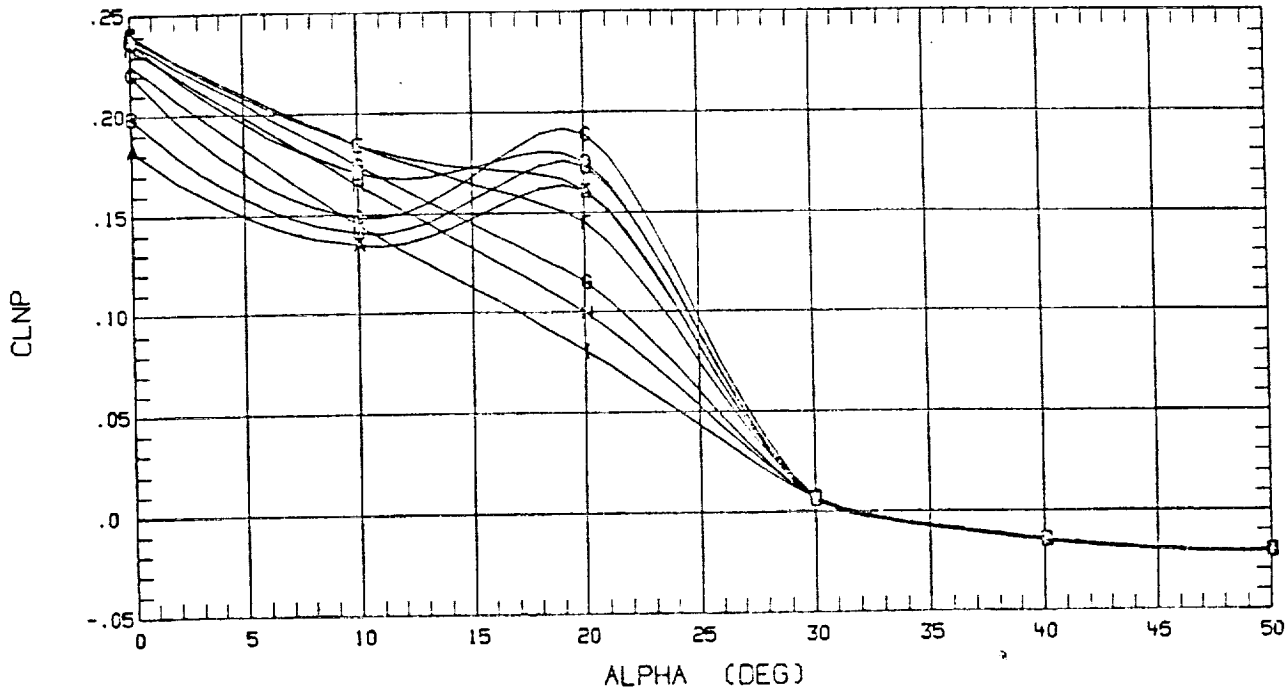
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE YAWING MOMENT INCR.							
0.0	-0.00026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00011	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00004	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.00030	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE 9-13-78

FIGURE 4.2.1.2-138
EFFECT OF SPEEDBRAKE



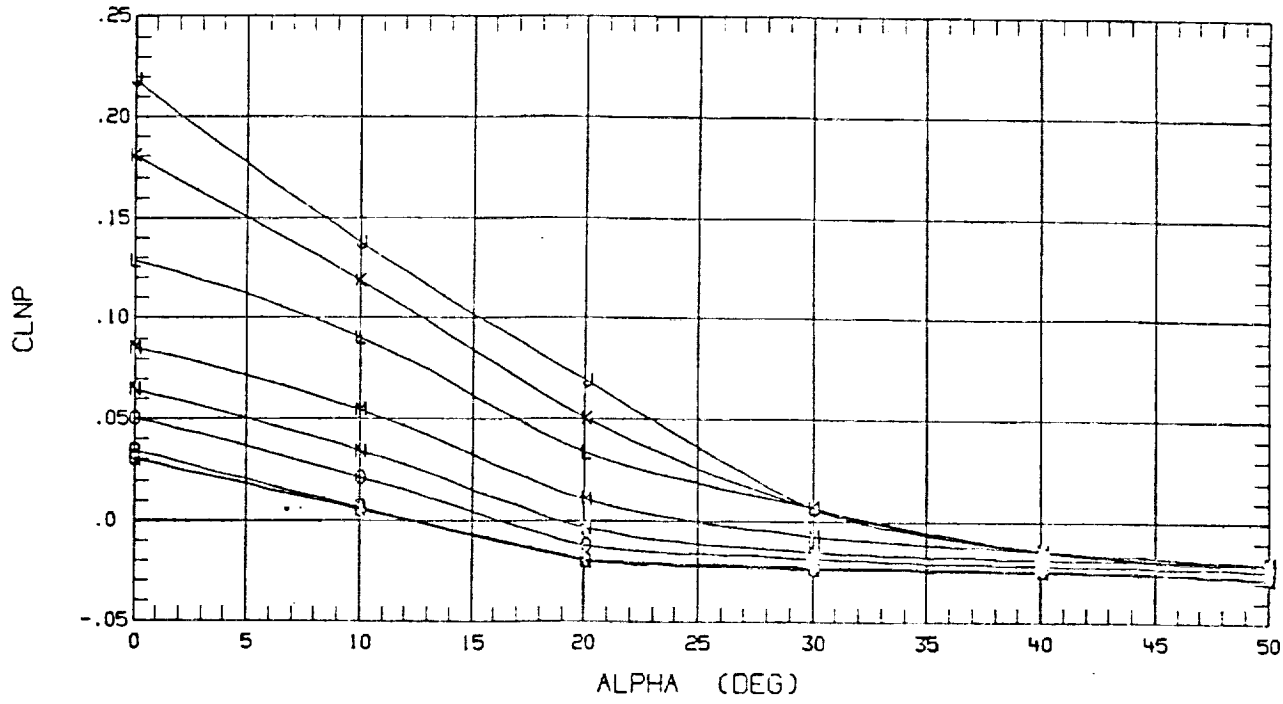
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	0.250	0.400	0.600	0.800	0.900	0.950	1.050	1.100	1.200
	A	B	C	D	E	F	G	H	I
ALPHA (DEG)	YAWING MOMENT DUE TO ROLL RATE								
0.0	0.18200	0.19800	0.22000	0.23690	0.24000	0.23690	0.23640	0.23340	0.22500
10.000	0.13400	0.14000	0.14800	0.17040	0.18400	0.18400	0.17390	0.16430	0.14400
20.000	0.16000	0.17200	0.18800	0.17440	0.16000	0.14420	0.11440	0.09930	0.08000
30.000	0.00600	0.00600	0.00600	0.00540	0.00600	0.00600	0.00600	0.00600	0.00600
40.000	-0.01500	-0.01500	-0.01500	-0.01480	-0.01500	-0.01530	-0.01480	-0.01530	-0.01500
50.000	-0.02100	-0.02100	-0.02100	-0.02140	-0.02100	-0.02090	-0.02140	-0.02140	-0.02100

ENGINEER_____
DATE_____

FIGURE 4.2.1.2-139
YAWING MOMENT DUE TO ROLL RATE



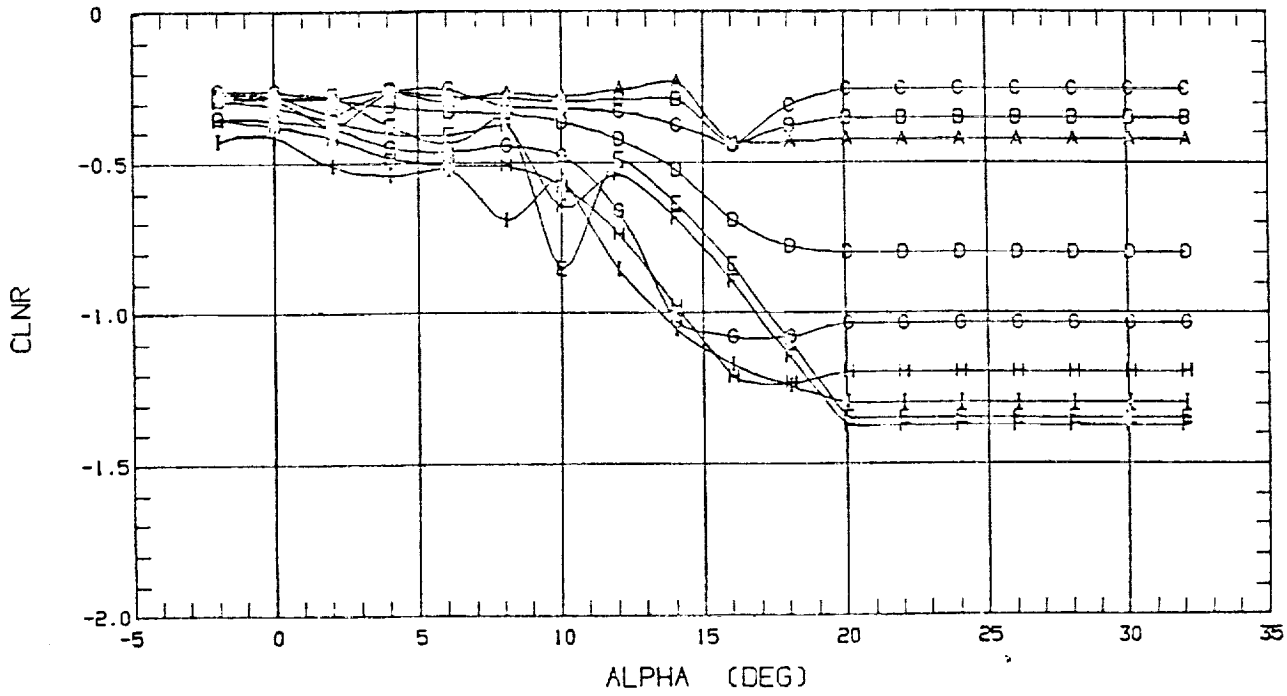
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	1.300	1.500	2.000	3.000	4.000	5.000	8.000	10.000	20.000
	J	K	L	M	N	O	P	Q	R
ALPHA (DEG)	YAWING MOMENT DUE TO ROLL RATE								
0.0	0.21770	0.18000	0.12800	0.08500	0.06400	0.05000	0.03400	0.03000	0.03000
10.000	0.13710	0.11800	0.09000	0.05400	0.03400	0.02100	0.00600	0.00500	0.00500
20.000	0.06850	0.05000	0.03300	0.01000	-0.00400	-0.01300	-0.02000	-0.02000	-0.02000
30.000	0.00540	0.00600	0.00600	-0.00800	-0.01600	-0.01900	-0.02300	-0.02400	-0.02400
40.000	-0.01480	-0.01500	-0.01500	-0.01500	-0.01900	-0.02200	-0.02500	-0.02500	-0.02500
50.000	-0.02140	-0.02100	-0.02100	-0.02100	-0.02100	-0.02400	-0.02800	-0.02900	-0.02900

ENGINEER_____
DATE_____

FIGURE 4.2.1.2-140
YAWING MOMENT DUE TO ROLL RATE



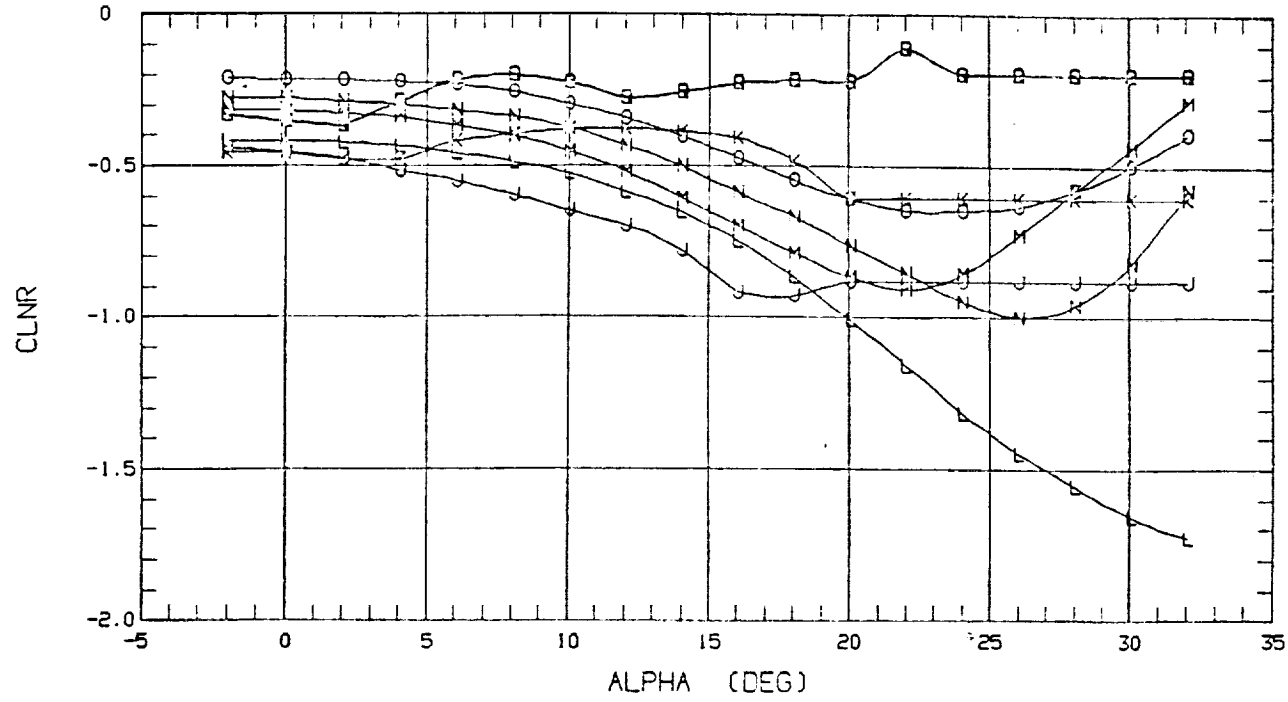
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	0.250 A	0.400 B	0.600 C	0.800 D	0.900 E	0.950 F	1.050 G	1.100 H	1.200 I
ALPHA (DEG)	YAW DAMPING								
-2.000	-0.28900	-0.27800	-0.26400	-0.28400	-0.29400	-0.29300	-0.35400	-0.35900	-0.42900
0.0	-0.29600	-0.28300	-0.26600	-0.28600	-0.28600	-0.31600	-0.36100	-0.38200	-0.41700
2.000	-0.38400	-0.34200	-0.28700	-0.29400	-0.27900	-0.36400	-0.38900	-0.42000	-0.51500
4.000	-0.27100	-0.26600	-0.26100	-0.31600	-0.38200	-0.40700	-0.45200	-0.48800	-0.54300
6.000	-0.29900	-0.28200	-0.26000	-0.33400	-0.43900	-0.40900	-0.46500	-0.51100	-0.52600
8.000	-0.27200	-0.29000	-0.31600	-0.34100	-0.36200	-0.38200	-0.44800	-0.51400	-0.69400
10.000	-0.28400	-0.30100	-0.32400	-0.36900	-0.85600	-0.65000	-0.48100	-0.58200	-0.56200
12.000	-0.26100	-0.29300	-0.33600	-0.42700	-0.49200	-0.54200	-0.66500	-0.74000	-0.85600
14.000	-0.23100	-0.29400	-0.37900	-0.53000	-0.64000	-0.69000	-1.02900	-0.97900	-1.05400
16.000	-0.43700	-0.44100	-0.44700	-0.69300	-0.84300	-0.89900	-1.08200	-1.21300	-1.17300
18.000	-0.43400	-0.38200	-0.31400	-0.78100	-1.09700	-1.14700	-1.08000	-1.23600	-1.24600
20.000	-0.42500	-0.35400	-0.26100	-0.80300	-1.35100	-1.37600	-1.03300	-1.19800	-1.29900
22.000	-0.42500	-0.35400	-0.26100	-0.80300	-1.35100	-1.37600	-1.03300	-1.19800	-1.29900
24.000	-0.42500	-0.35400	-0.26100	-0.80300	-1.35100	-1.37600	-1.03300	-1.19800	-1.29900
26.000	-0.42500	-0.35400	-0.26100	-0.80300	-1.35100	-1.37600	-1.03300	-1.19800	-1.29900
28.000	-0.42500	-0.35400	-0.26100	-0.80300	-1.35100	-1.37600	-1.03300	-1.19800	-1.29900
30.000	-0.42500	-0.35400	-0.26100	-0.80300	-1.35100	-1.37600	-1.03300	-1.19800	-1.29900
32.000	-0.42500	-0.35400	-0.26100	-0.80300	-1.35100	-1.37600	-1.03300	-1.19800	-1.29900

ENGINEER_____
DATE_____

FIGURE 4.2.1.2-141
YAW DAMPING



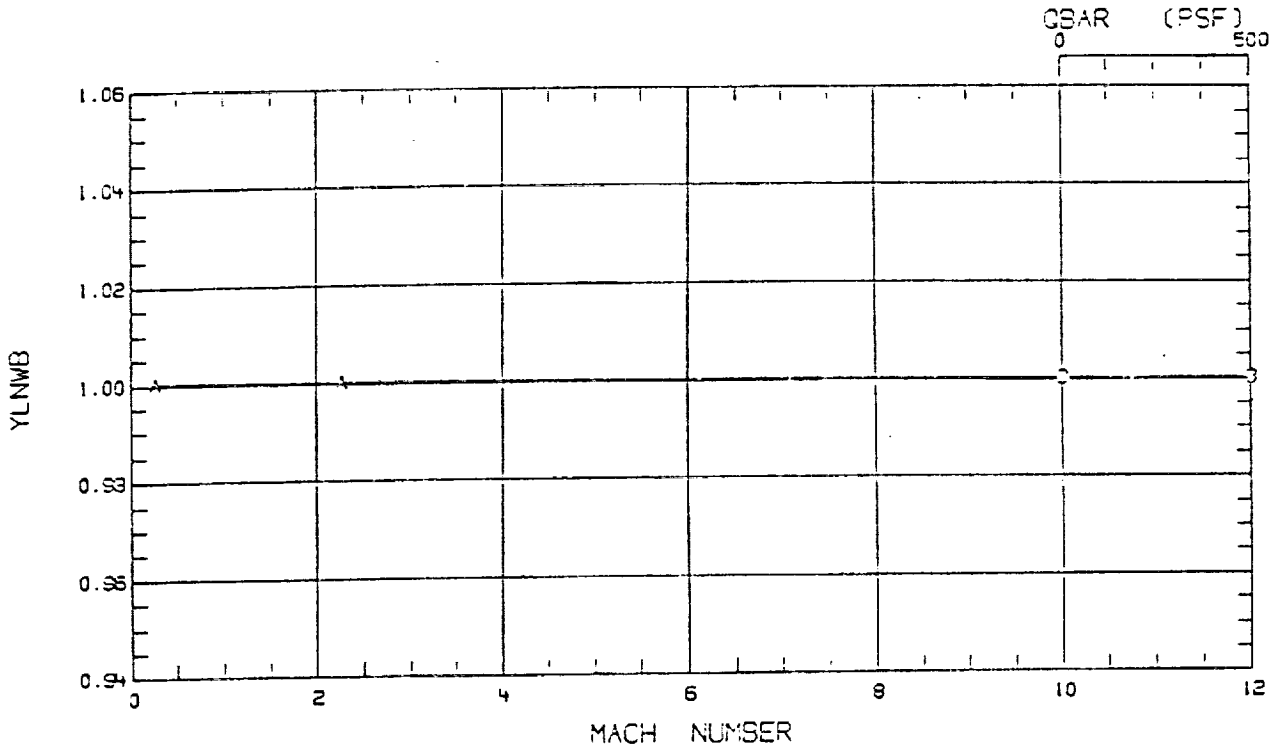
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	1.300	1.500	2.000	3.000	4.000	5.000	8.000	10.000	20.000
	J	K	L	M	N	O	P	Q	R
ALPHA (DEG)	YAW DAMPING								
-2.000	-0.44400	-0.46000	-0.42000	-0.32000	-0.28000	-0.21500	-0.33500	-0.33500	-0.33500
0.0	-0.45700	-0.46000	-0.42000	-0.32200	-0.28000	-0.21700	-0.35700	-0.35700	-0.35700
2.000	-0.47500	-0.48000	-0.42500	-0.33000	-0.29000	-0.22000	-0.36900	-0.36900	-0.36900
4.000	-0.51800	-0.48000	-0.43500	-0.34000	-0.30000	-0.22500	-0.29100	-0.29100	-0.29100
6.000	-0.55100	-0.42000	-0.46000	-0.37000	-0.32000	-0.23500	-0.21800	-0.21800	-0.21800
8.000	-0.59900	-0.40000	-0.49000	-0.40500	-0.34000	-0.26000	-0.20500	-0.20500	-0.20500
10.000	-0.65200	-0.38000	-0.53000	-0.45500	-0.38000	-0.30000	-0.23000	-0.23000	-0.23000
12.000	-0.70000	-0.38000	-0.59000	-0.52200	-0.43500	-0.34500	-0.27900	-0.27900	-0.27900
14.000	-0.78300	-0.39000	-0.65500	-0.61000	-0.50500	-0.40500	-0.26100	-0.26100	-0.26100
16.000	-0.91700	-0.41000	-0.75000	-0.70000	-0.59000	-0.47500	-0.22800	-0.22800	-0.22800
18.000	-0.93000	-0.48500	-0.87000	-0.79000	-0.67000	-0.55000	-0.22000	-0.22000	-0.22000
20.000	-0.88200	-0.61000	-1.01000	-0.87000	-0.76500	-0.61000	-0.22300	-0.22300	-0.22300
22.000	-0.88200	-0.61000	-1.16000	-0.91000	-0.86000	-0.65000	-0.11400	-0.11400	-0.11400
24.000	-0.88200	-0.61000	-1.32000	-0.86000	-0.95000	-0.65000	-0.19700	-0.19700	-0.19700
26.000	-0.88200	-0.61000	-1.45000	-0.73000	-1.00000	-0.63500	-0.19700	-0.19700	-0.19700
28.000	-0.88200	-0.61000	-1.56000	-0.58000	-0.96000	-0.58000	-0.19700	-0.19700	-0.19700
30.000	-0.88200	-0.61000	-1.66000	-0.44000	-0.82000	-0.50000	-0.19700	-0.19700	-0.19700
32.000	-0.88200	-0.61000	-1.73000	-0.29000	-0.58000	-0.39500	-0.19700	-0.19700	-0.19700

ENGINEER
DATE 11/5/82

FIGURE 4.2.1.2-142
YAW DAMPING



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER	
	0.250	10.000
	A	B
QBAR (PSF)	F/R WING-BODY YAWING	
0.0	1.00000	1.00000
500.000	1.00000	1.00000

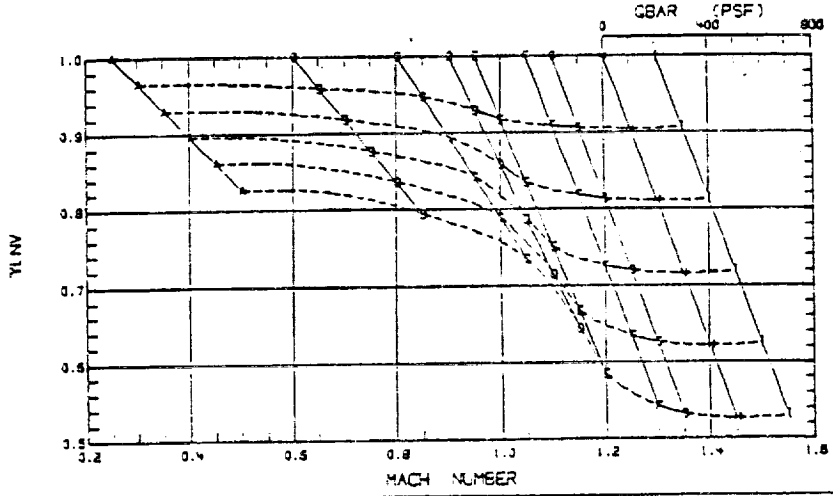
ENGINEER [signature]
DATE 4-3-79

FIGURE 4.2.1.2-143
FLEXIBLE/RIGID WING-BODY YAWING MOMENT DERIVATIVE

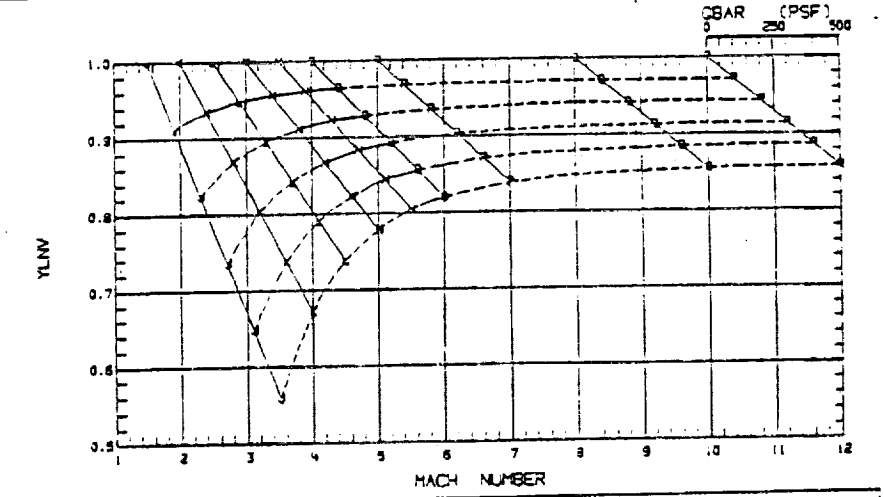
ST 74-SH-0000 1M

CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XB = FS 1076.7	IN.	WING AREA	SW = 3890.00	SQ.FT.
OR	YB = BL 0.0	IN.	WING SPAN	B = 79.056	FT.
MOMENT REFERENCE	ZB = WL 375.0	IN.	M.A.C.	C = 39.550	FT.
			BODY LENGTH	LB = 990.3	IN.



	MACH NUMBER								
	0.250	0.600	0.800	0.900	0.950	1.050	1.100	1.200	1.300
	A	B	C	D	E	F	G	H	I
QBAR (PSF)	F/R VERT TAIL YAWING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.96333	0.95667	0.94700	0.92967	0.91667	0.90833	0.90833	0.90533	0.90600
200.000	0.93067	0.91733	0.89400	0.85733	0.83333	0.81667	0.81267	0.81067	0.81200
300.000	0.89800	0.87500	0.84100	0.78500	0.75000	0.72500	0.71900	0.71600	0.71800
400.000	0.86133	0.83467	0.78800	0.71467	0.66667	0.63333	0.62533	0.62133	0.62400
500.000	0.82267	0.79333	0.73500	0.64333	0.58333	0.54167	0.53167	0.52867	0.53000



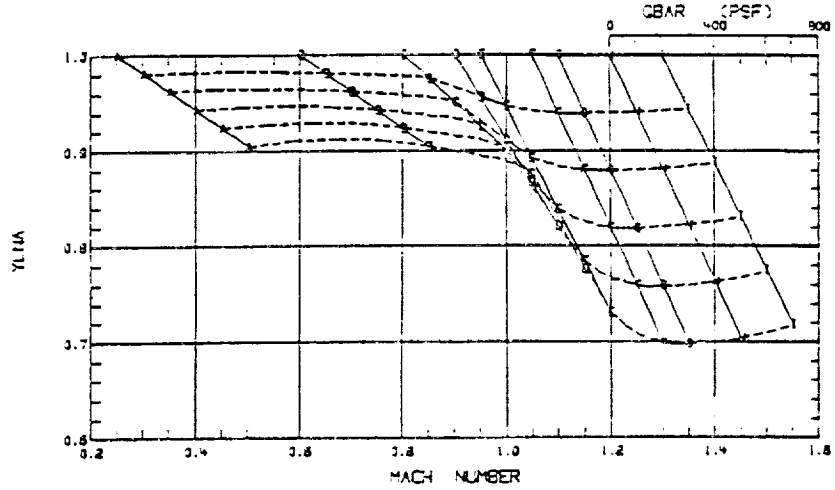
	MACH NUMBER								
	1.500	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	J	K	L	M	N	O	P	Q	R
QBAR (PSF)	F/R VERT TAIL YAWING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.91167	0.89433	0.84767	0.89567	0.88100	0.88400	0.88767	0.87100	0.87133
200.000	0.82333	0.78867	0.69533	0.81133	0.82200	0.82800	0.83533	0.84200	0.84267
300.000	0.73500	0.68300	0.54300	0.66700	0.68300	0.69200	0.70300	0.81300	0.81400
400.000	0.64667	0.57733	0.39067	0.52267	0.54400	0.55600	0.57067	0.68400	0.68533
500.000	0.55833	0.47167	0.23833	0.37933	0.40500	0.42100	0.43933	0.55600	0.55667

ENGINEER
DATE 4-3-79

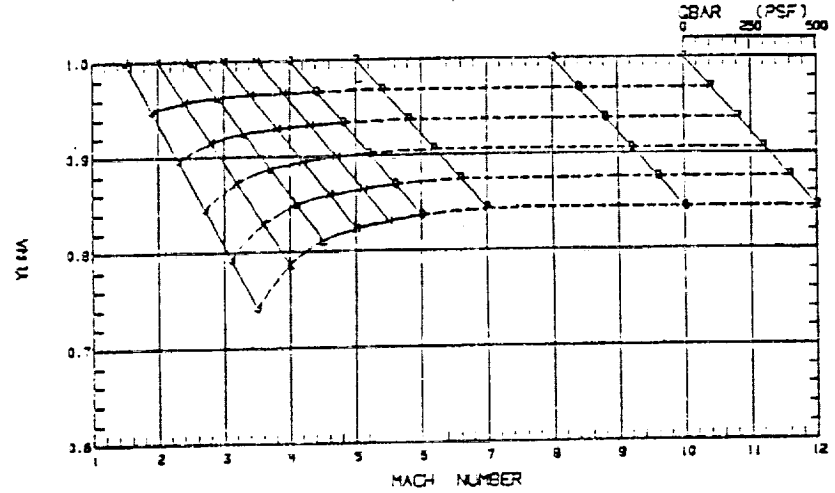
FIGURE 4.2.1.2-144
FLEXIBLE/RIGID VERTICAL TAIL YAWING MOMENT DERIVATIVE

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 220.3 IN.



QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	F/R AILERON YAWING MOMENT DERIV.								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98100	0.98087	0.97500	0.96817	0.94490	0.93957	0.93953	0.94077	0.94353
200.000	0.96200	0.96133	0.95000	0.91033	0.89180	0.87913	0.87907	0.89153	0.88707
300.000	0.94300	0.94200	0.92500	0.86550	0.83770	0.81870	0.81860	0.82230	0.83060
400.000	0.92400	0.92267	0.90000	0.82067	0.78350	0.75827	0.75813	0.76307	0.77413
500.000	0.90500	0.90333	0.87500	0.77583	0.72950	0.69783	0.69767	0.70383	0.71767



QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
	F/R AILERON YAWING MOMENT DERIV.								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.94833	0.95733	0.96233	0.96460	0.95810	0.95727	0.95857	0.95887	0.95887
200.000	0.89667	0.91467	0.92467	0.92920	0.91620	0.91453	0.91713	0.91733	0.91733
300.000	0.84500	0.87200	0.88700	0.89380	0.87430	0.87180	0.87570	0.87600	0.87600
400.000	0.79333	0.82933	0.84933	0.85840	0.83240	0.82907	0.83427	0.83467	0.83467
500.000	0.74167	0.78667	0.81167	0.82300	0.79050	0.78633	0.79283	0.79333	0.79333

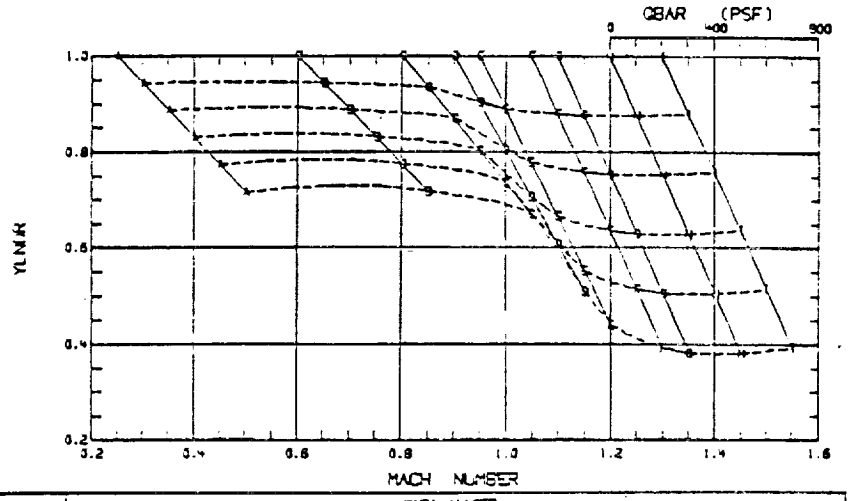
ENGINEER [signature]
DATE 4-3-25

FIGURE 4.2.1.2-145
FLEXIBLE/RIGID AILERON YAWING MOMENT DERIVATIVE

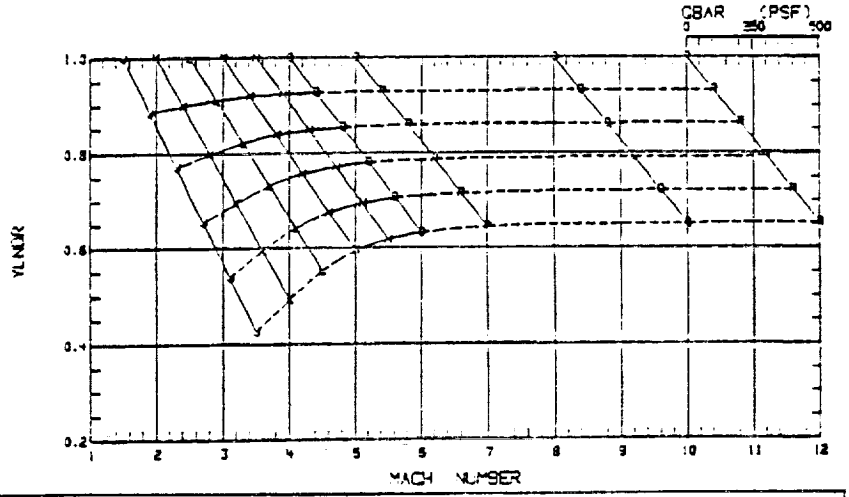
81 72-011-CCCO IM

CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XB = FS 1078.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YB = BL 0.0 IN.		WING SPAN	BW = 78.058 FT.	
MOMENT REFERENCE	ZB = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 390.3 IN.	



	MACH NUMBER								
	0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
QBAR (PSF)	F/R RUDDER YAWING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.94333	0.94300	0.93267	0.93167	0.93800	0.97833	0.97833	0.97333	0.97867
200.000	0.88667	0.88600	0.88733	0.87333	0.77500	0.75667	0.75267	0.75267	0.75733
300.000	0.83000	0.82900	0.80100	0.70500	0.66400	0.63500	0.62900	0.62900	0.63600
400.000	0.77333	0.77200	0.73467	0.60267	0.55200	0.51333	0.50533	0.50533	0.51467
500.000	0.71667	0.71500	0.66933	0.50133	0.44000	0.39167	0.38167	0.38167	0.39333

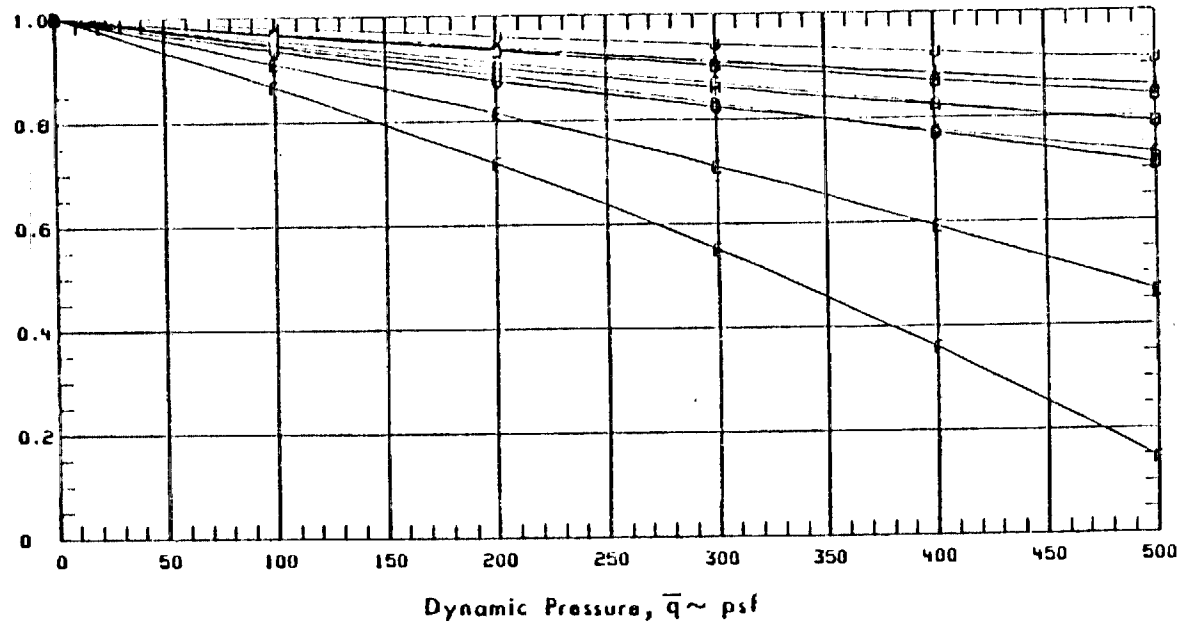


	MACH NUMBER								
	1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
QBAR (PSF)	F/R RUDDER YAWING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.96500	0.95867	0.91067	0.91900	0.92267	0.92667	0.92900	0.93033	0.93267
200.000	0.77000	0.79733	0.82133	0.83200	0.84733	0.85333	0.85800	0.86067	0.86133
300.000	0.69500	0.63500	0.73200	0.78700	0.77100	0.78000	0.78700	0.79100	0.79200
400.000	0.54000	0.55467	0.64267	0.67300	0.69467	0.70667	0.71600	0.72133	0.72267
500.000	0.42500	0.49333	0.55333	0.59500	0.61833	0.63333	0.64400	0.65167	0.65333

ENGINEER DJO
DATE 4-3-78

FIGURE 4.2.1.2-146
FLEXIBLE/RIGID RUDDER YAWING MOMENT DERIVATIVE

SL[illegible] CLASSIFIED



Roll Rate

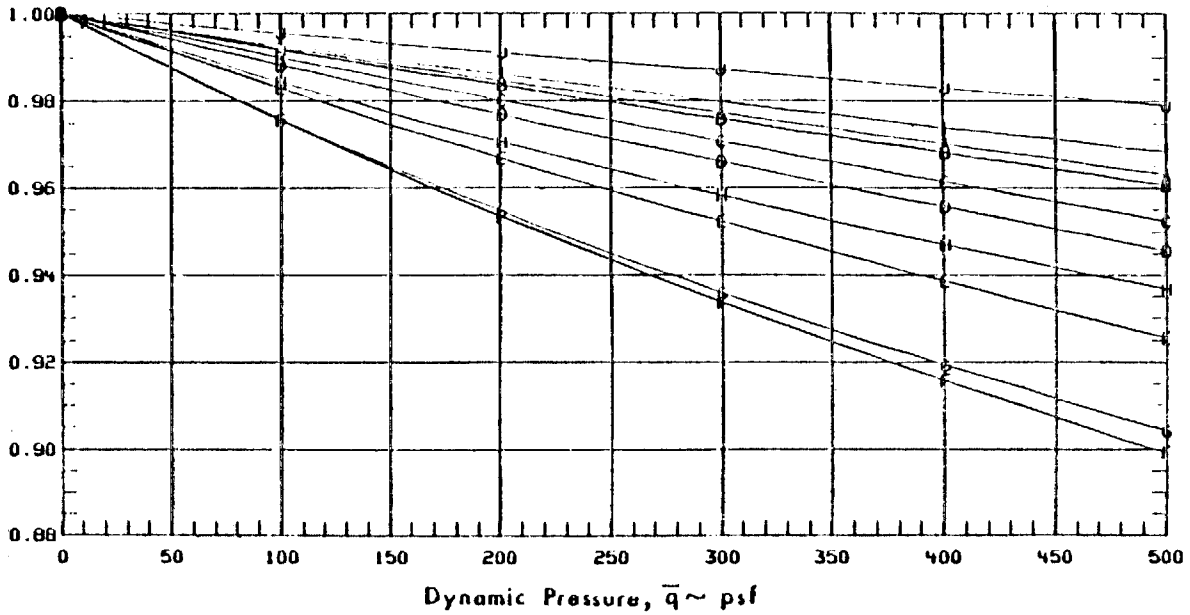
$$\eta_{n_p} = \frac{C^f_{n_p}}{C^R_{n_p}}$$

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, η_{n_p}									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.96905	0.96549	0.95403	0.94307	0.90930	0.86457	0.93408	0.94706	0.96649	0.97972
200.000	0.93928	0.93225	0.90963	0.88589	0.81249	0.71537	0.87511	0.90005	0.93574	0.96041
300.000	0.91061	0.90021	0.86672	0.82821	0.70802	0.54933	0.82216	0.85842	0.90752	0.94204
400.000	0.88287	0.86920	0.82512	0.76853	0.59077	0.35641	0.77357	0.82117	0.88140	0.92459
500.000	0.85584	0.83910	0.78456	0.70760	0.46439	0.14456	0.72840	0.78742	0.85684	0.90798

ENGINEER: DTD
DATE: 9/1/22
REVISED:

Figure 4.2.1.2-147
AEROELASTIC RATIOS

Rockwell International
Space Division



Yaw Rate

$$\eta_{n_r} = \frac{C_{n_r}^f}{C_{n_r}^R}$$

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, η_{n_r}									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99201	0.99152	0.98987	0.98806	0.98260	0.97534	0.97576	0.98427	0.99257	0.99536
200.000	0.98437	0.98339	0.98002	0.97668	0.96667	0.95333	0.95445	0.97033	0.98579	0.99097
300.000	0.97703	0.97557	0.97047	0.96585	0.95284	0.93361	0.93576	0.95798	0.97957	0.98681
400.000	0.96992	0.96798	0.96127	0.95552	0.93840	0.91552	0.91916	0.94681	0.97377	0.98283
500.000	0.96294	0.96050	0.95228	0.94552	0.92541	0.89088	0.90410	0.93670	0.96826	0.97888

ENGINEER: DTD
DATE: 9/1/77
REVISED:

Figure 4.2.1.2-148
AEROELASTIC RATIOS

Rockwell International
Space Division

CONFIGURATION

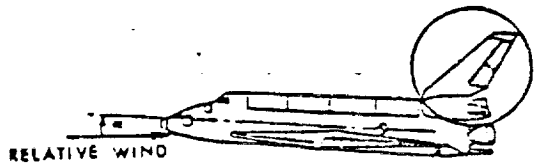
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_{B_S} = FS 1078.70; Y_{B_S} = BL 0.00; Z_{B_S} = WL 375.00

REFERENCE DIMENSIONS

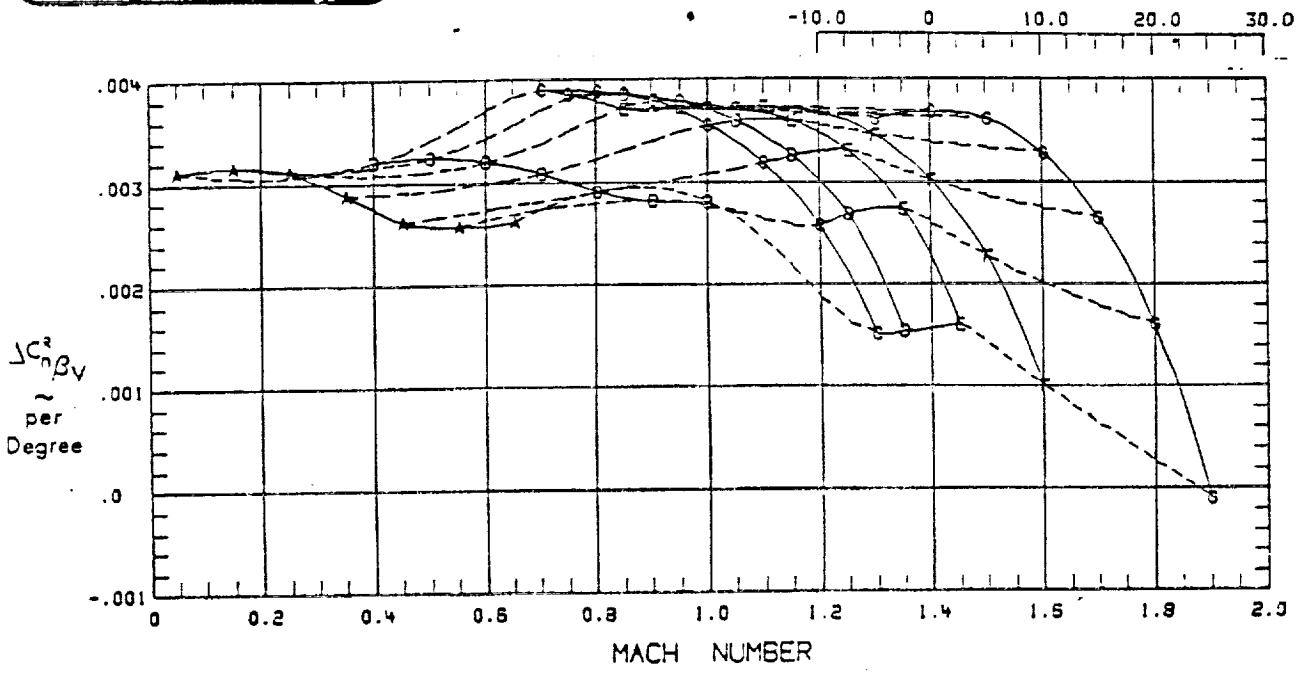
AREA S_W = 2690.000 ft²
SPAN b_W = 78.056 in
MAC c_W = 39.560 in
BODY LENGTH L_B = 1290.300 in

$\delta_e = 0°$
$\delta_{SF} = 0°$
$\delta_{SB} = 25°$



VERTICAL TAIL LOAD IN PRESENCE OF WING-BODY

$\alpha_{\sim}$ Degrees



$\alpha_{\sim}$ Degrees	Mach Number						
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500
	RIGID VERTICAL TAIL YAWING MOMENT COEFFICIENT DERIV.						
-10.000	0.00310	0.00320	0.00390	0.00385	0.00370	0.00370	0.00361
-5.000	0.00315	0.00324	0.00388	0.00385	0.00372	0.00372	0.00358
0.0	0.00310	0.00320	0.00379	0.00378	0.00370	0.00367	0.00361
5.000	0.00287	0.00308	0.00355	0.00359	0.00359	0.00345	0.00327
10.000	0.00260	0.00290	0.00318	0.00325	0.00330	0.00300	0.00264
15.000	0.00256	0.00281	0.00257	0.00268	0.00273	0.00225	0.00159
20.000	0.00260	0.00260	0.00150	0.00153	0.00160	0.00100	-0.00011
25.000							
30.000							
35.000							
40.000							

ENGINEER: DAB
DATE: 10/29/71
REVISED:

Figure 4.2.1.2-149
VERTICAL TAIL INCREMENT

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA S_w = 2690.000 ft²

SPAN b_w = 78.056 in

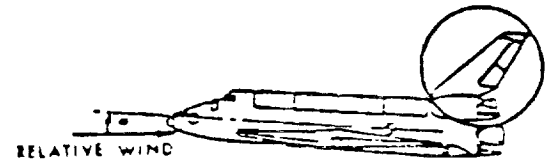
MAC c_w = 31.560 in

BODY LENGTH L_B = 1293.320 in

$\delta_e = 0°$

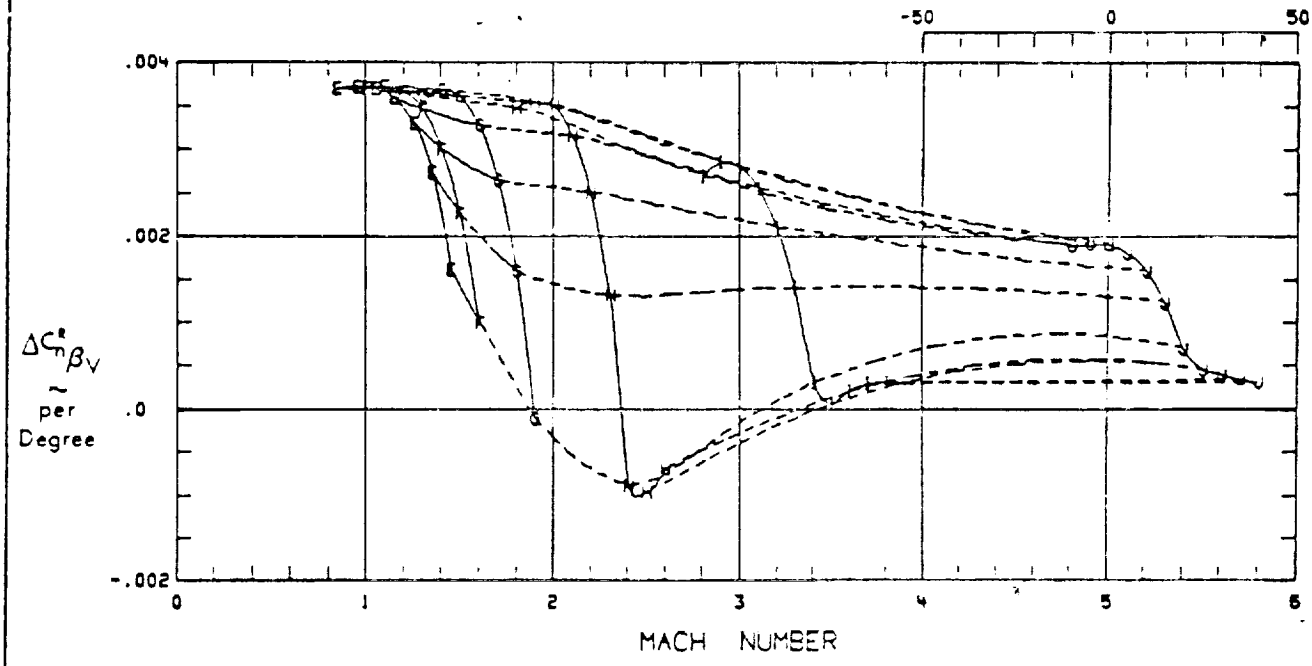
$\delta_{BF} = 0°$

$\delta_{SB} = 25°$



VERTICAL TAIL LOAD IN PRESENCE OF WING-BODY

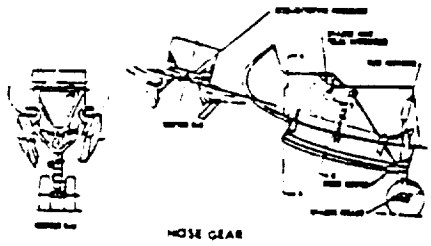
α ~ Degrees



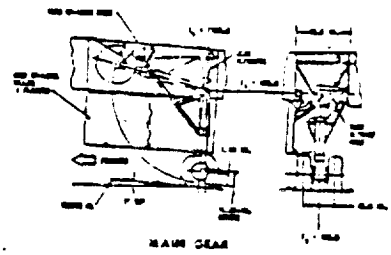
α ~ Degrees	Mach Number					
	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	RIGID VERTICAL TAIL YAWING MOMENT COEFFICIENT DERIV					
-10.000	0.00370	0.00370	0.00361	0.00348	0.00270	0.00189
-5.000	0.00372	0.00372	0.00368	0.00355	0.00285	0.00190
0.0	0.00370	0.00367	0.00361	0.00350	0.00280	0.00190
5.000	0.00359	0.00345	0.00327	0.00315	0.00255	0.00180
10.000	0.00330	0.00300	0.00264	0.00250	0.00210	0.00159
15.000	0.00273	0.00225	0.00159	0.00130	0.00140	0.00122
20.000	0.00160	0.00100	-0.00011	-0.00090	0.00030	0.00070
25.000				-0.00097	0.00005	0.00045
30.000				-0.00070	0.00020	0.00035
35.000					0.00026	0.0003-
40.000					0.00030	0.00030

ENGINEER: [illegible]
DATE: 10/29/77
REVISED:

Figure 4.2.1.2-150
VERTICAL TAIL INCREMENT



NOSE GEAR



MAIN GEAR

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY
CR
MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA
SPAN
MAC
BODY LENGTH

$$\Delta C_{n_{\substack{\text{LANDING}\\\text{GEAR}}}} = C_{n_{\beta_{\substack{\text{GEAR}\\\text{DOWN}}}}} - C_{n_{\beta_{\substack{\text{GEAR}\\\text{UP}}}}}$$

α Degrees	$\Delta C_{n_{\beta_{LG}}}$
-10.000	0.00023
-5.000	0.00006
0.0	-0.00018
5.000	-0.00041
10.000	-0.00063
15.000	-0.00025
20.000	0.00026
25.000	0.00078

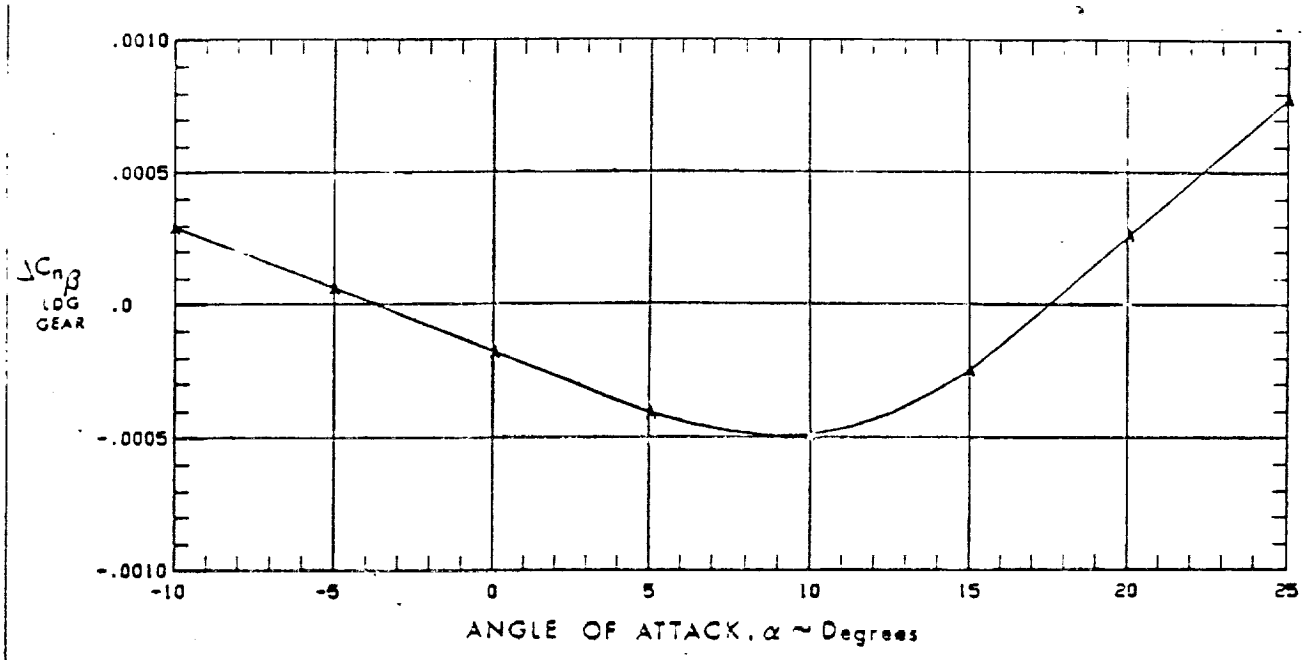
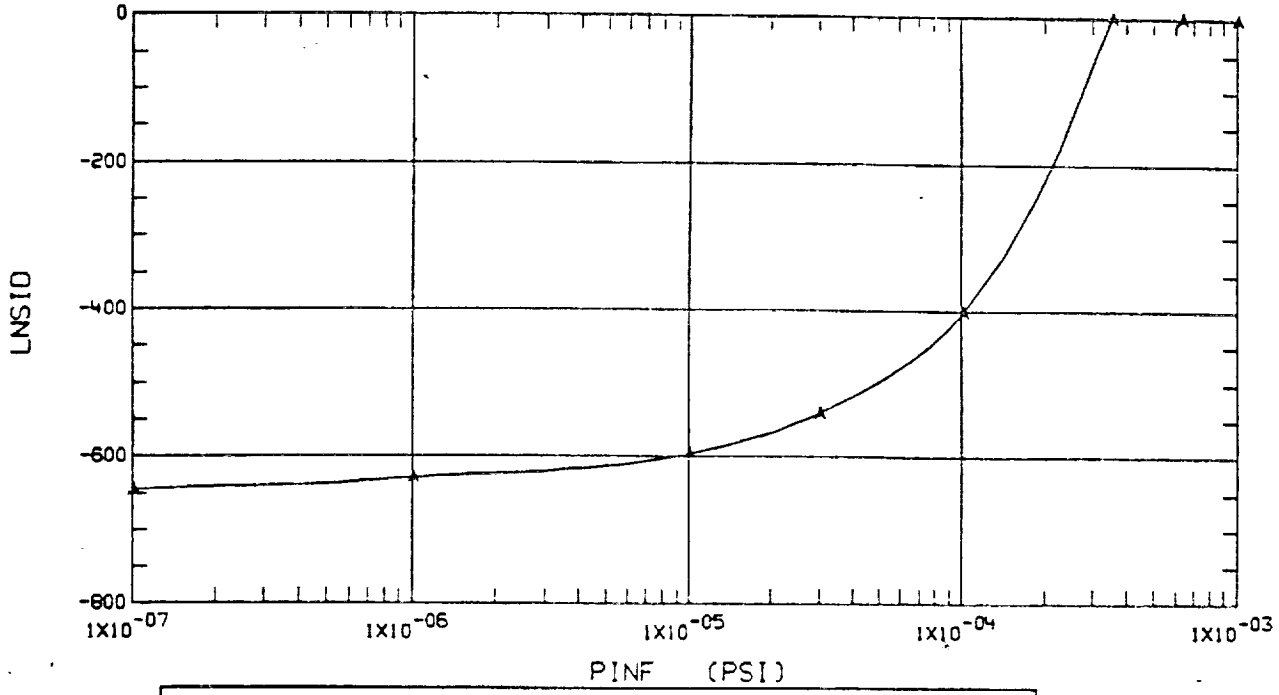


Figure 4.2.1.2-151
EFFECT OF LANDING GEAR



CONFIGURATION

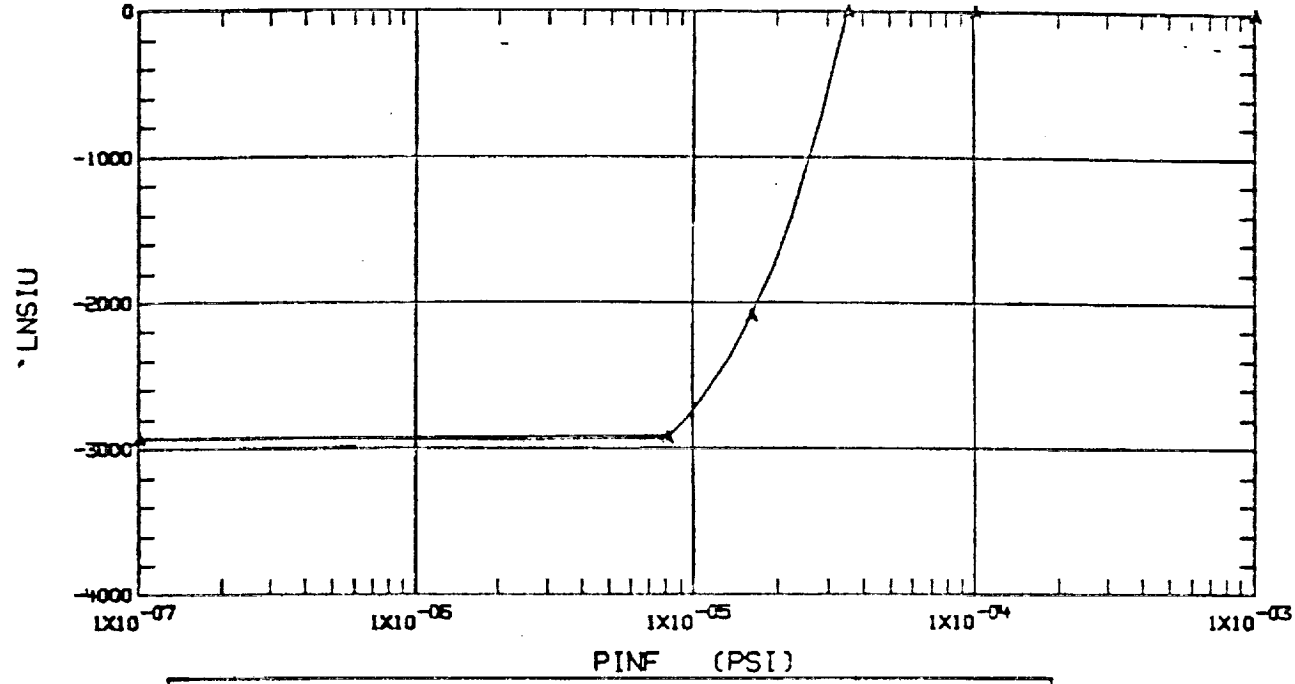
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

PINF (PSI)	$\sim_{SURF\ IMP}$ YAWING MOM $\frac{ft\text{-}lb}{n}$
1.000E-07	-645.460
1.000E-06	-629.250
1.000E-05	-597.110
3.000E-05	-540.520
1.000E-04	-403.430
3.500E-04	0.0
6.300E-04	0.0
1.000E-03	0.0

LH SHOWN
RH USE OPPOSITE SIGN

ENGINEER
DATE 7-7-82

FIGURE 4.2.1.2-152
YAWING MOMENT SURFACE IMPINGEMENT, DOWN-FIRING



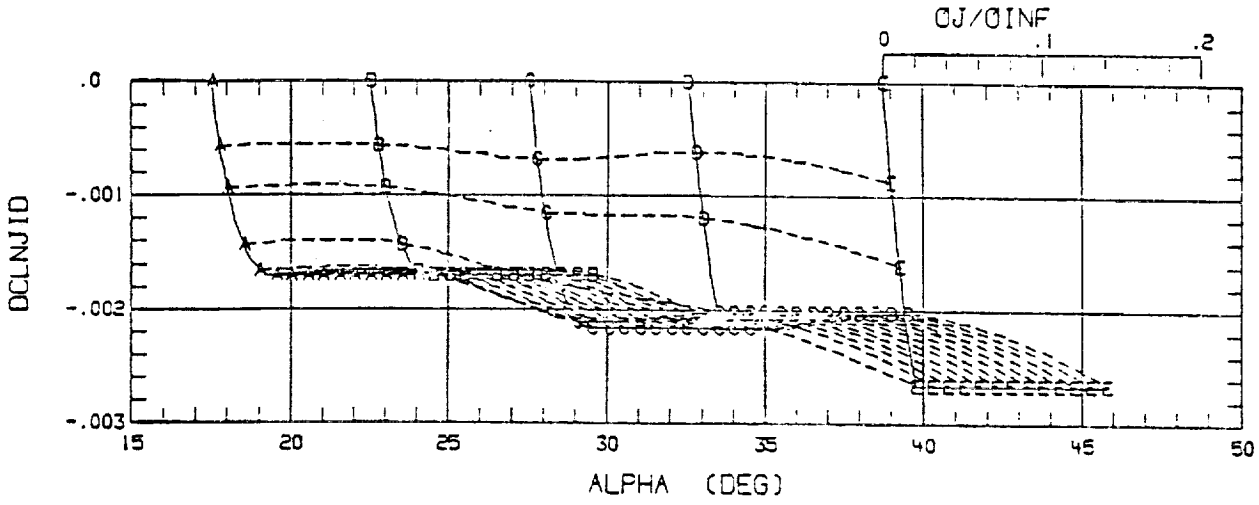
CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	B = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

LH SHOWN
RH USE OPPOSITE SIGN

PINF (PSI)	$N_{SURF\ IMP}$ ft-lb YAWING MOM
1.000E-07	-2932.80005
8.000E-06	-2932.80005
1.600E-05	-2100.00000
3.500E-05	0.0
1.000E-04	0.0
1.000E-03	0.0

ENGINEER LP
DATE 9/9/92

FIGURE 4.2.1.2-153
YAWING MOMENT SURFACE IMPINGEMENT.UP-FIRING



DJ/DINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	YAWING MOMENT COEF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00057	-0.00057	-0.00069	-0.00062	-0.00089
0.0100	-0.00094	-0.00094	-0.00116	-0.00120	-0.00182
0.0200	-0.00144	-0.00154	-0.00160	-0.00204	-0.00267
0.0300	-0.00167	-0.00168	-0.00211	-0.00204	-0.00267
0.0400	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.0500	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.0600	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.0700	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.0800	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.0900	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.1000	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.1100	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.1200	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.1300	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267
0.1400	-0.00171	-0.00171	-0.00217	-0.00204	-0.00267

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{n_{jt}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

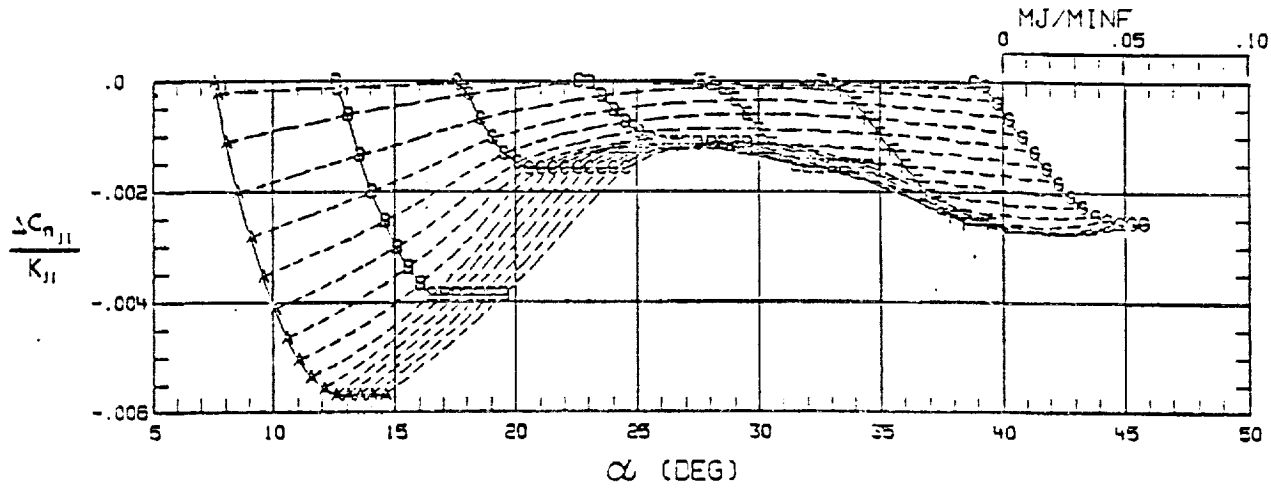
ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	YAWING MOMENT COEF					
17.500	-0.0001	-0.1040	2.0800	-12.1000	0.0050	0.0400
22.500	-0.0001	-0.1030	2.0300	-11.6000	0.0050	0.0400
27.500	-0.0001	-0.1300	2.5200	-14.1000	0.0050	0.0400
32.500	0.0001	-0.1570	2.8000	-14.9000	0.0050	0.0200
38.750	0.0	-0.1940	3.3600	-17.1000	0.0050	0.0200

Interpolate for α's not shown after calculation of given α's only

LH SHOWN
RH USE OPPOSITE SIGN

ENGINEER HSD
DATE 10/5/77

FIGURE 4.2.1.2-154
YAWING MOMENT JET INTERACTION, DOWN-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	YAWING MOMENT JI.SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00022	-0.00012	-0.00005	-0.00001	-0.00001	-0.00002	-0.00002
0.005	-0.00111	-0.00062	-0.00024	-0.00003	-0.00006	-0.00009	-0.00009
0.010	-0.00201	-0.00135	-0.00069	-0.00027	-0.00012	-0.00018	-0.00039
0.015	-0.00282	-0.00200	-0.00104	-0.00052	-0.00034	-0.00043	-0.00069
0.020	-0.00353	-0.00255	-0.00131	-0.00074	-0.00061	-0.00070	-0.00100
0.025	-0.00413	-0.00302	-0.00149	-0.00093	-0.00099	-0.00098	-0.00130
0.030	-0.00464	-0.00339	-0.00159	-0.00107	-0.00116	-0.00127	-0.00158
0.035	-0.00505	-0.00368	-0.00159	-0.00114	-0.00138	-0.00156	-0.00185
0.040	-0.00536	-0.00388	-0.00158	-0.00114	-0.00152	-0.00183	-0.00209
0.045	-0.00557	-0.00388	-0.00158	-0.00114	-0.00157	-0.00208	-0.00227
0.050	-0.00567	-0.00388	-0.00158	-0.00114	-0.00157	-0.00230	-0.00242
0.055	-0.00567	-0.00388	-0.00158	-0.00114	-0.00157	-0.00247	-0.00252
0.060	-0.00567	-0.00388	-0.00158	-0.00114	-0.00157	-0.00260	-0.00256
0.065	-0.00567	-0.00389	-0.00159	-0.00114	-0.00157	-0.00260	-0.00255
0.070	-0.00567	-0.00389	-0.00159	-0.00114	-0.00157	-0.00260	-0.00255

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{q_\infty}\right)$$

$$\Delta C_{n_{JI}} = \left[A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3\right] K_{JI}$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the table below.

$K_{JI} = 1.0$

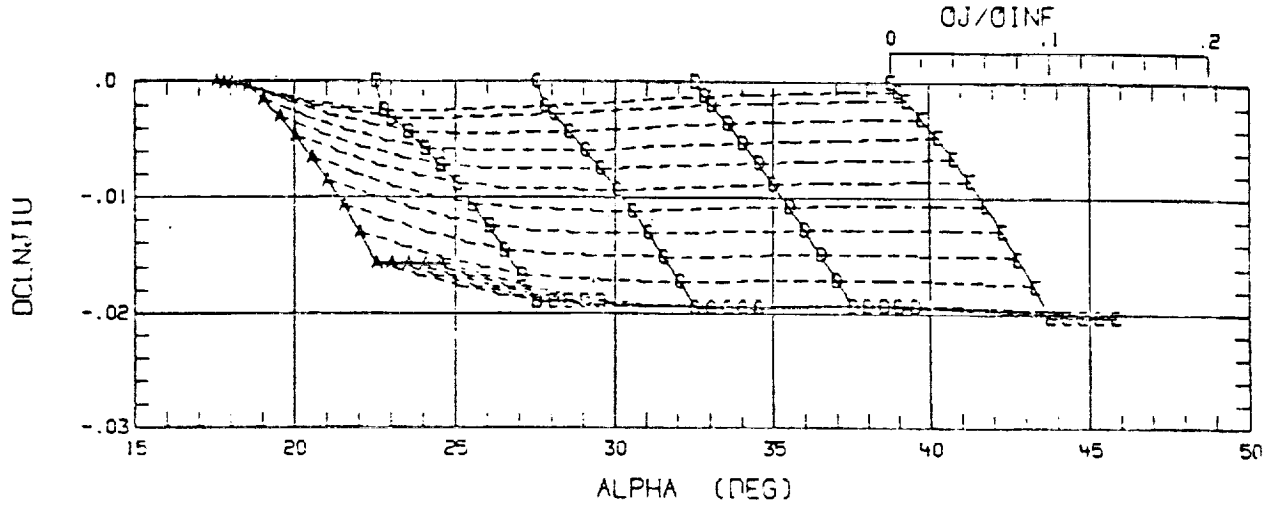
ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	YAWING MOMENT JI.SF					
7.500	-0.00010	-0.21110	1.95200	0.0	0.00500	0.05000
12.500	0.00020	-0.17330	1.76500	0.0	0.00500	0.04000
17.500	0.00030	-0.11700	1.84000	-0.96800	0.00500	0.03500
22.500	0.00020	-0.04360	-0.57000	20.90000	0.00500	0.03500
27.500	0.00010	-0.00030	-2.52000	37.80000	0.00500	0.04500
32.500	0.00020	-0.02920	-1.04000	12.50000	0.00500	0.06000
38.750	0.00020	-0.05510	-0.44500	9.96000	0.00500	0.06000

Interpolate for α's not shown after calculation. of given α's only

LH SHOWN
RH USE OPPOSITE SIGN

ENGINEER HP
DATE 4/5/79

FIGURE 4.2.1.2-155
YAWING MOMENT JET INTERACTION. SIDE-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	YAWING MOMENT DUE TO				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00005	-0.00265	-0.00209	-0.00012	-0.00050
0.0100	-0.00017	-0.00312	-0.00281	-0.00200	-0.00169
0.0200	-0.00074	-0.00478	-0.00431	-0.00356	-0.00311
0.0300	-0.00152	-0.00576	-0.00590	-0.00525	-0.00483
0.0400	-0.00309	-0.00727	-0.00757	-0.00719	-0.00686
0.0500	-0.00474	-0.00881	-0.00934	-0.00893	-0.00863
0.0600	-0.00657	-0.01068	-0.01120	-0.01081	-0.01070
0.0700	-0.00851	-0.01259	-0.01314	-0.01275	-0.01264
0.0800	-0.01076	-0.01461	-0.01517	-0.01493	-0.01511
0.0900	-0.01313	-0.01677	-0.01730	-0.01710	-0.01752
0.1000	-0.01567	-0.01906	-0.01951	-0.01949	-0.02009
0.1100	-0.01567	-0.01906	-0.01951	-0.01949	-0.02009
0.1200	-0.01567	-0.01906	-0.01951	-0.01949	-0.02009
0.1300	-0.01567	-0.01906	-0.01951	-0.01949	-0.02009
0.1400	-0.01567	-0.01906	-0.01951	-0.01949	-0.02009

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{n_{jl}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	YAWING [illegible]					
17.500	0.0017	[illegible]	[illegible]	[illegible]	0.0050	0.1000
22.500	-0.0002	[illegible]	[illegible]	[illegible]	0.0050	0.1000
27.500	-0.0007	[illegible]	[illegible]	[illegible]	0.0050	0.1000
32.500	-0.0008	[illegible]	[illegible]	[illegible]	0.0050	0.1000
38.750	-0.0011	[illegible]	[illegible]	[illegible]	0.0050	0.1000

Interpolate for α's not shown after calculation of given α's only.

LH SHOWN, RH USE OPPOSITE SIGN

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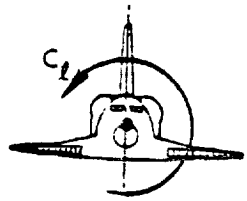
DATE [illegible]

FIGURE 4.2.1.2-156
YAWING MOMENT JET INTERACTION, UP FIRING

4.2.1.3 ROLLING MOMENT COEFFICIENT. The Orbiter Vehicle aerodynamic rolling moment coefficient is defined in this section. The basic aerodynamic rolling moment coefficient data are presented in three forms: 1) as a function of angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty^1$) from 0.005 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet through 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.2.1.3]. Uncertainties associated with the rolling moment characteristics are available in Section 6.0.



The RCS flow field interaction data are presented as a contribution to the total rolling moment ($\mathscr{L}$) rather than the coefficient (C_ℓ) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where RCS is used in conjunction with the aerodynamic rolling moment (cf. Section 3.6); i.e., the aerodynamic rolling moment coefficient must be converted to a dimensional moment *before* adding the RCS flow field interaction effect (see also Appendix B).

The total rolling moment is:

$$\mathscr{L}_{TOTAL} = \bar{q}\, S\, b\, C_{\ell_{\substack{TOTAL \\ AERO}}} + \mathscr{L}_{RCS}$$

* The total aerodynamic rolling moment coefficient about a moment reference center at 65 percent of the body length (FS 1076.7, WL 375.0, BL 0.0) is obtained by the following equation:

$$C_{\ell_{\substack{TOTAL \\ AERO}}} = C_{\ell_{BASIC}} + \Delta C_{\ell_{\substack{\beta \\ ELEVON}}} \beta + C_{\ell_{\delta_a}} \delta_a + \Delta C_{\ell_{\substack{BODY \\ FLAP}}} + C_{\ell_{\delta_r}} \delta_r + \Delta C_{\ell_{\substack{\beta \\ SPEED\ BRAKE}}} \beta$$

$$+ C_{\ell_{\hat{p}}} \frac{pb}{2V} + C_{\ell_{\hat{r}}} \frac{rb}{2V} + \Delta C_{\ell_{FLEX}} + \Delta C_{\ell_{\substack{\beta \\ LANDING\ GEAR}}} \beta + \Delta C_{\ell_{\substack{GROUND \\ EFFECT}}} + \Delta C_{\ell_{\substack{SILTS \\ POD}}}$$

where,

---

* Refer to Appendix D when using digitized data.

NOTE: The increment presented in Appendix E should be added to the total from above calculations to account for OV102 manufacturing misalignment.

$C_{\ell_{BASIC}}$ = Basic, full-scale, freestream, rigid-body rolling moment coefficient. (Figures 4.2.1.3-1 through -29)

NOTE: 1. Hypersonic-high altitude data given as C_{ℓ_β} (must be multiplied by β).

2. All control surfaces neutral *except* $\delta_{SB} = 25°$.

3. For Moment Reference Center other than 0.65 L_B,

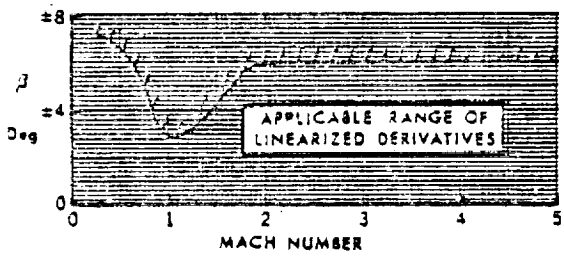
$$C_{\ell_{MRC}} = C_{\ell_{0.65L_B}} + \frac{\Delta Y}{b} C_N - \frac{\Delta Z}{b} C_Y$$

where, $\Delta Y = Y_{MRC}$

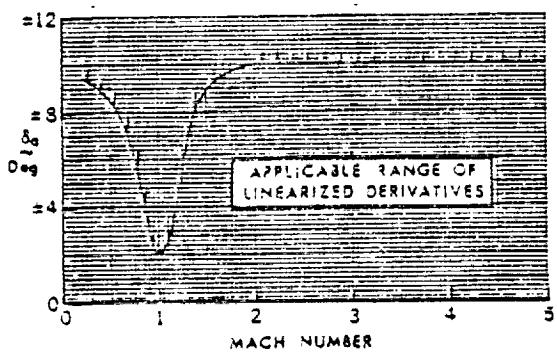
$\Delta Z = Z_{MRC} - 375.0$

4. Moment transfer of (3) applies to all following increments and/or slopes except as noted.

$\Delta C_{\ell_{\beta_{ELEVON}}}$ = Change in rolling moment coefficient with change in sideslip angle, β, due to elevon deflection, δ_e. (Figures 4.2.1.3-30 through -56)



$C_{\ell_{\delta_a}}$ = Change in total rolling moment coefficient with change in aileron deflection, δ_a, when inboard and outboard angles are equal. (Figures 4.2.1.3-57 through -93)

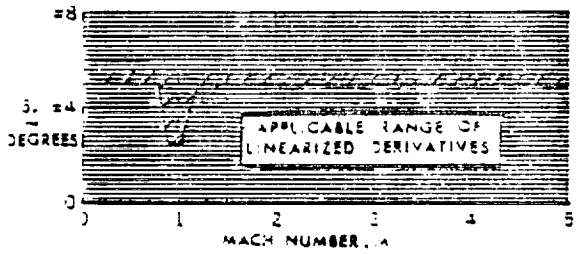


NOTE: 1. Partial span factor, K_{ℓ}, to be used for elevon-body flap interconnect flight system where δ_e is limited to ±5° and inboard and outboard angles are not equal. (Figure 4.2.1.3-94)

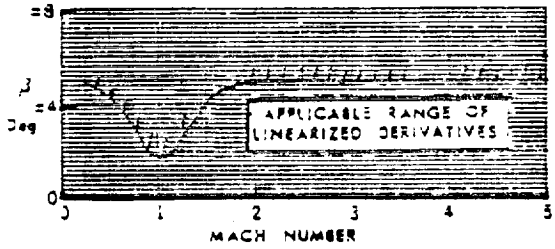
$$\Delta C_{\ell_{AILERON}} = C_{\ell_{\delta_c}} [K_{\ell} \delta_{a_i} + (1 - K_{\ell}) \delta_{a_o}]$$

$\Delta C_{\ell_{BODY\ FLAP}}$ = Change in rolling moment coefficient due to body flap deflection, δ_{BF}. (Assume zero)

$C_{\ell_{\delta_r}}$ = Change in rolling moment coefficient with change in rudder deflection, δ_r. (Figures 4.2.1.3-95 through -121)



$\Delta C_{\ell_{\beta_{SPEED\ BRAKE}}}$ = Change in rolling moment coefficient with change in sideslip angle, β, for various speed brake settings, δ_{SB}. (Figures 4.2.1.3-122 through -148)



C_{ℓ_p} = Change in rolling moment coefficient due to roll rate, p, (per radian).* (Figures 4.2.1.3-151 and -152)

C_{ℓ_r} = Change in rolling moment coefficient due to yaw rate, r, (per radian).* (Figures 4.2.1.3-149 and -150)

*For rotary derivative transfer equations see NASA SP-3070, "Summary of Transformation Equations and Equations of Motion Used in Free Flight and Wind Tunnel Data Reduction and Analysis," Gainer, T. G., and S. Hoffman, Langley Research Center, Hampton, Virginia (1972)

$\Delta C_{\ell_{FLEX}}$ = Change in rolling moment coefficient due to aeroelastic deformation.

$$= -(1 - \eta_{\ell_{WB}})(C^R_{\ell_{BASIC}} - \Delta C^R_{\ell_{\beta_V}} \beta) - (1 - \eta_{\ell_V})(\Delta C^R_{\ell_{\beta_V}} + \Delta C^R_{\ell_{\beta_{SB}}}) \beta$$

$$- (1 - \eta_{\ell_a})\Delta C_{\ell_{AILERON}} - (1 - \eta_{\ell_R}) C^R_{\ell_{\delta_r}} \delta_r - (1 - \eta_{\ell_p}) C^R_{\ell_p} \frac{pb}{2V}$$

$$- (1 - \eta_{\ell_r}) C^R_{\ell_r} \frac{rb}{2V} - (1 - \eta_{\ell_e})\Delta C_{\ell_{\beta_{ELEVON}}} \beta$$

where the flexible (F) to rigid (R) are,

$\eta_{\ell_{WB}}$ = wing-body contribution (Figure 4.2.1.3-153)

η_{ℓ_V} = vertical tail contribution (Figure 4.2.1.3-154)

η_{ℓ_a} = aileron (Figure 4.2.1.3-155)

η_{ℓ_R} = rudder (Figure 4.2.1.3-156)

η_{ℓ_p} = roll rate (Figure 4.2.1.3-157)

η_{ℓ_r} = yaw rate (Figure 4.2.1.3-158)

η_{ℓ_e} = elevon (Assume 1.0)

and,

$\Delta C^R_{\ell_{\beta_V}}$ = incremental effect of vertical tail due to sideslip (Figure 4.2.1.3-159 and -160.)

NOTE: 1. Detailed discussion of aeroelasticity may be obtained from Appendix A.

$\Delta C_{\ell_{\beta_{LANDING\ GEAR}}}$ = Change in rolling moment coefficient due to extending landing gear. (Figure 4.2.1.3-161)

$\Delta C_{\ell_{GROUND\ EFFECT}}$ = Change in rolling moment coefficient derivative due to proximity of ground, f(h/b).

$$= \Delta C_{\ell_{\beta_{GE}}} \beta + \Delta C_{\ell_{\delta a_{GE}}} \delta_a$$

$\Delta C_{\ell_{\beta_{GE}}}$ = Incremental rolling moment coefficient derivative due to sideslip. (Figure 4.2.1.3-162)

$\Delta C_{\ell_{\delta a_{GE}}}$ = Incremental rolling moment coefficient derivative due to aileron deflection. (Figure 4.2.1.3-163)

NOTE: 1. See Section 3.4 for ground clearance and scrape attitude.

$\Delta C_{\ell_{\substack{SILTS \\ POD}}}$ = Change in rolling moment coefficient due to addition of SILTS pod.

$= \Delta C_{\ell_{\substack{\beta_{SILTS} \\ POD}}} \beta + \Delta C_{\ell_{\substack{\delta_{SILTS} \\ POD}}} \delta_r$

where,

$\Delta C_{\ell_{\substack{\beta_{SILTS} \\ POD}}}$ = $-0.0000806963 + 0.0000446417\ M - 0.00000628417\ M^2$ for $M \leq 6.0$

= zero for $M > 6.0$

$\Delta C_{\ell_{\substack{\delta_{SILTS} \\ POD}}}$ = $-0.000074168 + 0.000088076\ M - 0.000019544\ M^2$ for $M \leq 6.0$

= zero for $M > 6.0$

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

* The effect of the RCS may be described as a dimensional rolling moment (foot-pounds) in terms of the significant contributing elements by:

$$\mathscr{L}_{RCS} = \mathscr{L}_{JT} + [\mathscr{L}_{SURF} + \Delta\mathscr{L}_{ELEVON} \pm \Delta\mathscr{L}_{\substack{BODY \\ FLAP}}]_{IMP} + \bar{q}\ S\ b[\Delta C_{\ell} + \Delta C_{\ell_{ELEVON}} + \Delta C_{\ell_{\substack{BODY \\ FLAP}}} + \Delta C_{\ell_{\substack{DOWN\ FIRING \\ CARRYOVER \\ 2\ SIDES}}}]_{JI}$$

where,

$\mathscr{L}_{JI}$ = Rolling moment resulting from number (n) of jets being fired. (cf. Appendix B)

$= \sum_{OJG} [\mathscr{L}_{JET} \cdot n]$ ~ ft-lb

NOTE: 1. OJG = operating jet group

3. Values given in Figure B-1 are for reference only.

* Refer to Appendix D when using digitized data.

$\mathscr{L}_{\substack{SURF \\ IMP}}$ = Rolling moment resulting from jet impingement on Orbiter Vehicle surface(s). (Figures 4.2.1.3-164 and -165)

$$= \sum_{OJG} [\mathscr{L}_{\substack{SURF \\ IMP}} \cdot \quad n\ ] \sim \text{ft-lb}$$

$\mathscr{L}_{\substack{ELEVON \\ IMP}}$ = Change in rolling moment due to jet impingement on elevon effectiveness. (Figure 4.2.1.3-166)

$$\sum_{OJG} [\frac{\partial \mathscr{L}}{\partial \delta_e} \delta_e \cdot \ n\ ] \sim \text{ft-lb}$$

$\mathscr{L}_{\substack{BODY \\ FLAP \\ IMP}}$ = Change in rolling moment due to jet impingement on body flap effectiveness. (Figure 4.2.1.3-167)

$$= \sum_{OJG} [\ \frac{\partial \mathscr{L}}{\partial \delta_{BF}} \delta_{BF} \cdot \ n\ ] \sim \text{ft-lb}$$

$\Delta C_{\ell_{JI}}$ = Change in rolling moment coefficient due to jet interaction. (Figures 4.2.1.3-168 through -170)

$$= \sum_{OJG} [\Delta C_{\ell_{JI}}]$$

$\Delta C_{\substack{\ell_{ELEVON} \\ JI}}$ = Change in rolling moment coefficient due to jet interaction effect on elevon effectiveness.

$$= \sum_{OJG} [(\Delta C_\ell)_{\delta_{e_{REF}}} (\delta_e/\delta_{e_{REF}})^{0.75}]$$

NOTE: 1. Down-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.2.1.3-171)

$\delta e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.2.1.3-172)

2. Side firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.2.1.3-173)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.2.1.3-174)

3. Up-firing jets (No effect)

$\Delta C_{\ell_{\substack{\text{BODY}\\\text{FLAP}\\\text{JI}}}}$ = Change in rolling moment coefficient due to jet interaction on body flap effectiveness. (No effect)

$$= \sum_{OJG} \left[(\Delta C_\ell)_{\delta_{BF_{REF}}} \left(\delta_{BF} / \delta_{BF_{REF}} \right)^{0.75} \right]$$

$\Delta C_{\ell_{\substack{\text{DOWN}\\\text{FIRING}\\\text{CARRYOVER}\\\text{JI}\\\text{2 SIDES}}}}$ = Effect of carry-over between left- and right-down firing jet groups due to jet interaction. (No effect)

$$= \left[\frac{\partial C_\ell}{\partial (\phi_j / \phi_\infty)} \right] \left[(\overline{\phi_j / \phi_\infty}) \right]$$

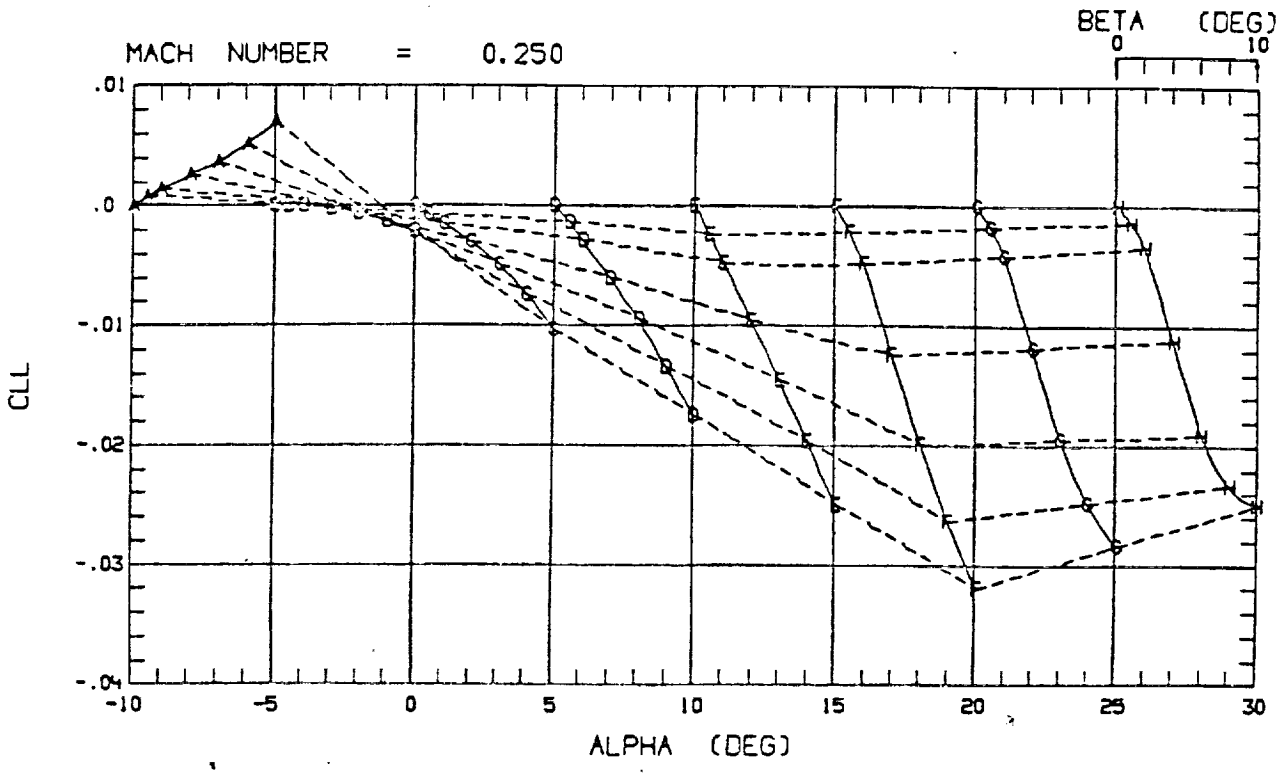
NOTE: 1. $\phi_j / \phi_\infty = (0.1543 / \overline{q}_\infty) n$

2. This term is zero when down-firing jet group is inoperative on one side.

3. $(\overline{\phi_j / \phi_\infty}) = \frac{1}{2} \left[(\phi_j / \phi_\infty)_{LD} + (\phi_j / \phi_\infty)_{RD} \right]$

where: $0 < (\overline{\phi_j / \phi_\infty}) < 0.03$

The total RCS effect, $\mathscr{L}_{RCS}$, during thrust build-up and decay is obtained by reducing the full thrust value by the ratio of momentary thrust (see Ref. 4-3) to full thrust.

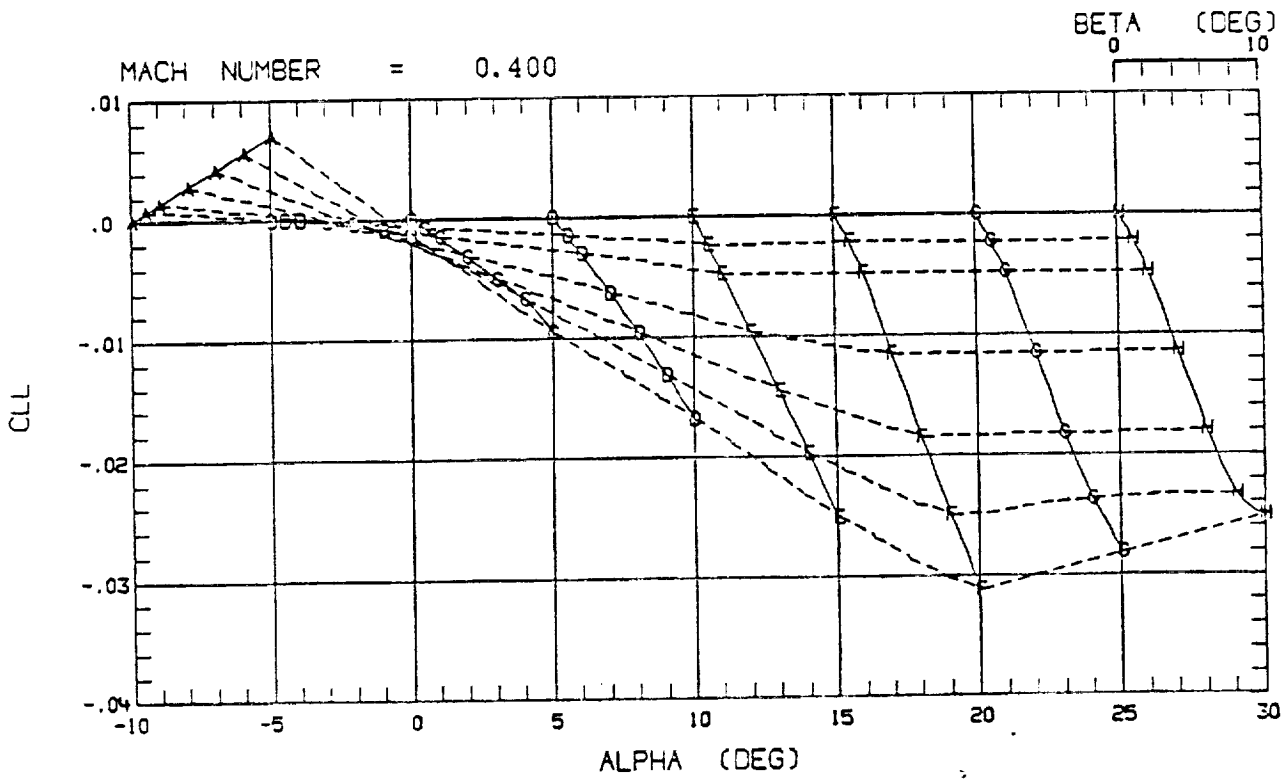


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00073	0.00001	-0.00073	-0.00147	-0.00239	-0.00223	-0.00181	-0.00139
2.000	0.00140	-0.00003	-0.00150	-0.00300	-0.00480	-0.00490	-0.00420	-0.00350
4.000	0.00245	-0.00025	-0.00313	-0.00617	-0.00965	-0.01245	-0.01190	-0.01135
6.000	0.00350	-0.00063	-0.00500	-0.00960	-0.01460	-0.02000	-0.01960	-0.01920
8.000	0.00507	-0.00130	-0.00746	-0.01342	-0.01972	-0.02639	-0.02486	-0.02334
10.000	0.00700	-0.00220	-0.01040	-0.01760	-0.02500	-0.03200	-0.02850	-0.02500

ENGINEER LL
DATE 9/11/78

FIGURE 4.2.1.3-1
BASIC ROLLING MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00075	-0.00001	-0.00078	-0.00153	-0.00241	-0.00223	-0.00231	-0.00219
2.000	0.00140	-0.00003	-0.00159	-0.00308	-0.00484	-0.00482	-0.00480	-0.00480
4.000	0.00290	-0.00019	-0.00324	-0.00631	-0.00971	-0.01160	-0.01154	-0.01145
6.000	0.00420	-0.00045	-0.00504	-0.00965	-0.01468	-0.01650	-0.01830	-0.01805
8.000	0.00560	-0.00086	-0.00680	-0.01323	-0.01987	-0.02507	-0.02370	-0.02334
10.000	0.00700	-0.00140	-0.00959	-0.01695	-0.02621	-0.03119	-0.02915	-0.02513

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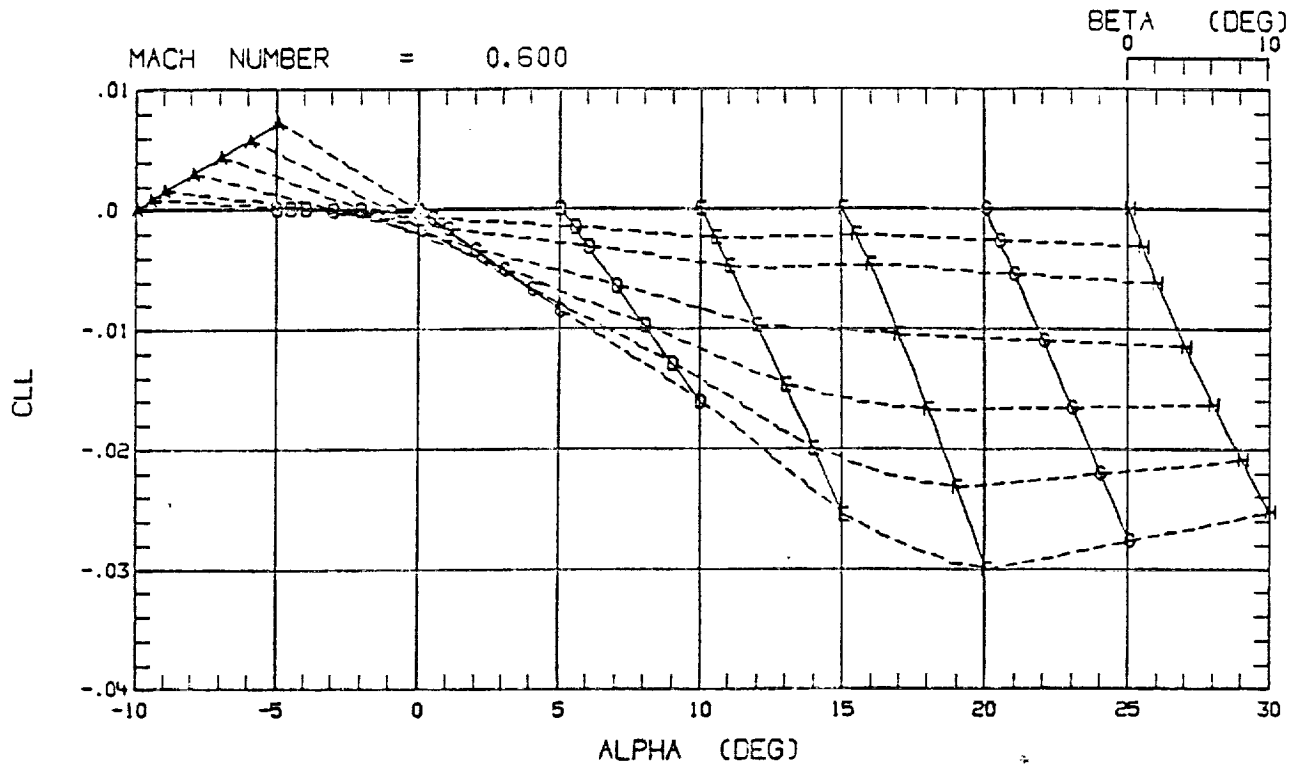
DATE 9-7-82

FIGURE 4.2.1.3-2
BASIC ROLLING MOMENT COEFFICIENT



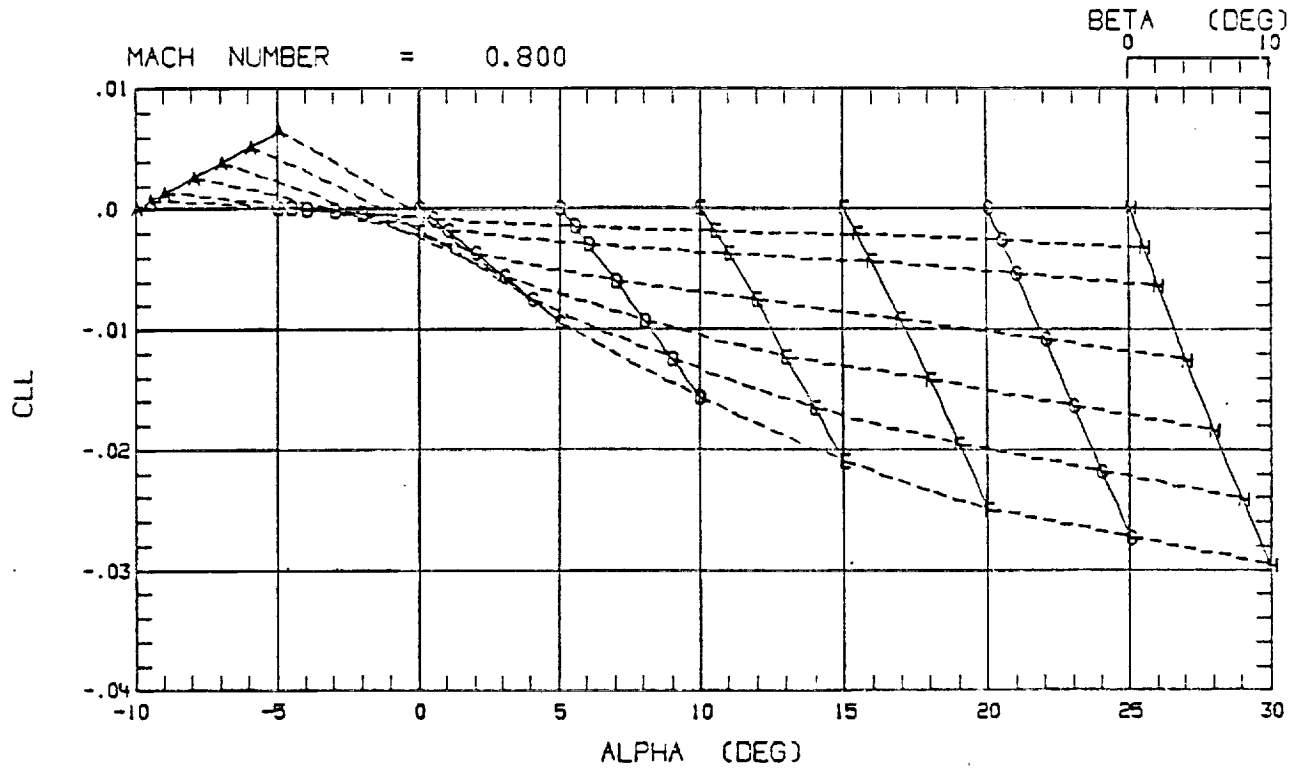
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00076	-0.00001	-0.00085	-0.00159	-0.00245	-0.00224	-0.00275	-0.00325
2.000	0.00150	-0.00003	-0.00170	-0.00320	-0.00490	-0.00470	-0.00550	-0.00630
4.000	0.00290	-0.00012	-0.00340	-0.00650	-0.00980	-0.01052	-0.01105	-0.01158
6.000	0.00430	-0.00020	-0.00510	-0.00980	-0.01480	-0.01660	-0.01660	-0.01640
8.000	0.00574	-0.00027	-0.00680	-0.01299	-0.02007	-0.02330	-0.02215	-0.02100
10.000	0.00720	-0.00033	-0.00850	-0.01610	-0.02550	-0.03010	-0.02770	-0.02530

ENGINEER LLL
DATE 9-11-28

FIGURE 4.2.1.3-3
BASIC ROLLING MOMENT COEFFICIENT



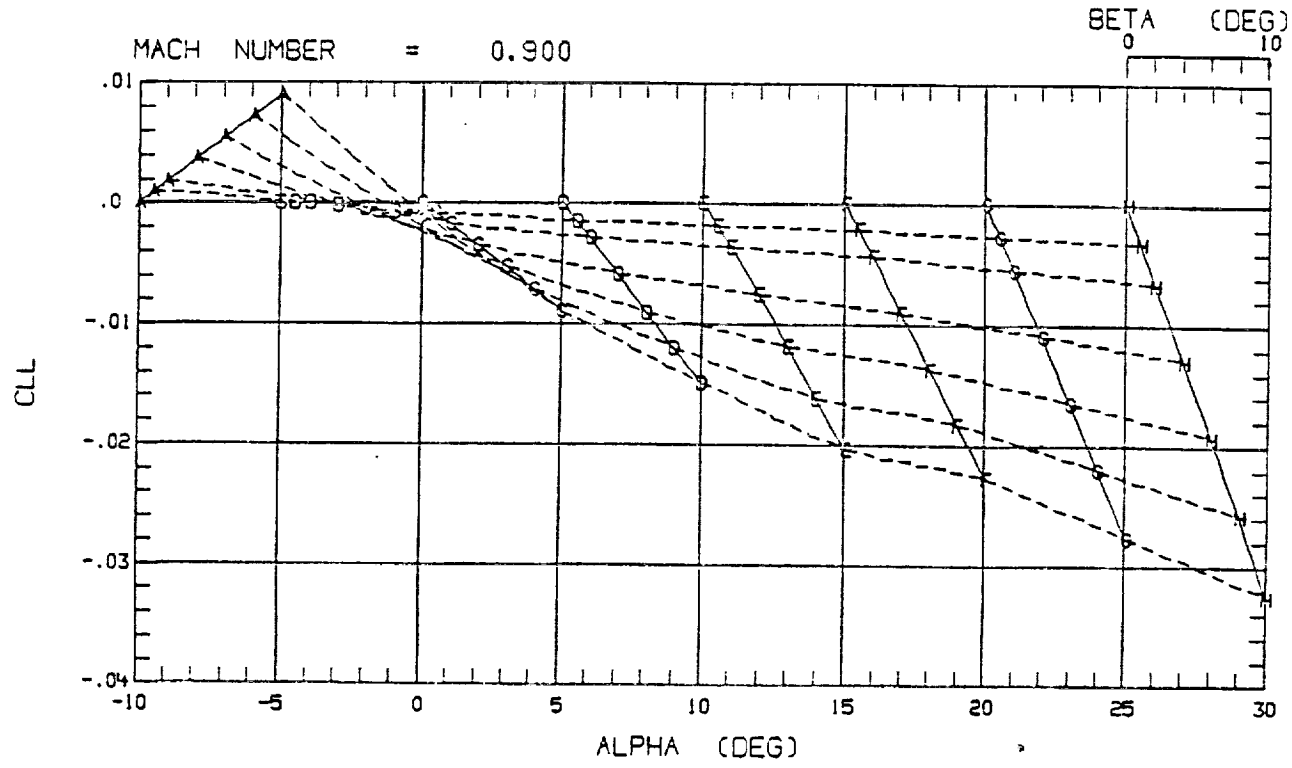
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00065	-0.00006	-0.00095	-0.00153	-0.00192	-0.00221	-0.00275	-0.00329
2.000	0.00130	-0.00013	-0.00190	-0.00306	-0.00384	-0.00450	-0.00550	-0.00650
4.000	0.00255	-0.00032	-0.00380	-0.00612	-0.00768	-0.00933	-0.01100	-0.01257
6.000	0.00380	-0.00050	-0.00570	-0.00940	-0.01240	-0.01440	-0.01650	-0.01860
8.000	0.00509	-0.00062	-0.00760	-0.01259	-0.01671	-0.01965	-0.02196	-0.02427
10.000	0.00640	-0.00070	-0.00950	-0.01580	-0.02110	-0.02510	-0.02740	-0.02970

ENGINEER CLL
DATE 9-22-78

FIGURE 4.2.1.3-4
BASIC ROLLING MOMENT COEFFICIENT



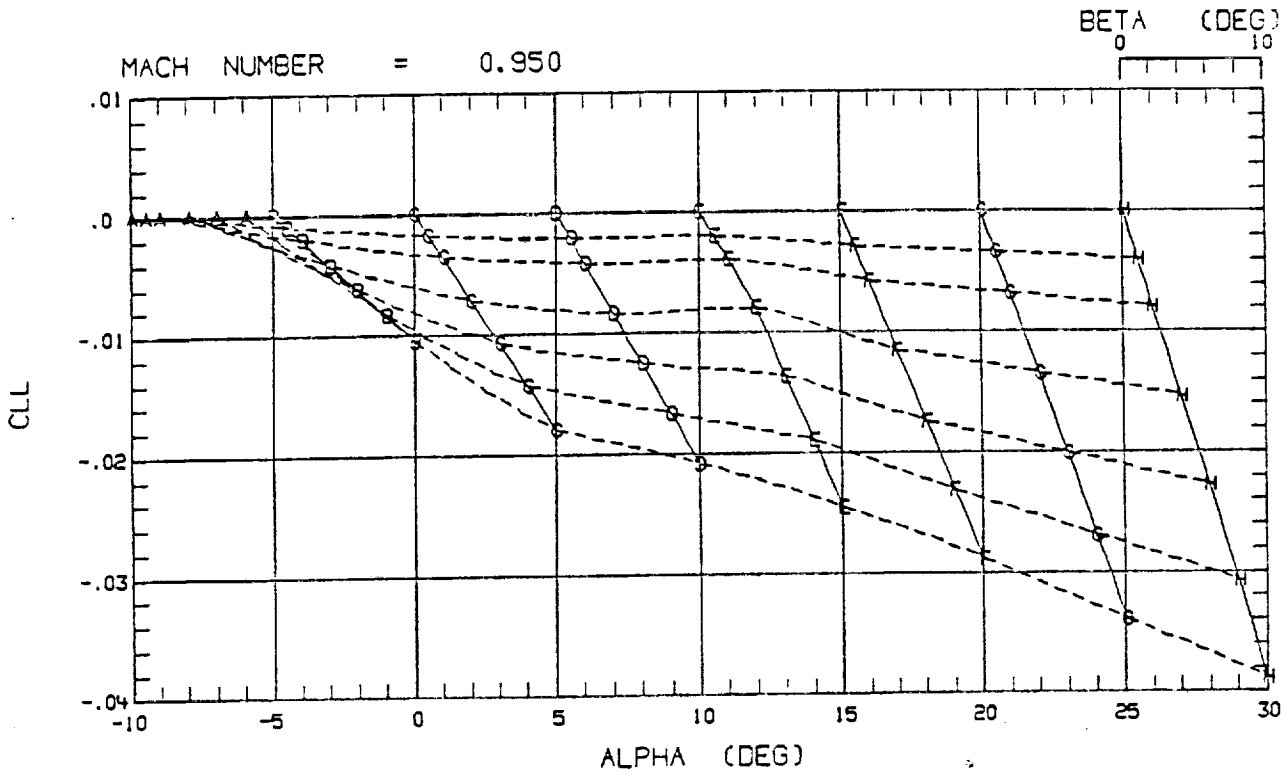
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00090	0.00002	-0.00090	-0.00149	-0.00187	-0.00224	-0.00281	-0.00338
2.000	0.00180	0.0	-0.00180	-0.00300	-0.00374	-0.00450	-0.00560	-0.00670
4.000	0.00360	-0.00027	-0.00360	-0.00600	-0.00760	-0.00915	-0.01110	-0.01305
6.000	0.00540	-0.00053	-0.00540	-0.00910	-0.01190	-0.01380	-0.01660	-0.01940
8.000	0.00720	-0.00078	-0.00720	-0.01210	-0.01630	-0.01837	-0.02217	-0.02597
10.000	0.00900	-0.00100	-0.00900	-0.01500	-0.02050	-0.02290	-0.02780	-0.03270

ENGINEER CL
DATE 9-11-78

FIGURE 4.2.1.3-5
BASIC ROLLING MOMENT COEFFICIENT



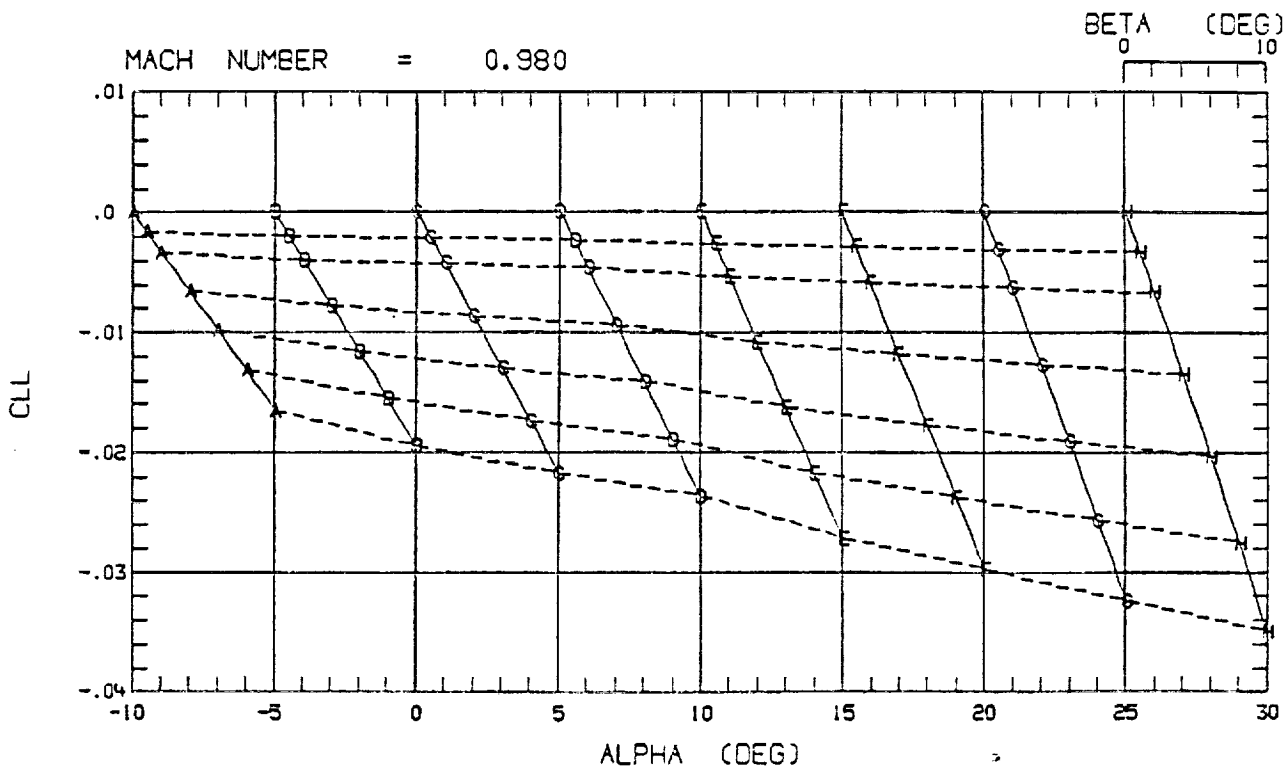
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.0	-0.00105	-0.00180	-0.00210	-0.00200	-0.00290	-0.00347	-0.00405
2.000	0.0	-0.00210	-0.00360	-0.00420	-0.00400	-0.00580	-0.00690	-0.00800
4.000	0.0	-0.00420	-0.00720	-0.00840	-0.00800	-0.01165	-0.01355	-0.01545
6.000	0.0	-0.00630	-0.01080	-0.01260	-0.01370	-0.01750	-0.02020	-0.02290
8.000	0.0	-0.00840	-0.01440	-0.01680	-0.01910	-0.02327	-0.02704	-0.03080
10.000	0.0	-0.01050	-0.01800	-0.02100	-0.02460	-0.02900	-0.03400	-0.03900

ENGINEER CLL
DATE 9-11-78

FIGURE 4.2.1.3-6
BASIC ROLLING MOMENT COEFFICIENT



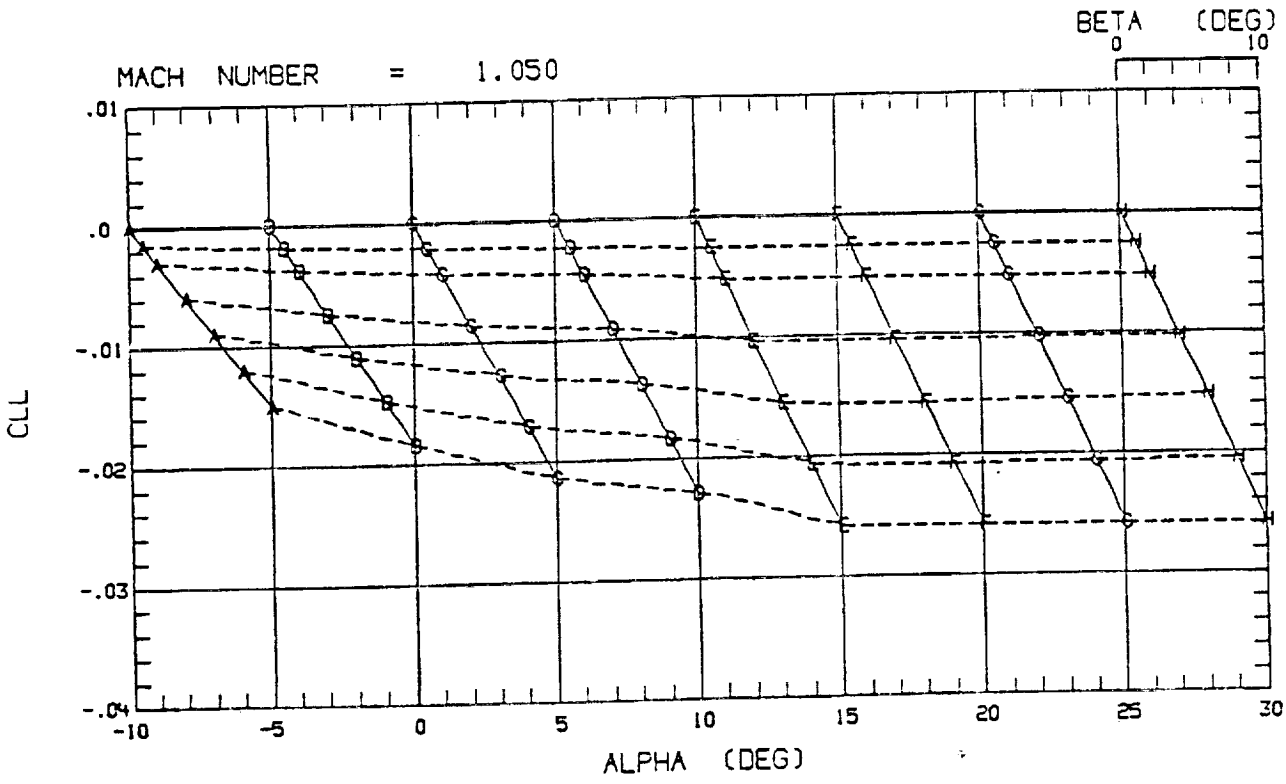
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00171	-0.00205	-0.00219	-0.00238	-0.00273	-0.00300	-0.00320	-0.00340
2.000	-0.00340	-0.00407	-0.00438	-0.00476	-0.00546	-0.00600	-0.00640	-0.00680
4.000	-0.00665	-0.00788	-0.00876	-0.00952	-0.01092	-0.01195	-0.01280	-0.01365
6.000	-0.00990	-0.01170	-0.01314	-0.01428	-0.01638	-0.01790	-0.01920	-0.02050
8.000	-0.01322	-0.01563	-0.01752	-0.01904	-0.02184	-0.02389	-0.02579	-0.02769
10.000	-0.01660	-0.01963	-0.02190	-0.02380	-0.02730	-0.02990	-0.03250	-0.03510

ENGINEER LL
DATE 8-11-78

FIGURE 4.2.1.3-7
BASIC ROLLING MOMENT COEFFICIENT



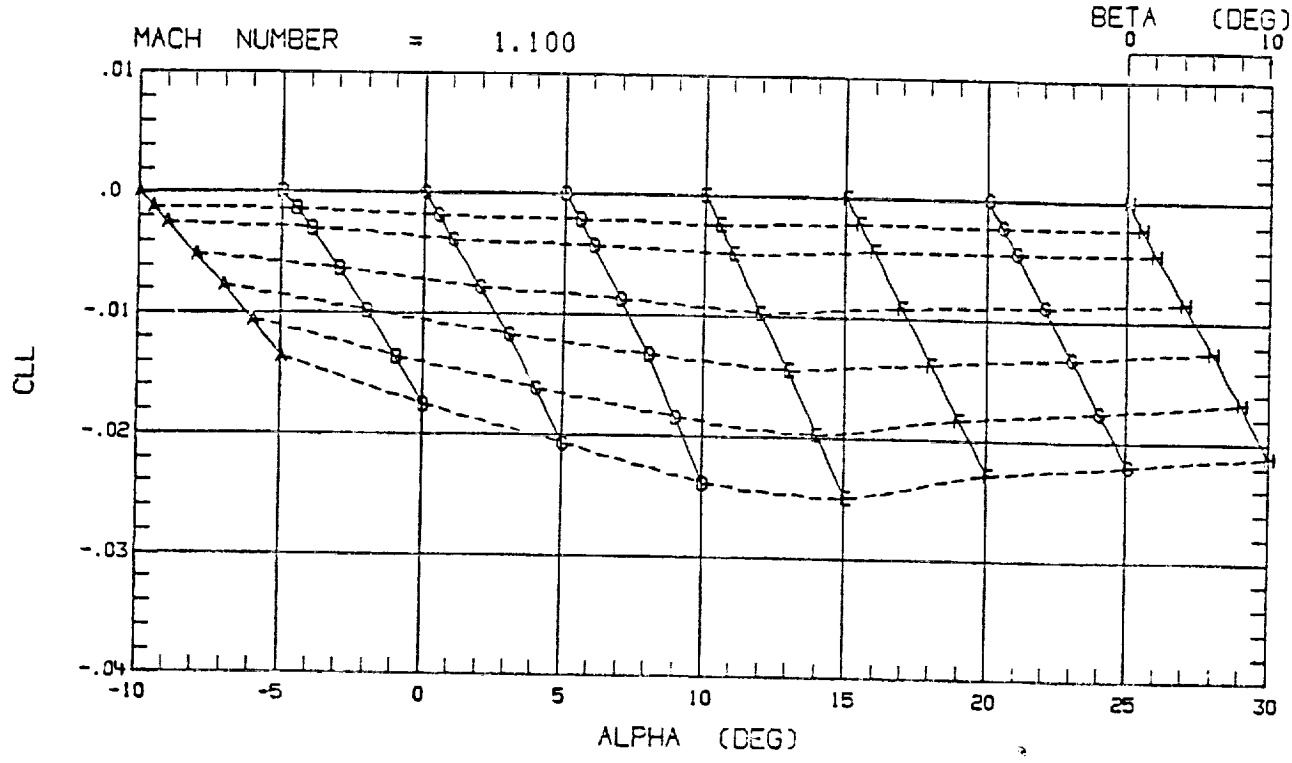
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00156	-0.00191	-0.00215	-0.00230	-0.00260	-0.00260	-0.00260	-0.00261
2.000	-0.00310	-0.00380	-0.00430	-0.00460	-0.00520	-0.00520	-0.00520	-0.00520
4.000	-0.00605	-0.00748	-0.00860	-0.00920	-0.01040	-0.01045	-0.01035	-0.01025
6.000	-0.00900	-0.01113	-0.01290	-0.01380	-0.01560	-0.01570	-0.01550	-0.01530
8.000	-0.01202	-0.01484	-0.01720	-0.01840	-0.02076	-0.02084	-0.02069	-0.02054
10.000	-0.01510	-0.01857	-0.02150	-0.02300	-0.02590	-0.02590	-0.02590	-0.02590

ENGINEER CH
DATE 2-1-78

FIGURE 4.2.1.3-8
BASIC ROLLING MOMENT COEFFICIENT

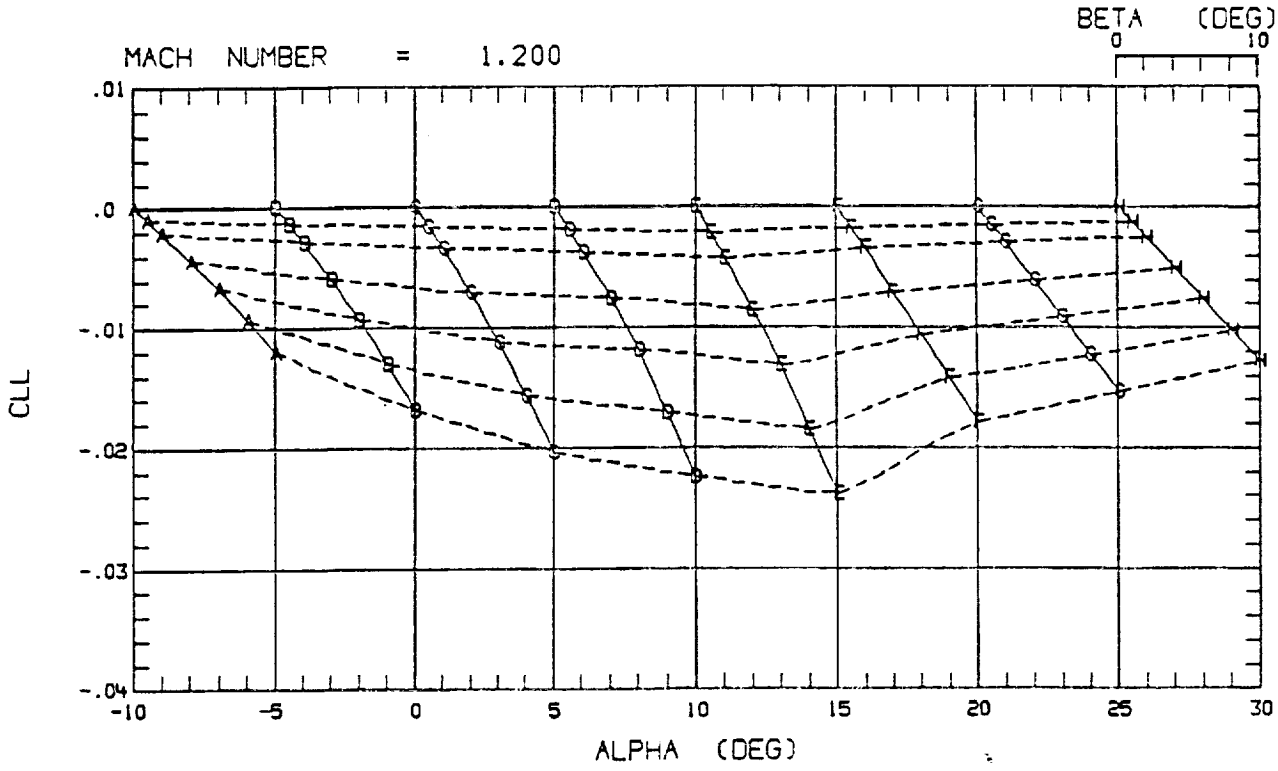


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00130	-0.00148	-0.00197	-0.00215	-0.00245	-0.00224	-0.00226	-0.00229
2.000	-0.00260	-0.00303	-0.00394	-0.00430	-0.00490	-0.00450	-0.00450	-0.00450
4.000	-0.00520	-0.00638	-0.00788	-0.00875	-0.00980	-0.00915	-0.00865	-0.00855
6.000	-0.00780	-0.00993	-0.01160	-0.01340	-0.01450	-0.01380	-0.01320	-0.01260
8.000	-0.01066	-0.01370	-0.01624	-0.01860	-0.01980	-0.01841	-0.01762	-0.01684
10.000	-0.01370	-0.01767	-0.02090	-0.02400	-0.02500	-0.02300	-0.02210	-0.02120

ENGINEER LLL
DATE 9-11-78

FIGURE 4.2.1.3-9
BASIC ROLLING MOMENT COEFFICIENT

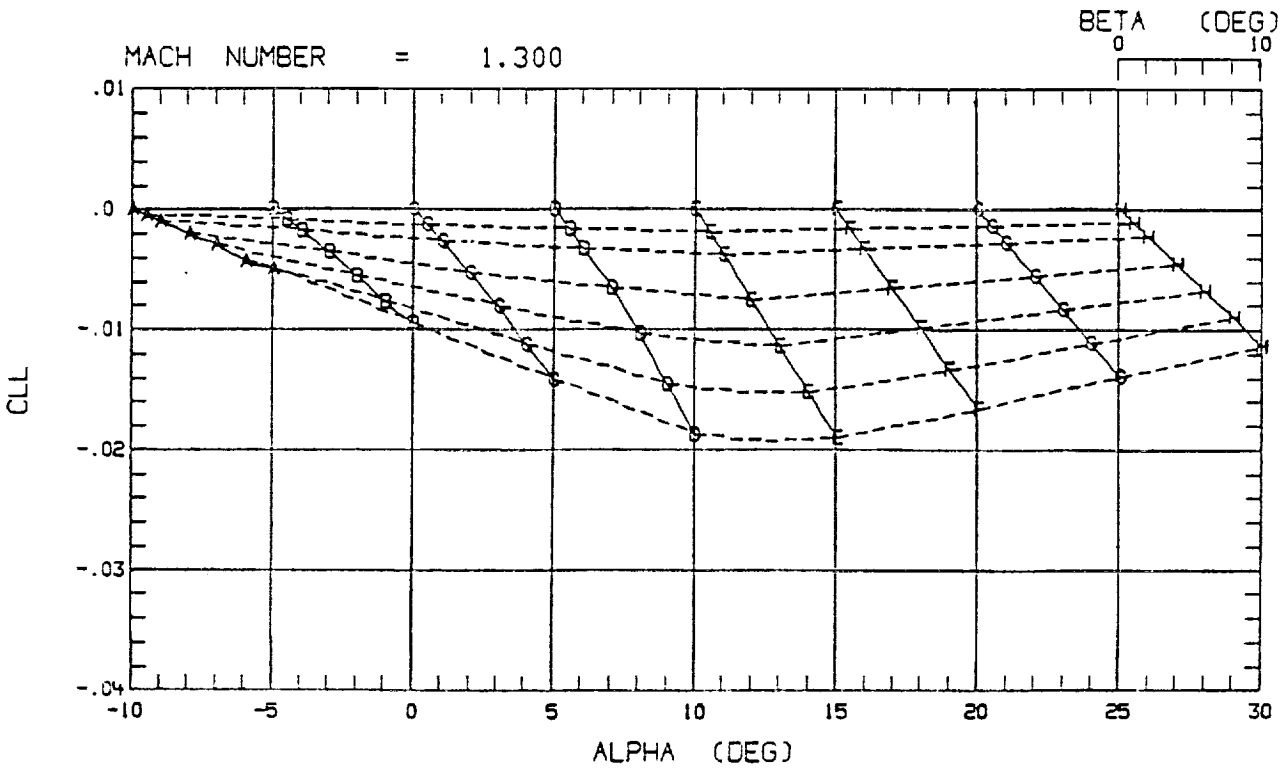


CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00109	-0.00142	-0.00165	-0.00190	-0.00215	-0.00174	-0.00149	-0.00124
2.000	-0.00220	-0.00290	-0.00340	-0.00380	-0.00430	-0.00350	-0.00300	-0.00250
4.000	-0.00445	-0.00605	-0.00718	-0.00760	-0.00860	-0.00710	-0.00610	-0.00510
6.000	-0.00680	-0.00943	-0.01130	-0.01200	-0.01320	-0.01070	-0.00920	-0.00770
8.000	-0.00936	-0.01306	-0.01570	-0.01720	-0.01860	-0.01430	-0.01230	-0.01030
10.000	-0.01210	-0.01693	-0.02040	-0.02250	-0.02390	-0.01790	-0.01540	-0.01290

ENGINEER LL
DATE 9-11-75

FIGURE 4.2.1.3-10
BASIC ROLLING MOMENT COEFFICIENT



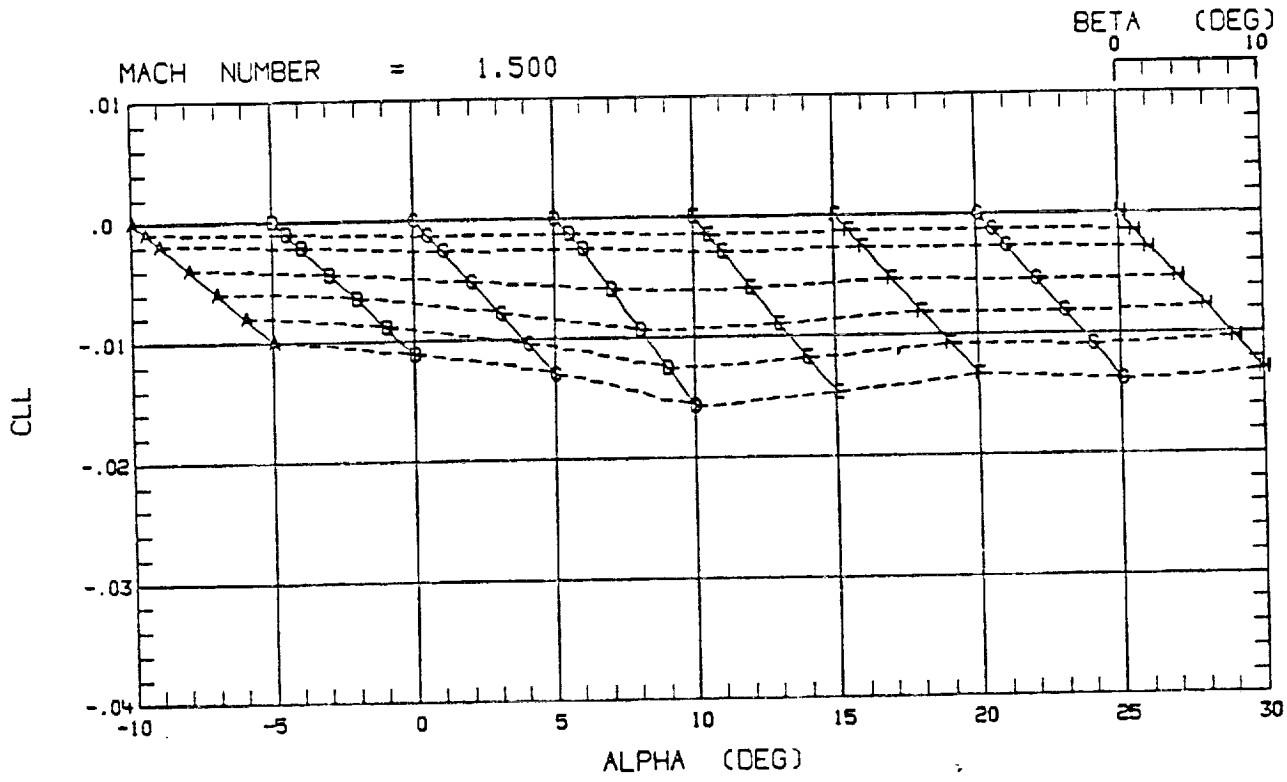
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00050	-0.00090	-0.00135	-0.00165	-0.00190	-0.00166	-0.00140	-0.00114
2.000	-0.00100	-0.00180	-0.00270	-0.00330	-0.00380	-0.00332	-0.00280	-0.00228
4.000	-0.00200	-0.00360	-0.00540	-0.00660	-0.00760	-0.00664	-0.00560	-0.00456
6.000	-0.00300	-0.00560	-0.00820	-0.01040	-0.01140	-0.00996	-0.00840	-0.00684
8.000	-0.00430	-0.00780	-0.01130	-0.01460	-0.01520	-0.01340	-0.01120	-0.00900
10.000	-0.00500	-0.00960	-0.01420	-0.01880	-0.01900	-0.01660	-0.01400	-0.01140

ENGINEER LL
DATE 9-11-78

FIGURE 4.2.1.3-11
BASIC ROLLING MOMENT COEFFICIENT



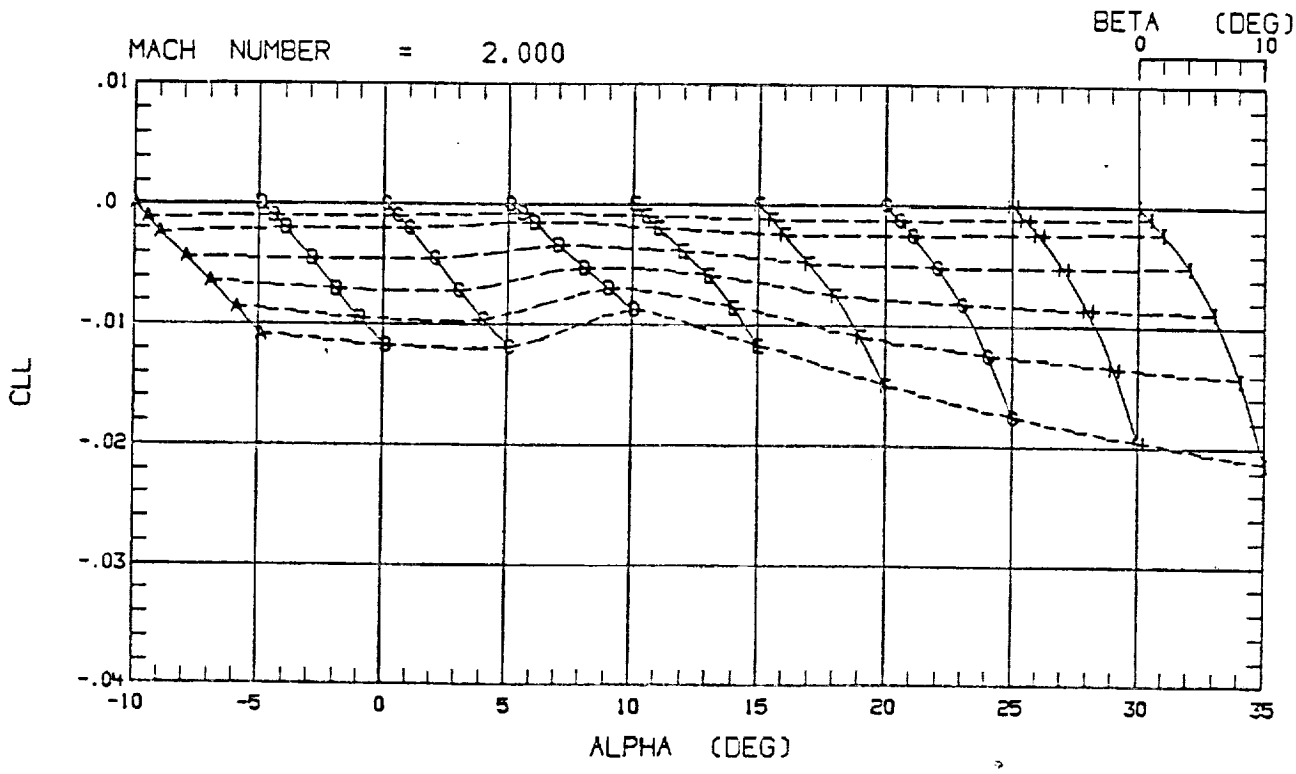
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00095	-0.00110	-0.00131	-0.00131	-0.00150	-0.00134	-0.00125	-0.00149
2.000	-0.00192	-0.00221	-0.00262	-0.00262	-0.00300	-0.00268	-0.00270	-0.00290
4.000	-0.00392	-0.00445	-0.00524	-0.00602	-0.00600	-0.00541	-0.00550	-0.00535
6.000	-0.00596	-0.00651	-0.00786	-0.00938	-0.00900	-0.00814	-0.00820	-0.00780
8.000	-0.00802	-0.00897	-0.01044	-0.01254	-0.01189	-0.01079	-0.01090	-0.01040
10.000	-0.01010	-0.01123	-0.01300	-0.01590	-0.01470	-0.01340	-0.01380	-0.01310

ENGINEER LIL
DATE 9-11-78

FIGURE 4.2.1.3-12
BASIC ROLLING MOMENT COEFFICIENT

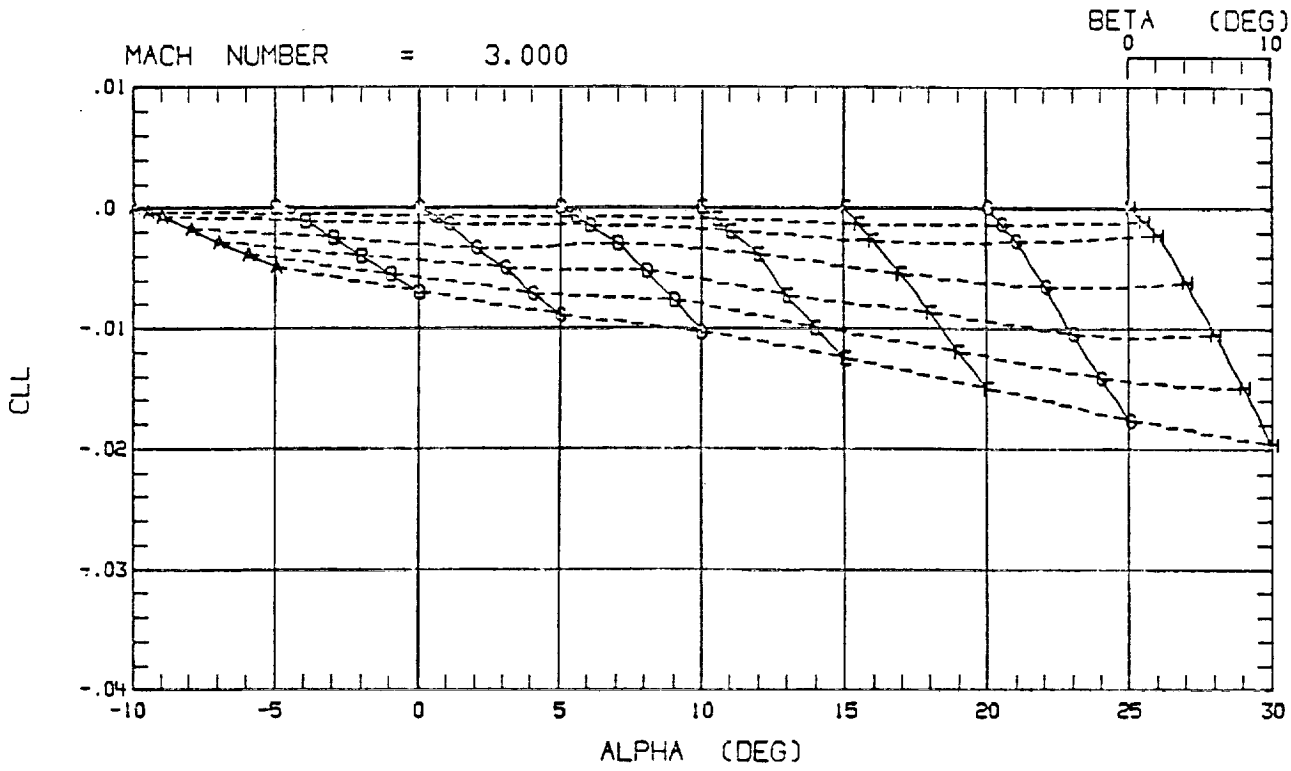


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00123	-0.00099	-0.00100	-0.00075	-0.00100	-0.00128	-0.00127	-0.00116	-0.00107
2.000	-0.00240	-0.00207	-0.00200	-0.00150	-0.00200	-0.00256	-0.00254	-0.00243	-0.00230
4.000	-0.00445	-0.00462	-0.00460	-0.00350	-0.00400	-0.00498	-0.00519	-0.00521	-0.00510
6.000	-0.00650	-0.00717	-0.00720	-0.00530	-0.00600	-0.00761	-0.00830	-0.00869	-0.00890
8.000	-0.00866	-0.00957	-0.00961	-0.00700	-0.00860	-0.01108	-0.01255	-0.01362	-0.01445
10.000	-0.01090	-0.01187	-0.01190	-0.00880	-0.01180	-0.01515	-0.01770	-0.01975	-0.02150

ENGINEER LLL
DATE 9-12-72

FIGURE 4.2.1.3-13
BASIC ROLLING MOMENT COEFFICIENT

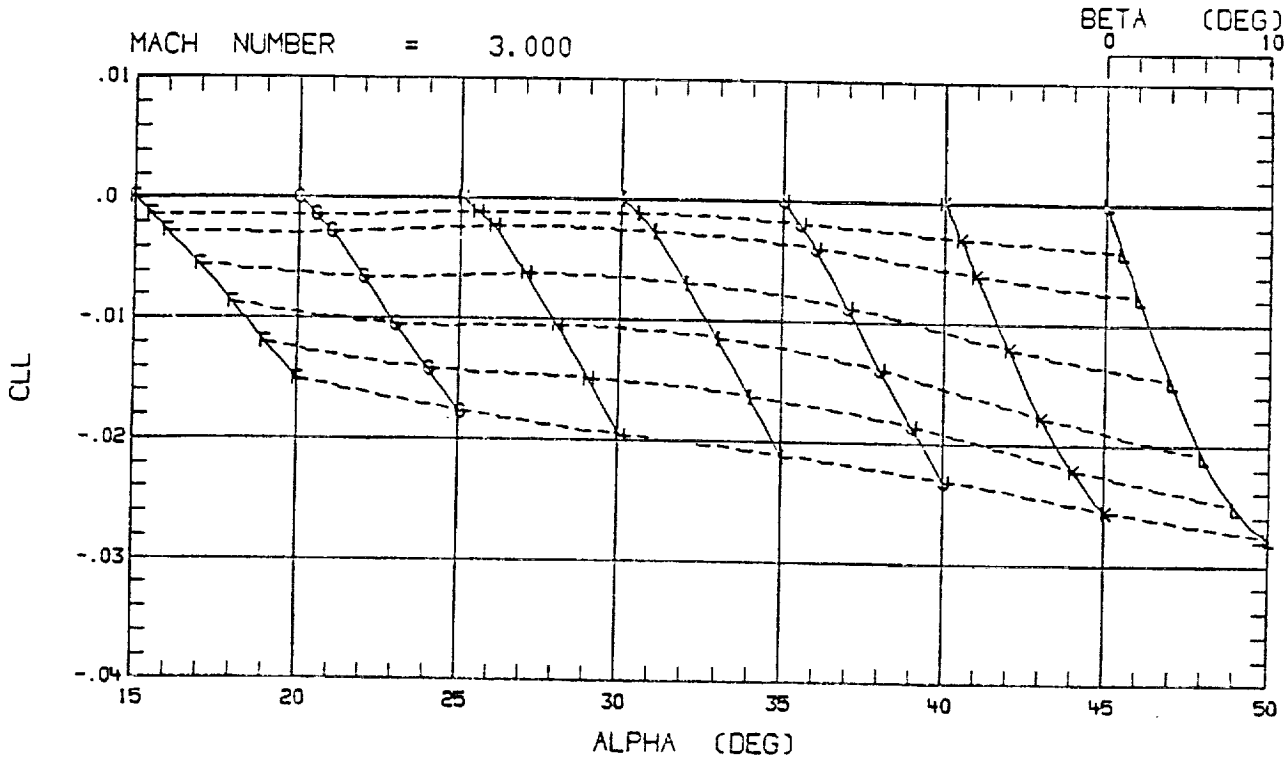


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00038	-0.00052	-0.00071	-0.00076	-0.00100	-0.00141	-0.00142	-0.00114
2.000	-0.00080	-0.00111	-0.00142	-0.00152	-0.00200	-0.00282	-0.00284	-0.00228
4.000	-0.00185	-0.00257	-0.00350	-0.00304	-0.00400	-0.00564	-0.00660	-0.00629
6.000	-0.00290	-0.00409	-0.00510	-0.00540	-0.00738	-0.00880	-0.01060	-0.01054
8.000	-0.00395	-0.00561	-0.00720	-0.00780	-0.01000	-0.01210	-0.01430	-0.01498
10.000	-0.00500	-0.00717	-0.00900	-0.01040	-0.01250	-0.01510	-0.01780	-0.01970

ENGINEER LLL
DATE 9-11-85

FIGURE 4.2.1.3-14
BASIC ROLLING MOMENT COEFFICIENT

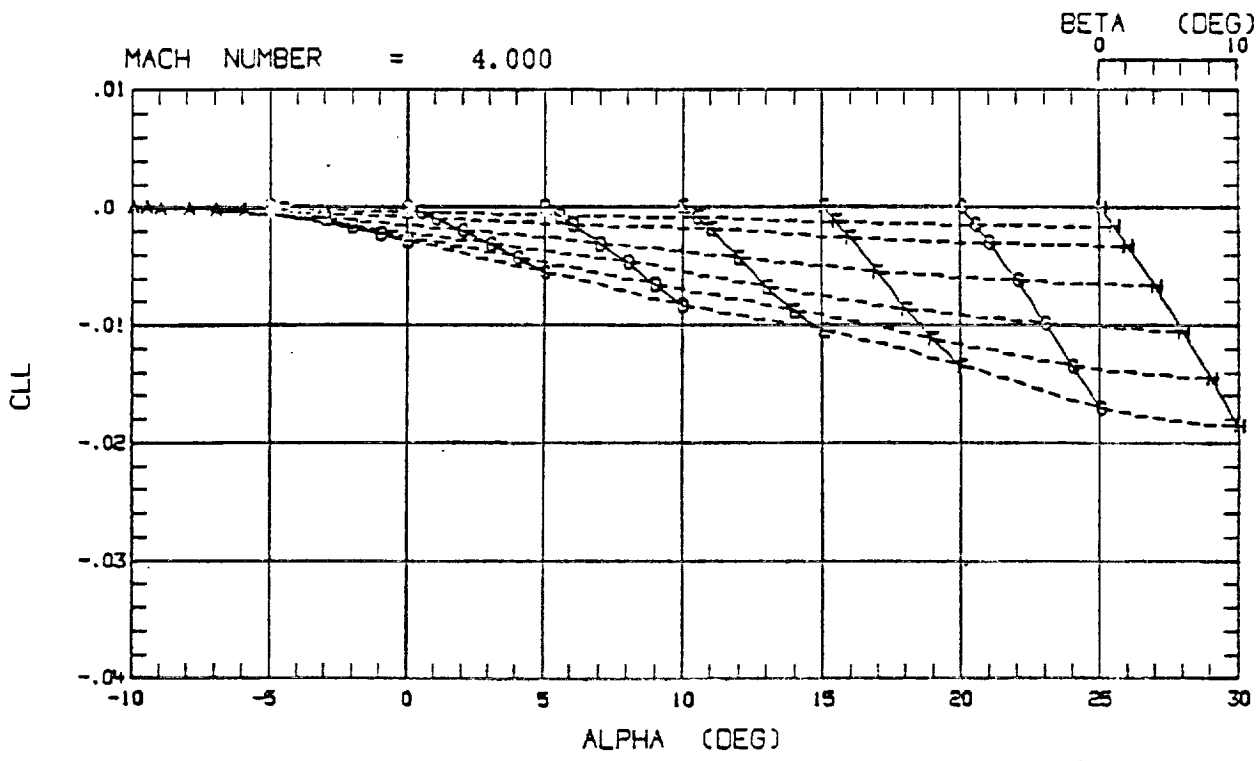


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00141	-0.00142	-0.00114	-0.00120	-0.00187	-0.00310	-0.00407
2.000	-0.00282	-0.00284	-0.00228	-0.00270	-0.00392	-0.00616	-0.00791
4.000	-0.00564	-0.00660	-0.00629	-0.00698	-0.00893	-0.01219	-0.01483
6.000	-0.00680	-0.01060	-0.01054	-0.01160	-0.01403	-0.01788	-0.02108
8.000	-0.01210	-0.01430	-0.01498	-0.01635	-0.01874	-0.02224	-0.02526
10.000	-0.01510	-0.01780	-0.01970	-0.02130	-0.02323	-0.02560	-0.02785

ENGINEER [illegible]
DATE 9-11-78

FIGURE 4.2.1.3-15
BASIC ROLLING MOMENT COEFFICIENT

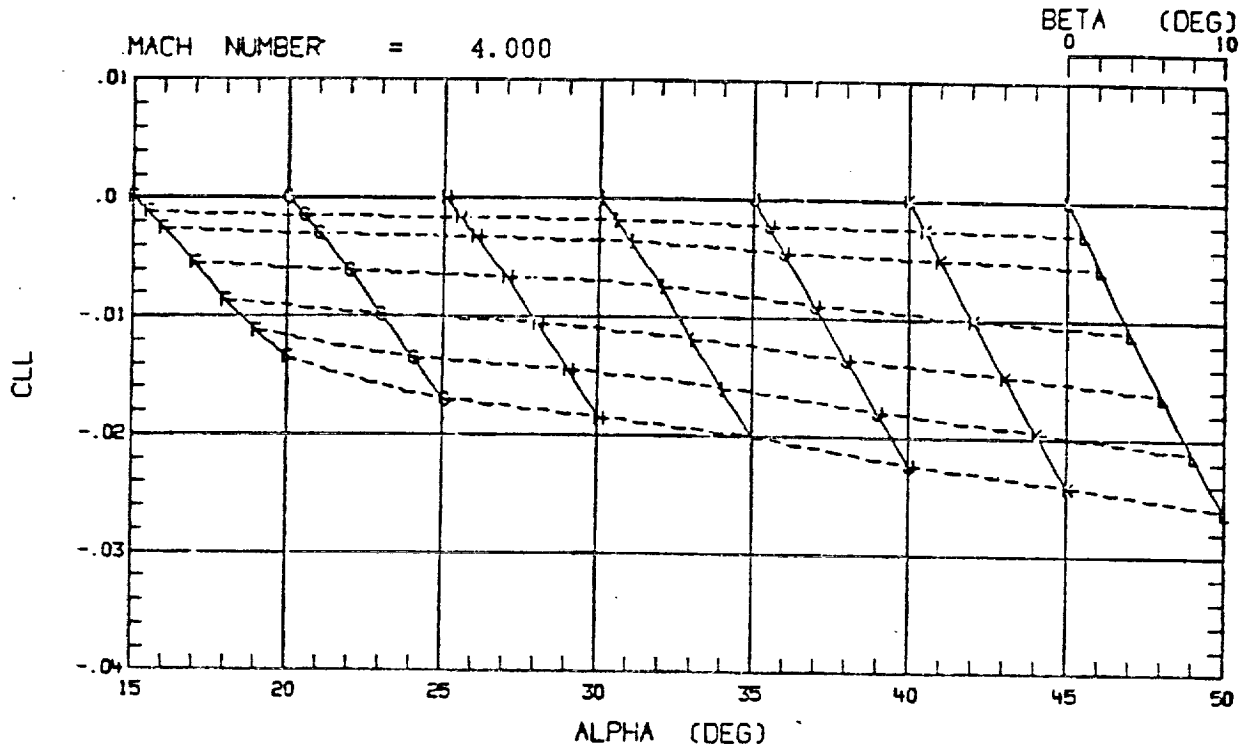


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00005	-0.00026	-0.00051	-0.00076	-0.00097	-0.00134	-0.00155	-0.00168
2.000	-0.00010	-0.00053	-0.00102	-0.00152	-0.00194	-0.00268	-0.00310	-0.00336
4.000	-0.00018	-0.00109	-0.00206	-0.00314	-0.00438	-0.00556	-0.00630	-0.00672
6.000	-0.00024	-0.00169	-0.00318	-0.00476	-0.00692	-0.00875	-0.00990	-0.01068
8.000	-0.00029	-0.00231	-0.00436	-0.00668	-0.00885	-0.01132	-0.01360	-0.01462
10.000	-0.00030	-0.00297	-0.00560	-0.00840	-0.01060	-0.01360	-0.01720	-0.01870

ENGINEER [illegible]
DATE 9-11-78

FIGURE 4.2.1.3-16
BASIC ROLLING MOMENT COEFFICIENT



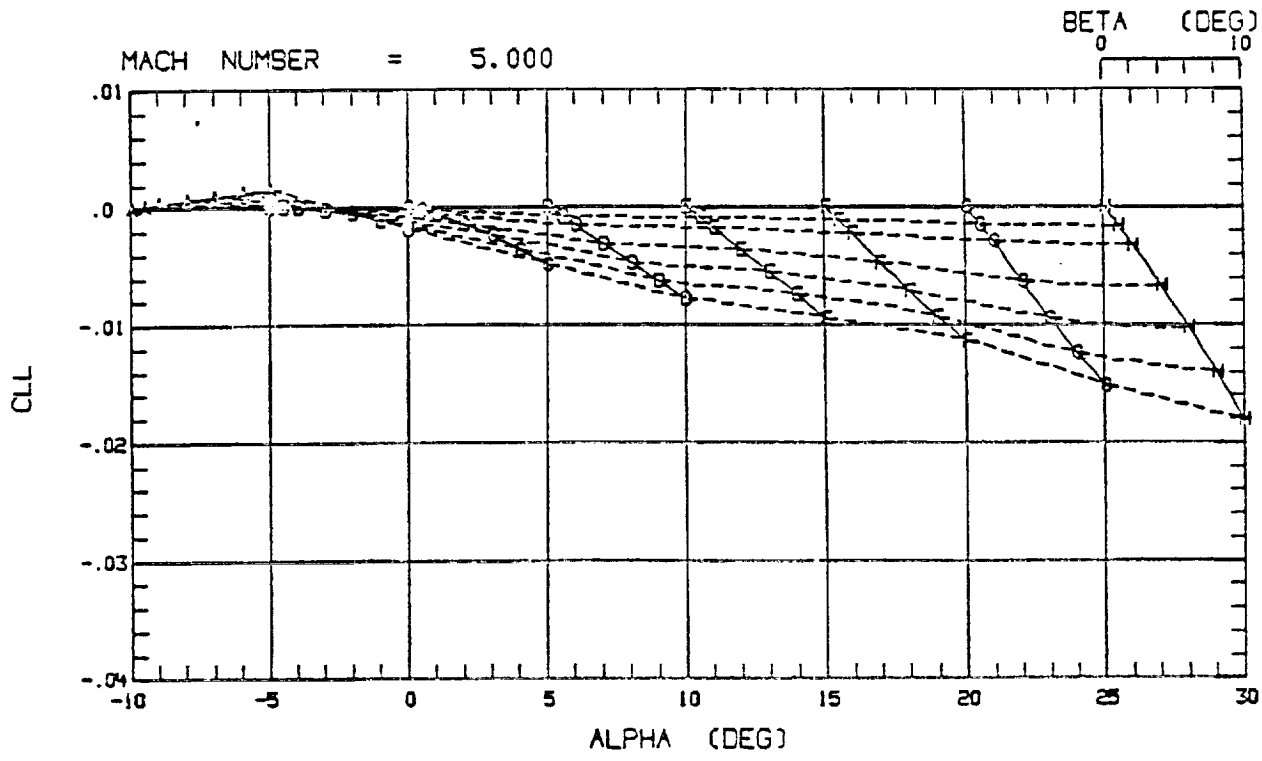
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00134	-0.00155	-0.00168	-0.00187	-0.00227	-0.00256	-0.00285
2.000	-0.00269	-0.00310	-0.00336	-0.00374	-0.00454	-0.00512	-0.00570
4.000	-0.00556	-0.00630	-0.00672	-0.00748	-0.00906	-0.01013	-0.01122
6.000	-0.00875	-0.00990	-0.01068	-0.01197	-0.01355	-0.01500	-0.01649
8.000	-0.01132	-0.01360	-0.01462	-0.01608	-0.01804	-0.01972	-0.02153
10.000	-0.01360	-0.01720	-0.01870	-0.02025	-0.02250	-0.02430	-0.02632

ENGINEER CLL
DATE 9-22-75

FIGURE 4.2.1.3-17
BASIC ROLLING MOMENT COEFFICIENT

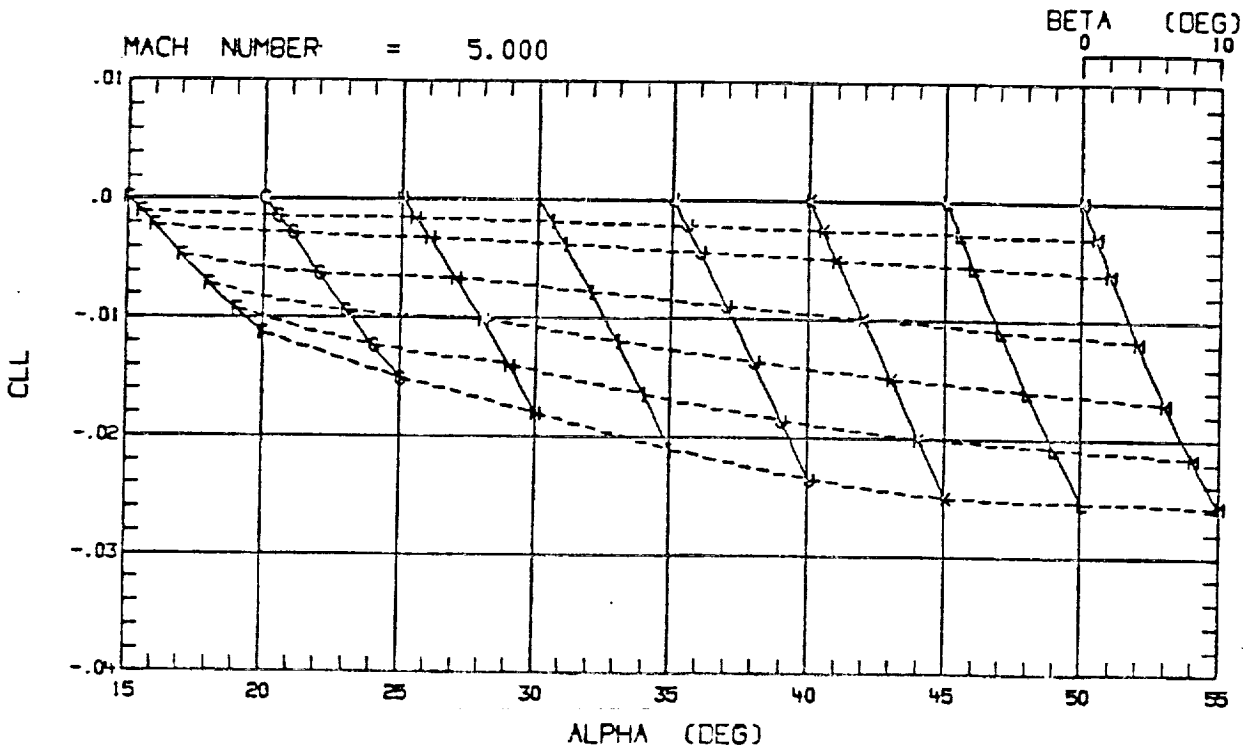


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00015	0.0	-0.00031	-0.00079	-0.00093	-0.00115	-0.00150	-0.00164
2.000	0.00030	-0.00003	-0.00066	-0.00160	-0.00186	-0.00230	-0.00300	-0.00329
4.000	0.00060	-0.00022	-0.00149	-0.00321	-0.00375	-0.00480	-0.00640	-0.00670
6.000	0.00090	-0.00059	-0.00249	-0.00479	-0.00560	-0.00730	-0.00960	-0.01031
8.000	0.00120	-0.00114	-0.00366	-0.00635	-0.00750	-0.00940	-0.01250	-0.01411
10.000	0.00150	-0.00187	-0.00500	-0.00790	-0.00950	-0.01140	-0.01520	-0.01820

ENGINEER LL
DATE 9-11-78

FIGURE 4.2.1.3-18
BASIC ROLLING MOMENT COEFFICIENT

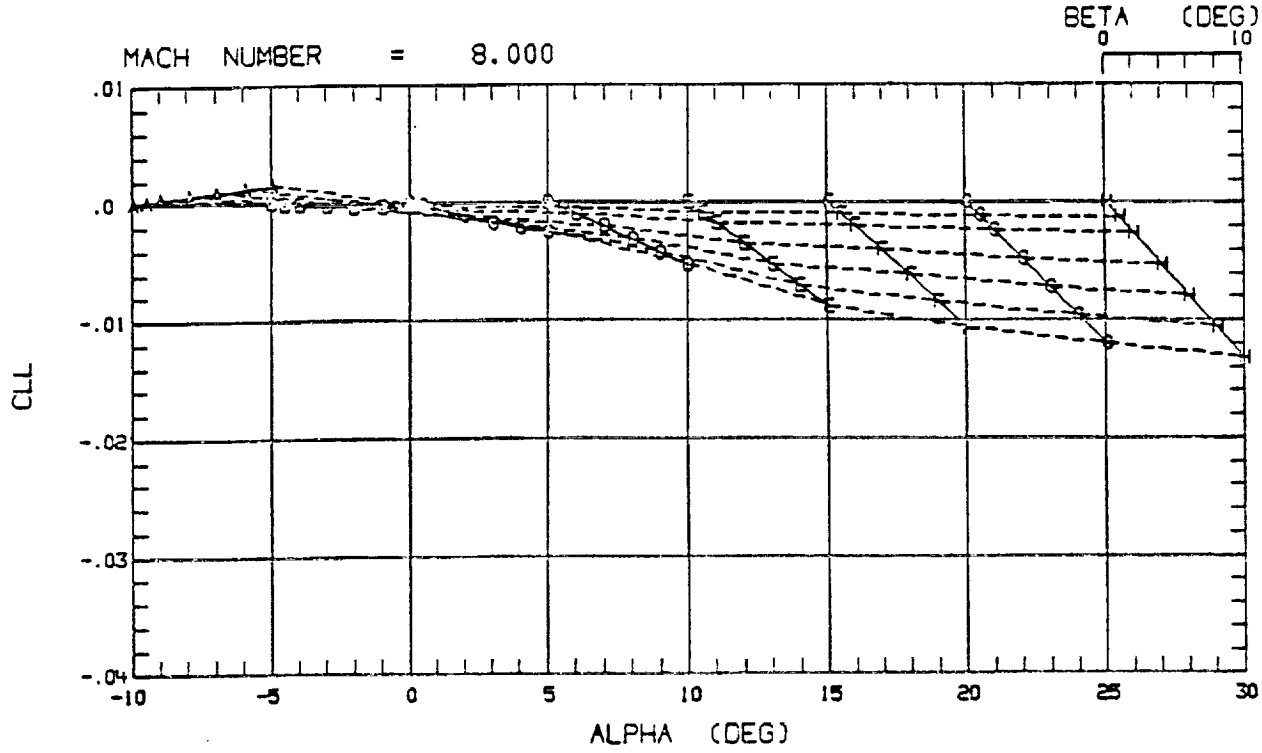


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00115	-0.00150	-0.00164	-0.00193	-0.00223	-0.00252	-0.00281	-0.00310
2.000	-0.00230	-0.00300	-0.00328	-0.00386	-0.00446	-0.00504	-0.00562	-0.00620
4.000	-0.00480	-0.00640	-0.00570	-0.00788	-0.00903	-0.01008	-0.01102	-0.01197
6.000	-0.00730	-0.00960	-0.01031	-0.01211	-0.01375	-0.01512	-0.01614	-0.01716
8.000	-0.00940	-0.01250	-0.01411	-0.01655	-0.01863	-0.02016	-0.02096	-0.02177
10.000	-0.01140	-0.01520	-0.01830	-0.02120	-0.02365	-0.02520	-0.02650	-0.02690

EER 44
DATE 9-11-78

FIGURE 4.2.1.3-19
BASIC ROLLING MOMENT COEFFICIENT



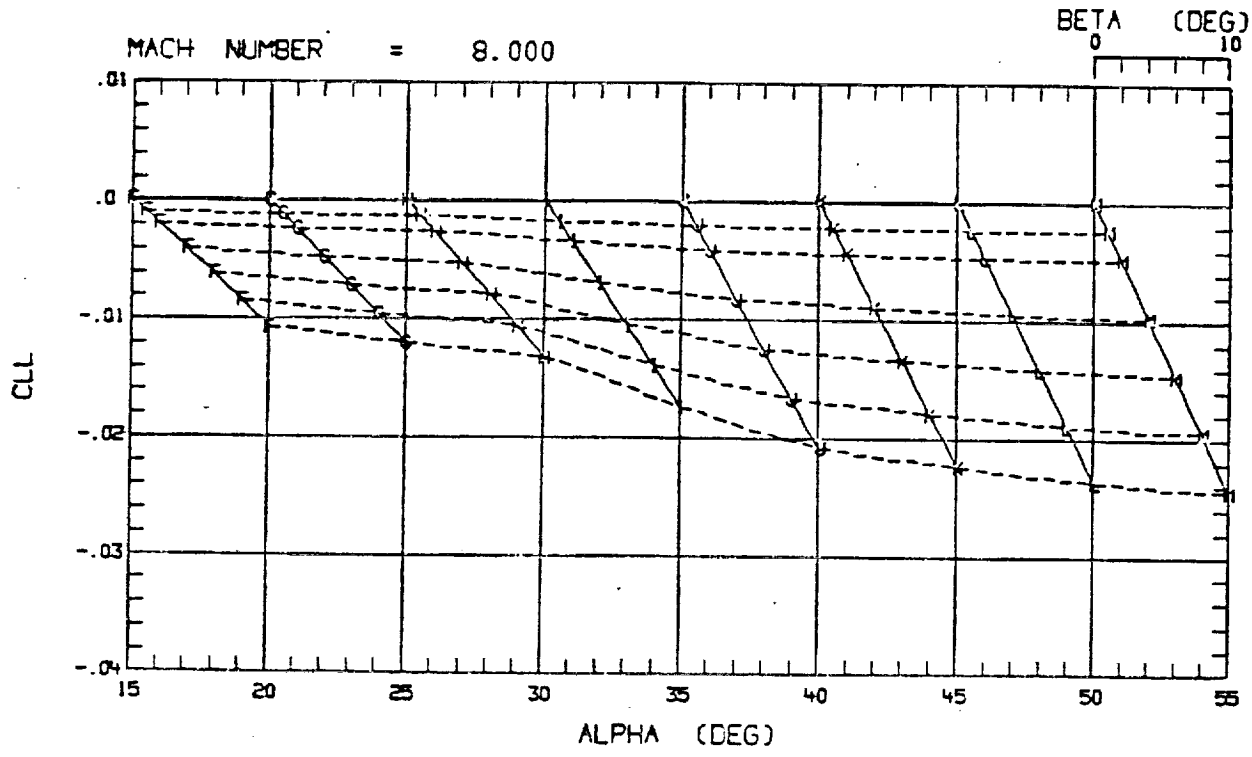
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00015	-0.00011	-0.00033	-0.00051	-0.00088	-0.00100	-0.00121	-0.00133
2.000	0.00030	-0.00019	-0.00064	-0.00104	-0.00176	-0.00203	-0.00242	-0.00266
4.000	0.00060	-0.00031	-0.00122	-0.00211	-0.00353	-0.00413	-0.00484	-0.00532
6.000	0.00090	-0.00036	-0.00174	-0.00319	-0.00531	-0.00628	-0.00726	-0.00796
8.000	0.00120	-0.00036	-0.00220	-0.00429	-0.00710	-0.00849	-0.00968	-0.01064
10.000	0.00150	-0.00030	-0.00260	-0.00540	-0.00890	-0.01075	-0.01210	-0.01330

ENGINEER LLL
DATE 9-11-78

FIGURE 4.2.1.3-20
BASIC ROLLING MOMENT COEFFICIENT



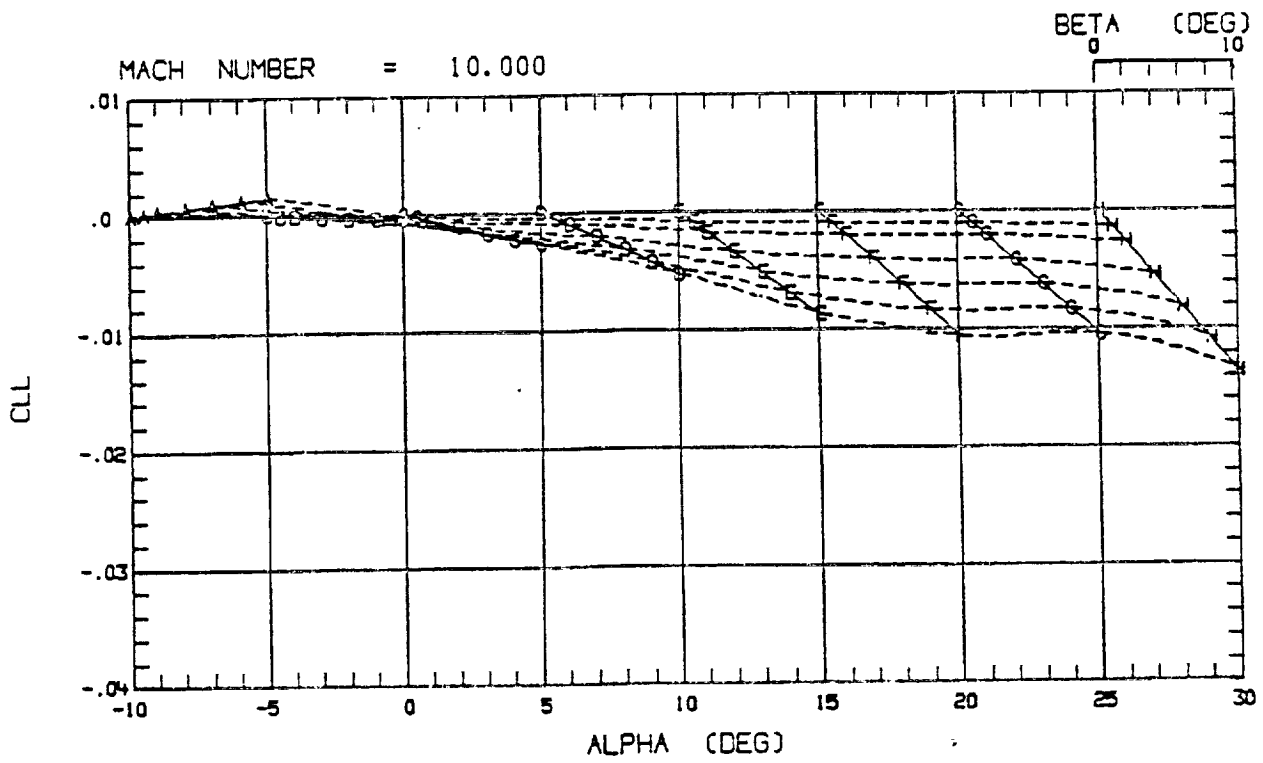
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00100	-0.00121	-0.00133	-0.00175	-0.00210	-0.00225	-0.00238	-0.00245
2.000	-0.00203	-0.00242	-0.00266	-0.00350	-0.00420	-0.00450	-0.00476	-0.00490
4.000	-0.00413	-0.00484	-0.00532	-0.00700	-0.00840	-0.00900	-0.00952	-0.00980
6.000	-0.00628	-0.00726	-0.00796	-0.01050	-0.01260	-0.01350	-0.01428	-0.01470
8.000	-0.00849	-0.00968	-0.01054	-0.01400	-0.01680	-0.01800	-0.01904	-0.01960
10.000	-0.01075	-0.01210	-0.01330	-0.01750	-0.02100	-0.02250	-0.02380	-0.02450

ENGINEER LL
DATE 9-11-73

FIGURE 4.2.1.3-21
BASIC ROLLING MOMENT COEFFICIENT



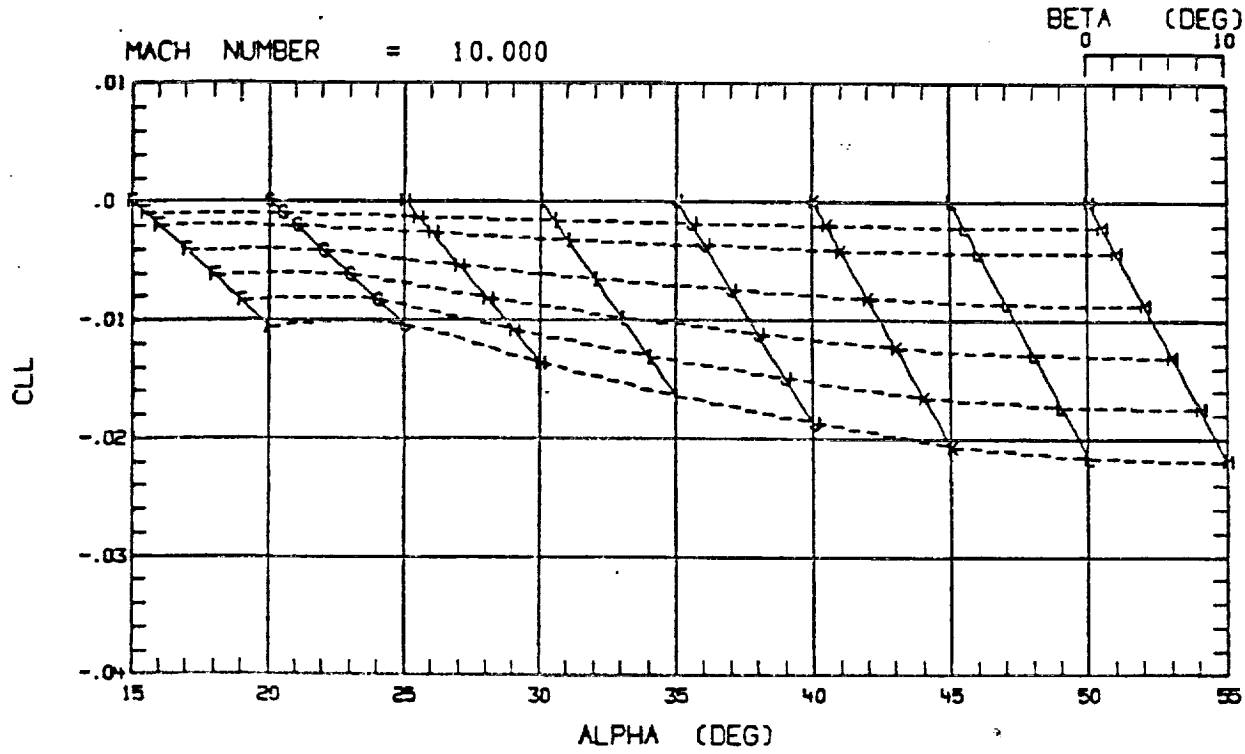
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00015	-0.00011	-0.00033	-0.00051	-0.00087	-0.00099	-0.00105	-0.00137
2.000	0.00030	-0.00019	-0.00064	-0.00104	-0.00174	-0.00202	-0.00210	-0.00274
4.000	0.00060	-0.00031	-0.00122	-0.00211	-0.00349	-0.00412	-0.00420	-0.00548
6.000	0.00090	-0.00039	-0.00176	-0.00319	-0.00525	-0.00626	-0.00630	-0.00822
8.000	0.00120	-0.00042	-0.00226	-0.00429	-0.00702	-0.00846	-0.00840	-0.01096
10.000	0.00150	-0.00040	-0.00270	-0.00540	-0.00960	-0.01070	-0.01050	-0.01370

ENGINEER ''
DATE 10-3-73

FIGURE 4.2.1.3-22
BASIC ROLLING MOMENT COEFFICIENT



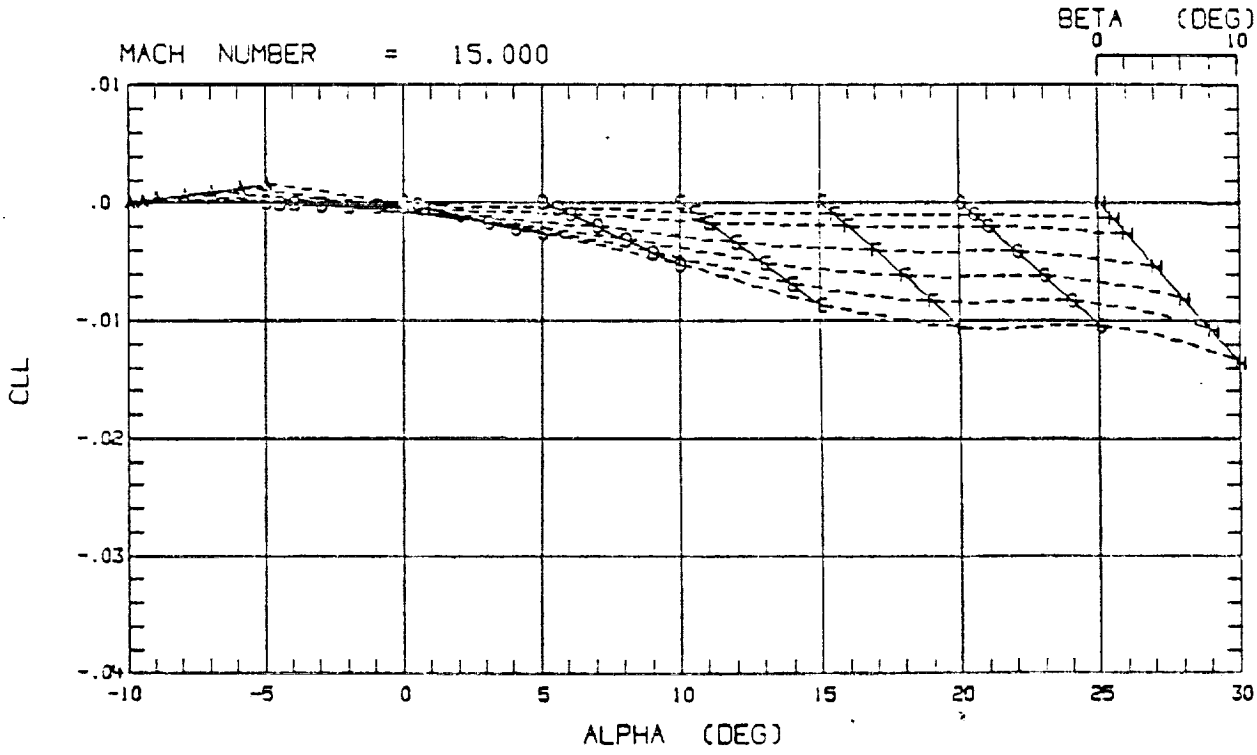
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00099	-0.00105	-0.00137	-0.00165	-0.00188	-0.00208	-0.00217	-0.00220
2.000	-0.00202	-0.00210	-0.00274	-0.00330	-0.00376	-0.00416	-0.00434	-0.00440
4.000	-0.00412	-0.00420	-0.00548	-0.00660	-0.00752	-0.00832	-0.00868	-0.00880
6.000	-0.00626	-0.00630	-0.00822	-0.00990	-0.01128	-0.01248	-0.01302	-0.01320
8.000	-0.00846	-0.00840	-0.01096	-0.01320	-0.01504	-0.01664	-0.01736	-0.01760
10.000	-0.01070	-0.01050	-0.01370	-0.01650	-0.01880	-0.02080	-0.02170	-0.02200

ENGINEER LH
DATE 12-3-28.

FIGURE 4.2.1.3-23
BASIC ROLLING MOMENT COEFFICIENT



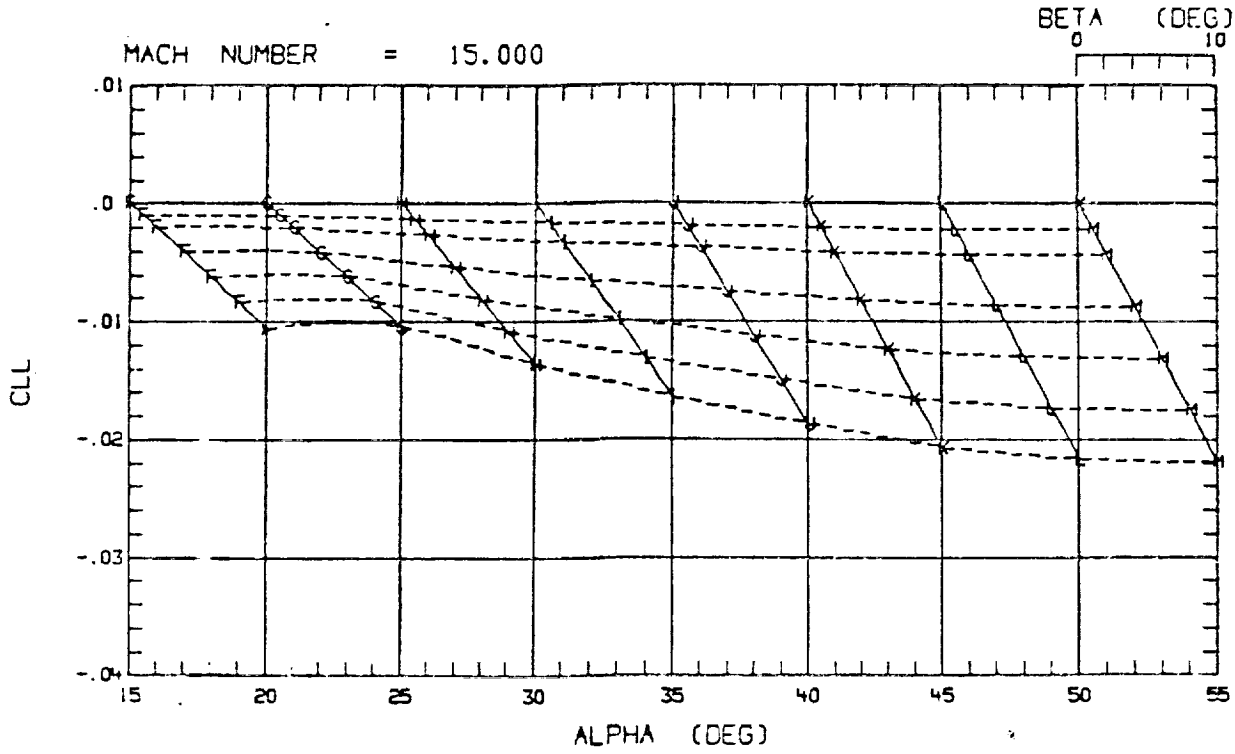
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00015	-0.00011	-0.00033	-0.00051	-0.00087	-0.00099	-0.00105	-0.00137
2.000	0.00030	-0.00019	-0.00064	-0.00104	-0.00174	-0.00202	-0.00210	-0.00274
4.000	0.00060	-0.00031	-0.00122	-0.00211	-0.00349	-0.00412	-0.00420	-0.00548
6.000	0.00090	-0.00039	-0.00176	-0.00319	-0.00525	-0.00626	-0.00630	-0.00822
8.000	0.00120	-0.00042	-0.00226	-0.00429	-0.00702	-0.00846	-0.00840	-0.01096
10.000	0.00150	-0.00040	-0.00270	-0.00540	-0.00880	-0.01070	-0.01050	-0.01370

ENGINEER ///
DATE 12-3-75

FIGURE 4.2.1.3-24
BASIC ROLLING MOMENT COEFFICIENT



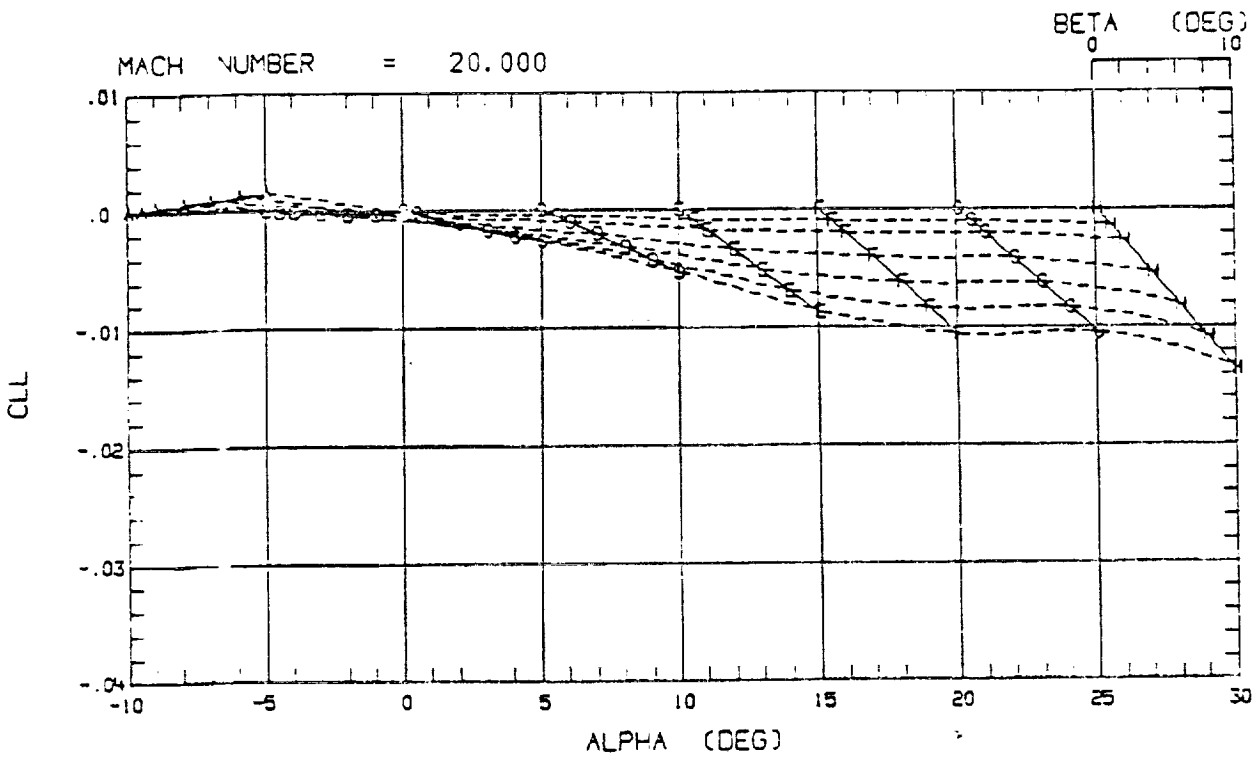
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00099	-0.00105	-0.00137	-0.00165	-0.00188	-0.00208	-0.00217	-0.00220
2.000	-0.00202	-0.00210	-0.00274	-0.00330	-0.00376	-0.00416	-0.00434	-0.00440
4.000	-0.00412	-0.00420	-0.00548	-0.00660	-0.00752	-0.00832	-0.00868	-0.00880
6.000	-0.00626	-0.00630	-0.00822	-0.00990	-0.01128	-0.01248	-0.01302	-0.01320
8.000	-0.00845	-0.00840	-0.01096	-0.01320	-0.01504	-0.01664	-0.01736	-0.01760
10.000	-0.01070	-0.01050	-0.01370	-0.01650	-0.01880	-0.02080	-0.02170	-0.02200

ENGINEER
DATE

FIGURE 4.2.1.3-25
BASIC ROLLING MOMENT COEFFICIENT



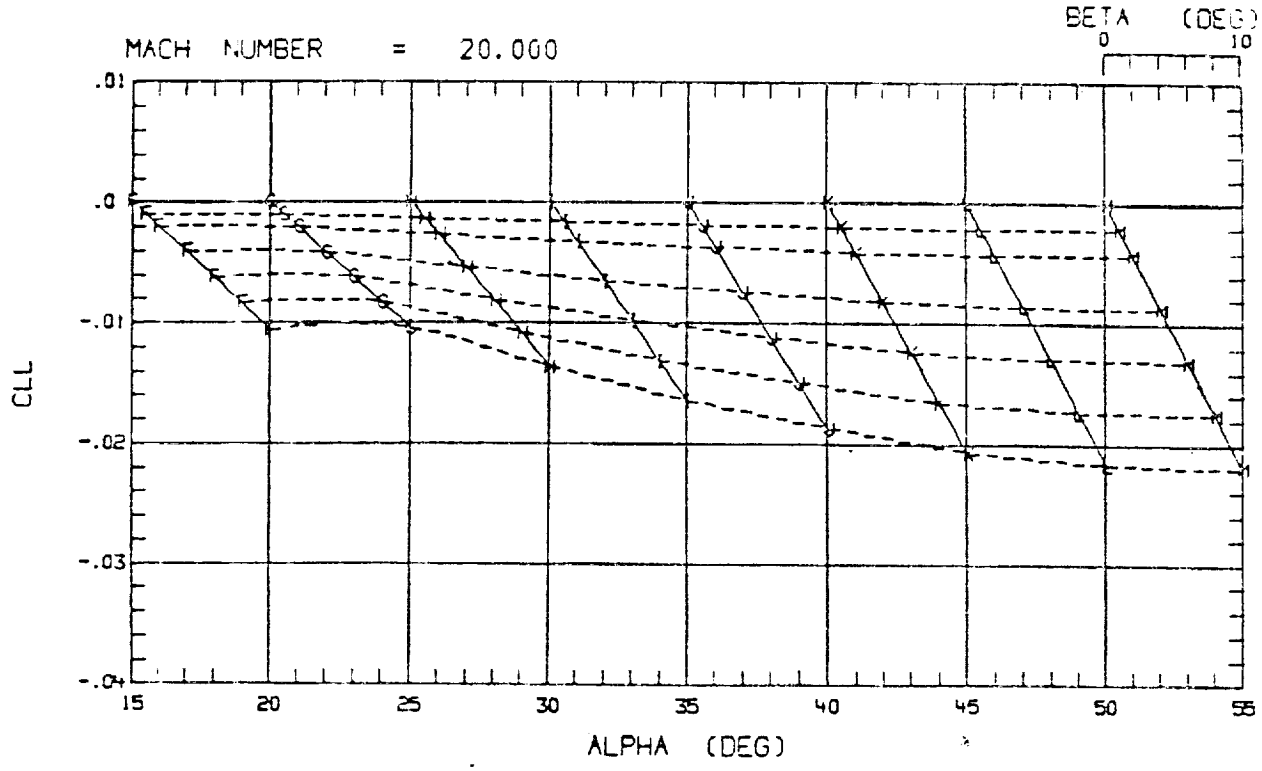
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.00015	-0.00011	-0.00033	-0.00051	-0.00087	-0.00099	-0.00105	-0.00137
2.000	0.00030	-0.00019	-0.00064	-0.00104	-0.00174	-0.00202	-0.00210	-0.00274
4.000	0.00060	-0.00031	-0.00122	-0.00211	-0.00349	-0.00412	-0.00420	-0.00548
6.000	0.00090	-0.00039	-0.00176	-0.00319	-0.00525	-0.00626	-0.00630	-0.00822
8.000	0.00120	-0.00042	-0.00226	-0.00429	-0.00702	-0.00846	-0.00840	-0.01096
10.000	0.00150	-0.00040	-0.00270	-0.00540	-0.00880	-0.01070	-0.01050	-0.01370

ENGINEER L.A.
DATE 12-31-79

FIGURE 4.2.1.3-26
BASIC ROLLING MOMENT COEFFICIENT



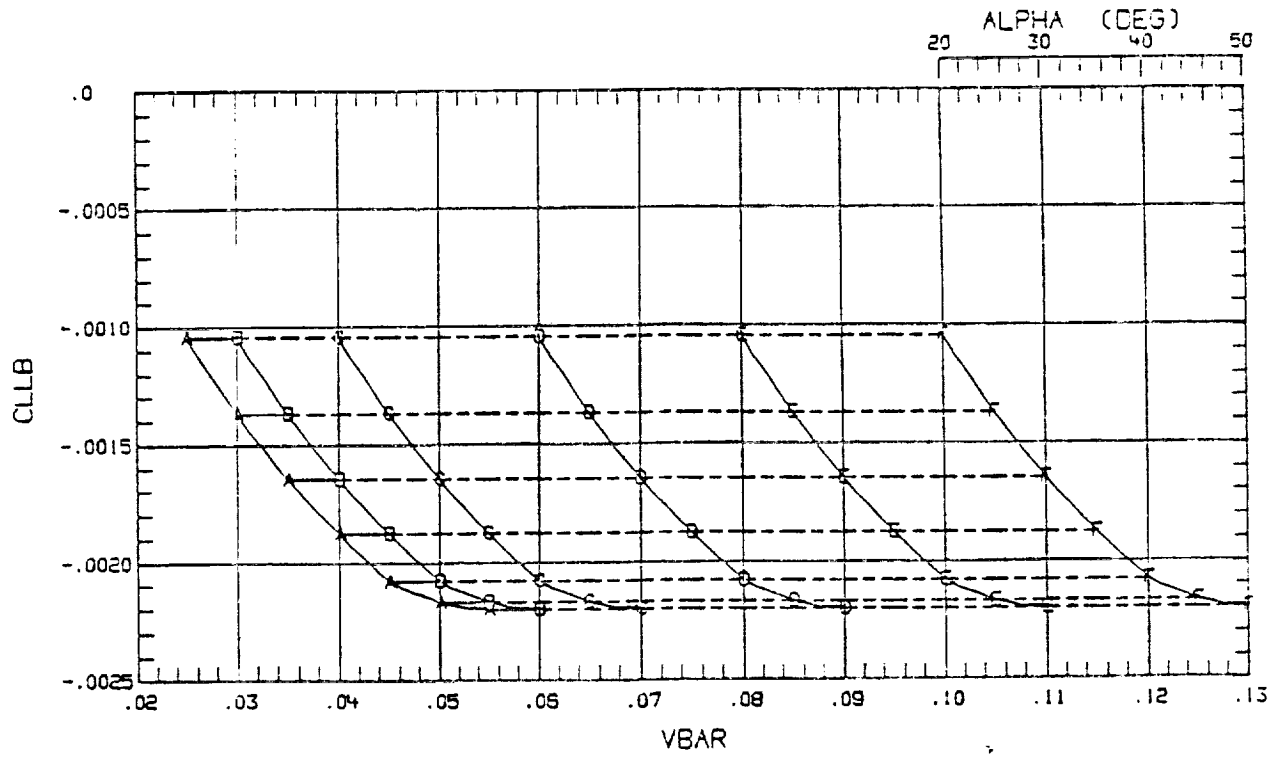
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
BETA (DEG)	BASIC ROLLING MOMENT COEFFICIENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	-0.00099	-0.00105	-0.00137	-0.00165	-0.00188	-0.00208	-0.00217	-0.00220
2.000	-0.00202	-0.00210	-0.00274	-0.00330	-0.00376	-0.00416	-0.00434	-0.00440
4.000	-0.00412	-0.00420	-0.00548	-0.00660	-0.00752	-0.00832	-0.00868	-0.00880
6.000	-0.00626	-0.00630	-0.00822	-0.00990	-0.01129	-0.01248	-0.01302	-0.01320
8.000	-0.00846	-0.00840	-0.01096	-0.01320	-0.01504	-0.01664	-0.01736	-0.01760
10.000	-0.01070	-0.01050	-0.01370	-0.01650	-0.01880	-0.02080	-0.02170	-0.02200

ENGINEER [illegible]
DATE 12.3.72

FIGURE 4.2.1.3-27
BASIC ROLLING MOMENT COEFFICIENT



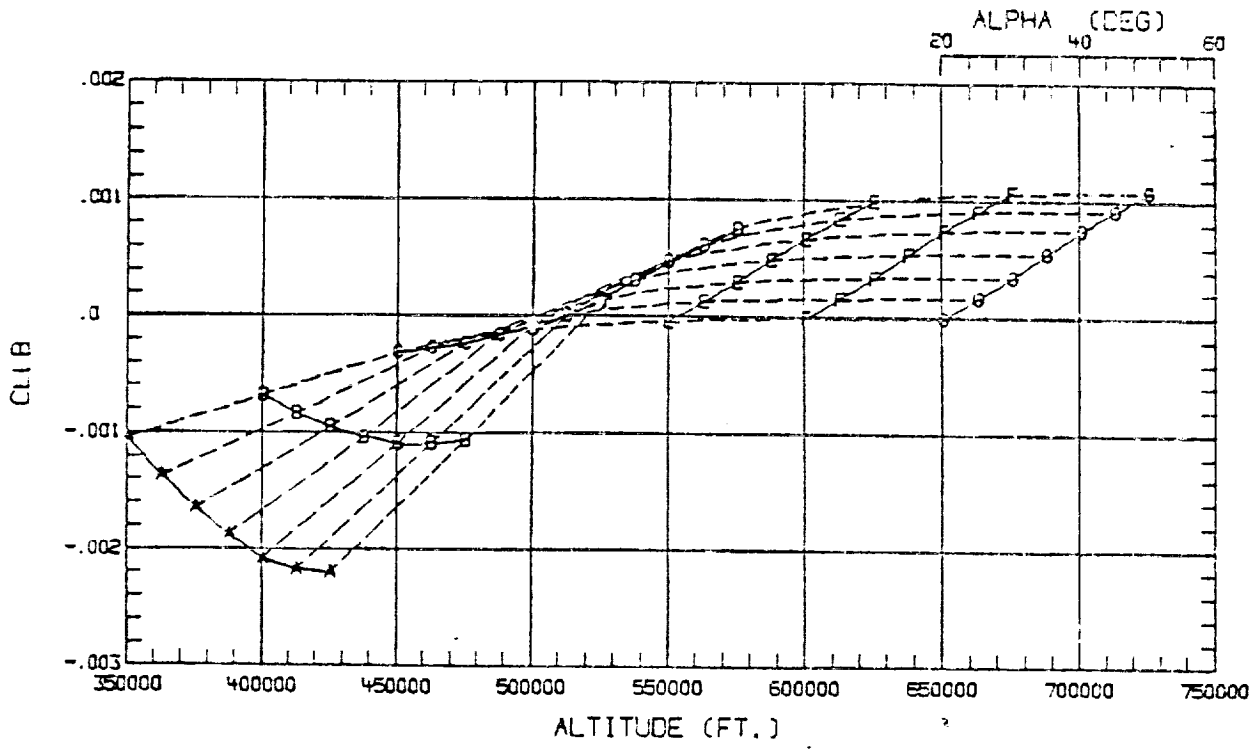
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005	0.010	0.020	0.040	0.060	0.080
	A	B	C	D	E	F
ALPHA (DEG)	VISCOUS ROLLING MOMENT DERIVATIV					
20.000	-0.00105	-0.00105	-0.00105	-0.00105	-0.00105	-0.00105
25.000	-0.00137	-0.00137	-0.00137	-0.00137	-0.00137	-0.00137
30.000	-0.00165	-0.00165	-0.00165	-0.00165	-0.00165	-0.00165
35.000	-0.00188	-0.00188	-0.00188	-0.00188	-0.00188	-0.00188
40.000	-0.00208	-0.00208	-0.00208	-0.00208	-0.00208	-0.00208
45.000	-0.00217	-0.00217	-0.00217	-0.00217	-0.00217	-0.00217
50.000	-0.00220	-0.00220	-0.00220	-0.00220	-0.00220	-0.00220

ENGINEER NASA
DATE

FIGURE 4.2.1.3-28
BASIC ROLLING MOMENT COEFFICIENT

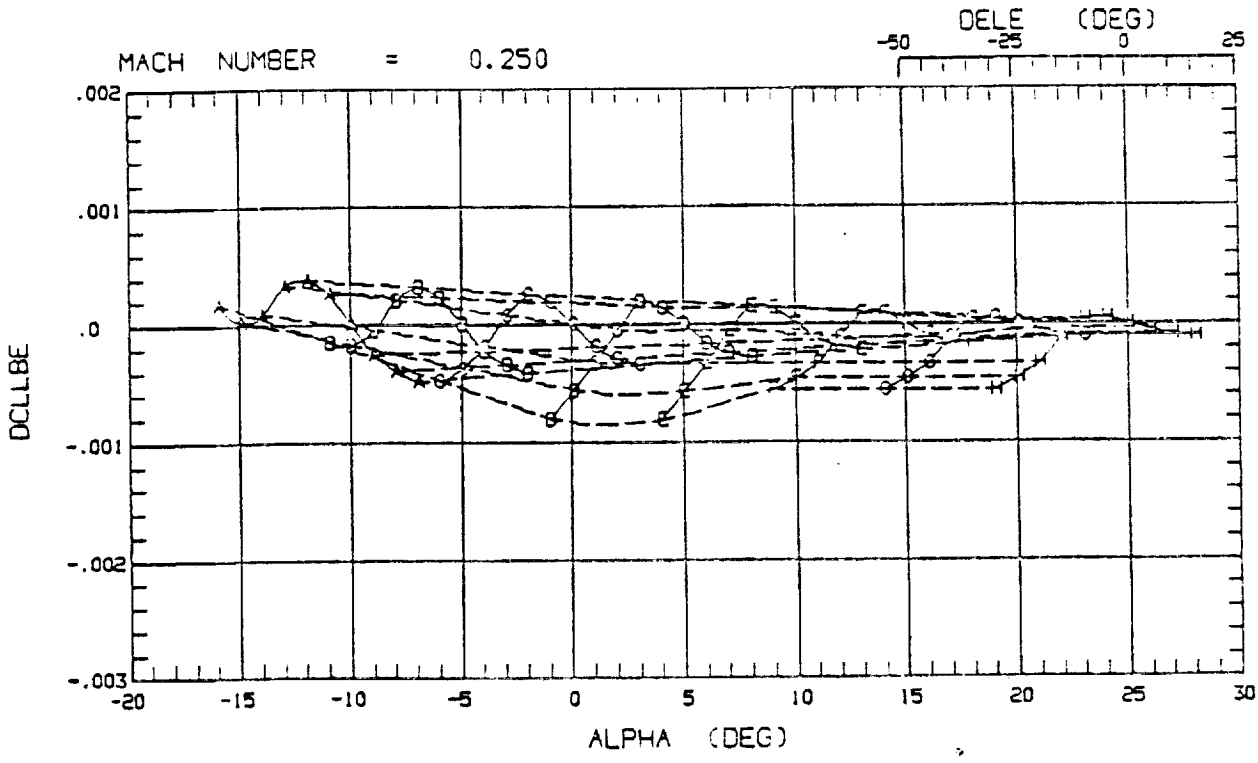


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALT. ROLLING MOMENT DERIVAT						
20.000	-0.00105	-0.00069	-0.00032	-0.00012	-0.00005	-0.00002	-0.00002
25.000	-0.00137	-0.00084	-0.00029	0.0	0.00012	0.00015	0.00016
30.000	-0.00165	-0.00096	-0.00024	0.00014	0.00029	0.00033	0.00034
35.000	-0.00186	-0.00104	-0.00017	0.00030	0.00048	0.00053	0.00054
40.000	-0.00208	-0.00110	-0.00009	0.00046	0.00066	0.00073	0.00074
45.000	-0.00217	-0.00110	0.0	0.00060	0.00083	0.00090	0.00091
50.000	-0.00220	-0.00107	0.00011	0.00074	0.00098	0.00106	0.00107

ENGINEER NASA
DATE

FIGURE 4.2.1.3-29
BASIC ROLLING MOMENT COEFFICIENT



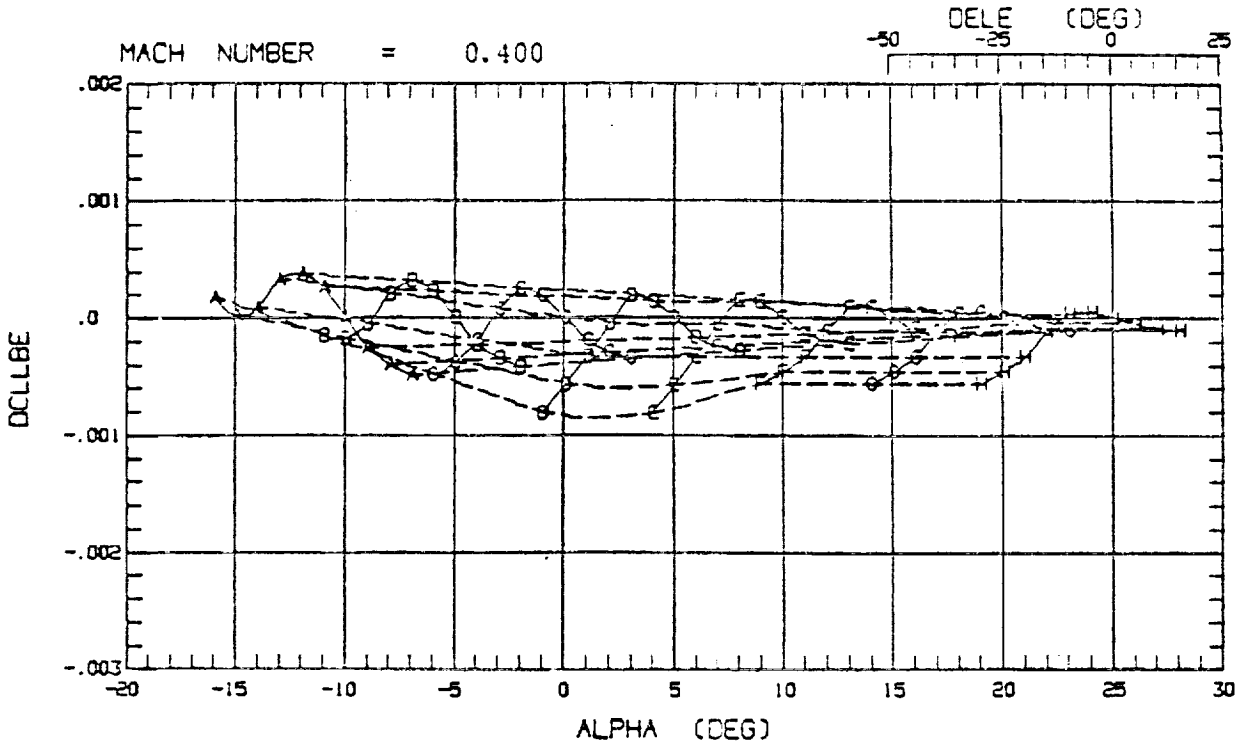
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00017	-0.00016	-0.00049	-0.00082	-0.00082	-0.00056	-0.00056	-0.00056
-25.000	0.00002	-0.00018	-0.00038	-0.00058	-0.00058	-0.00046	-0.00046	-0.00046
-20.000	0.00008	-0.00006	-0.00020	-0.00034	-0.00034	-0.00034	-0.00034	-0.00034
-15.000	0.00033	0.00020	0.00007	-0.00006	-0.00006	-0.00012	-0.00012	-0.00012
-10.000	0.00037	0.00031	0.00025	0.00019	0.00015	0.00009	0.00003	0.00003
-5.000	0.00026	0.00022	0.00018	0.00014	0.00013	0.00009	0.00004	0.00004
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00026	-0.00023	-0.00020	-0.00017	-0.00014	-0.00010	-0.00005	-0.00005
10.000	-0.00040	-0.00035	-0.00030	-0.00025	-0.00019	-0.00015	-0.00010	-0.00010
15.000	-0.00049	-0.00042	-0.00035	-0.00028	-0.00022	-0.00016	-0.00011	-0.00011

ENGINEER [illegible]
DATE 10/23/73

FIGURE 4.2.1.3-30
EFFECT OF ELEVON



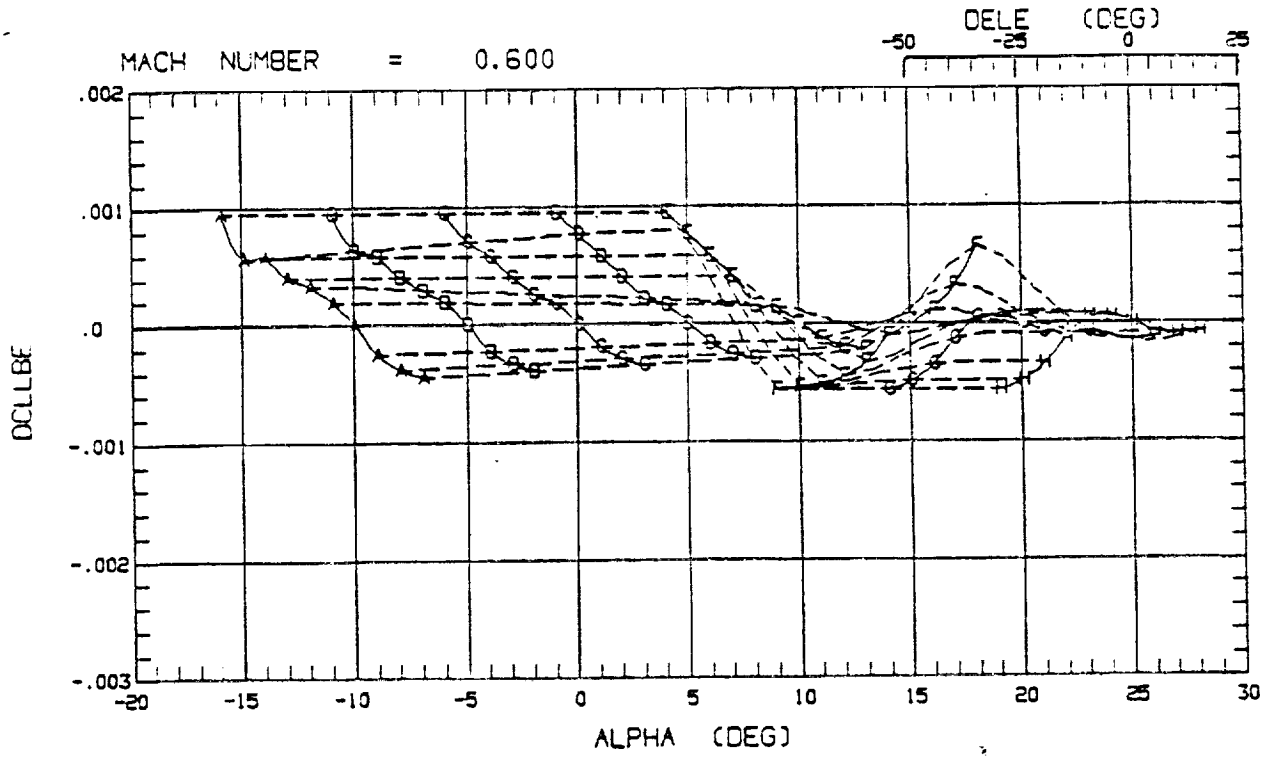
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00017	-0.00016	-0.00049	-0.00082	-0.00082	-0.00056	-0.00056	-0.00056
-25.000	0.00002	-0.00018	-0.00038	-0.00058	-0.00058	-0.00046	-0.00046	-0.00046
-20.000	0.00008	-0.00006	-0.00020	-0.00034	-0.00034	-0.00034	-0.00034	-0.00034
-15.000	0.00033	0.00020	0.00007	-0.00006	-0.00006	-0.00012	-0.00012	-0.00012
-10.000	0.00037	0.00031	0.00025	0.00019	0.00015	0.00009	0.00003	0.00003
-5.000	0.00026	0.00022	0.00018	0.00014	0.00013	0.00009	0.00004	0.00004
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00026	-0.00023	-0.00020	-0.00017	-0.00014	-0.00010	-0.00005	-0.00005
10.000	-0.00040	-0.00035	-0.00030	-0.00025	-0.00019	-0.00015	-0.00010	-0.00010
15.000	-0.00049	-0.00042	-0.00035	-0.00029	-0.00022	-0.00016	-0.00011	-0.00011

ENGINEER _____
DATE 10/3/73

FIGURE 4.2.1.3-31
EFFECT OF ELEVON



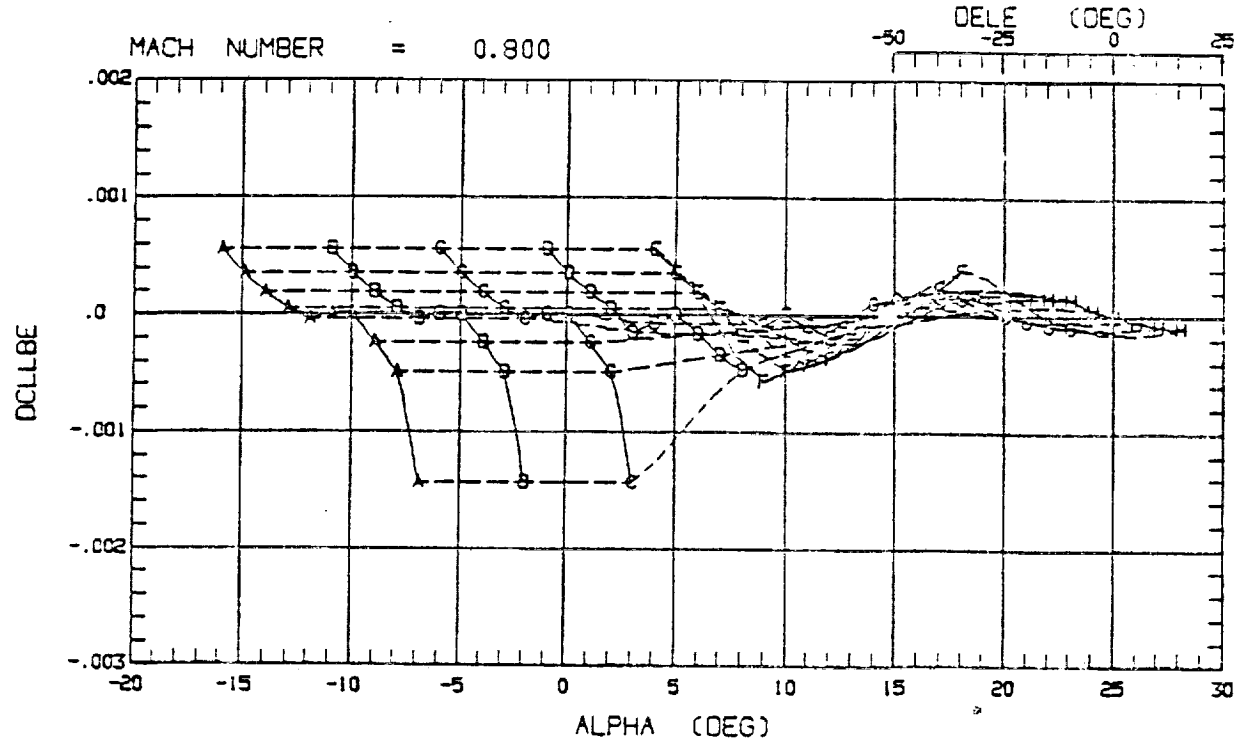
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00095	0.00095	0.00095	0.00095	0.00095	-0.00056	-0.00056	-0.00056
-25.000	0.00056	0.00063	0.00070	0.00077	0.00077	-0.00054	-0.00049	-0.00049
-20.000	0.00058	0.00058	0.00058	0.00058	0.00058	-0.00051	-0.00035	-0.00035
-15.000	0.00040	0.00040	0.00040	0.00040	0.00040	-0.00045	-0.00013	-0.00013
-10.000	0.00033	0.00029	0.00025	0.00021	0.00015	-0.00034	0.00005	0.00005
-5.000	0.00019	0.00018	0.00017	0.00016	0.00013	-0.00011	0.00005	0.00005
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00026	-0.00023	-0.00020	-0.00017	-0.00013	0.00011	-0.00008	-0.00008
10.000	-0.00038	-0.00034	-0.00030	-0.00026	-0.00019	0.00033	-0.00009	-0.00009
15.000	-0.00045	-0.00040	-0.00035	-0.00030	-0.00022	0.00066	-0.00008	-0.00008

ENGINEER XP
DATE 10/3/73

FIGURE 4.2.1.3-32
EFFECT OF ELEVON



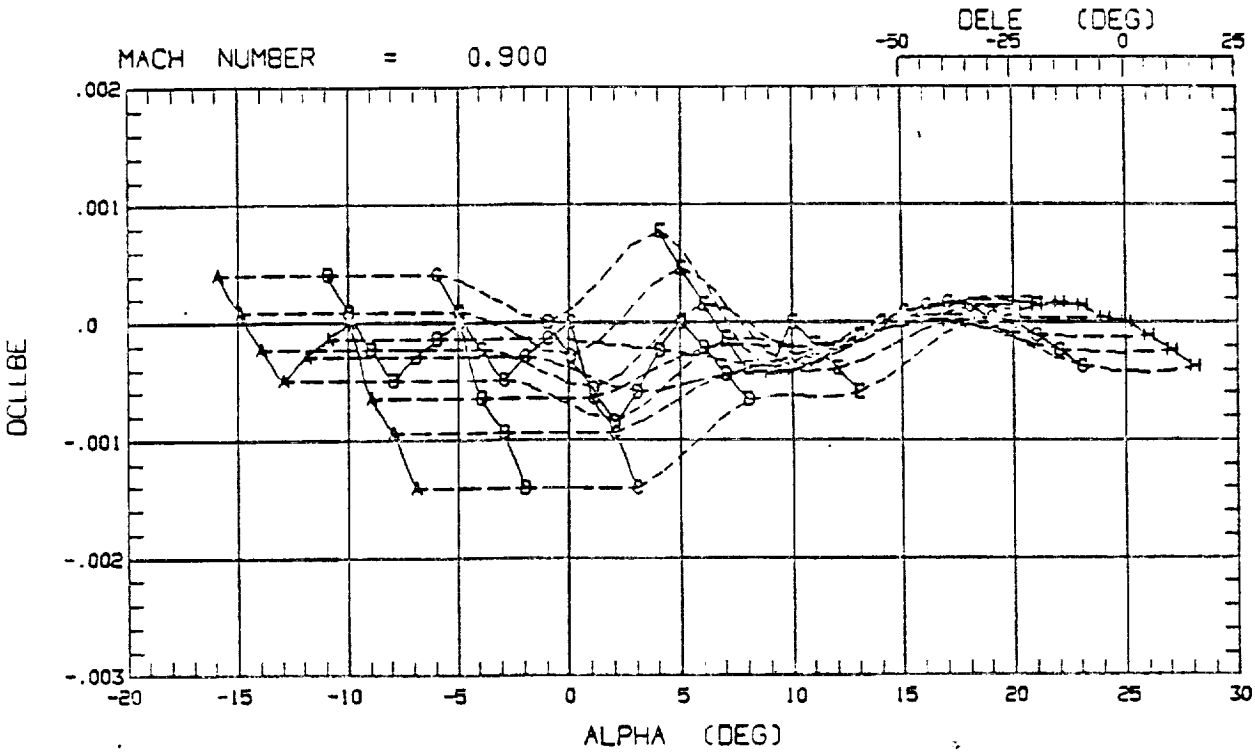
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00055	0.00055	0.00055	0.00055	0.00055	-0.00057	0.00010	0.00010
-25.000	0.00035	0.00035	0.00035	0.00035	0.00035	-0.00049	0.00013	0.00013
-20.000	0.00018	0.00018	0.00018	0.00018	0.00018	-0.00044	0.00015	0.00015
-15.000	0.00005	0.00005	0.00005	0.00005	0.00005	-0.00037	0.00015	0.00015
-10.000	-0.00004	-0.00004	-0.00004	-0.00018	-0.00018	-0.00026	0.00014	0.00014
-5.000	0.0	0.0	0.0	-0.00008	-0.00009	-0.00010	0.00005	0.00005
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00025	-0.00025	-0.00025	-0.00017	-0.00010	0.00007	-0.00005	-0.00005
10.000	-0.00050	-0.00050	-0.00050	-0.00035	-0.00020	0.00022	-0.00009	-0.00009
15.000	-0.00144	-0.00144	-0.00144	-0.00048	-0.00011	0.00038	-0.00011	-0.00011

ENGINEER
DATE 3/2/73

FIGURE 4.2.1.3-33
EFFECT OF ELEVON



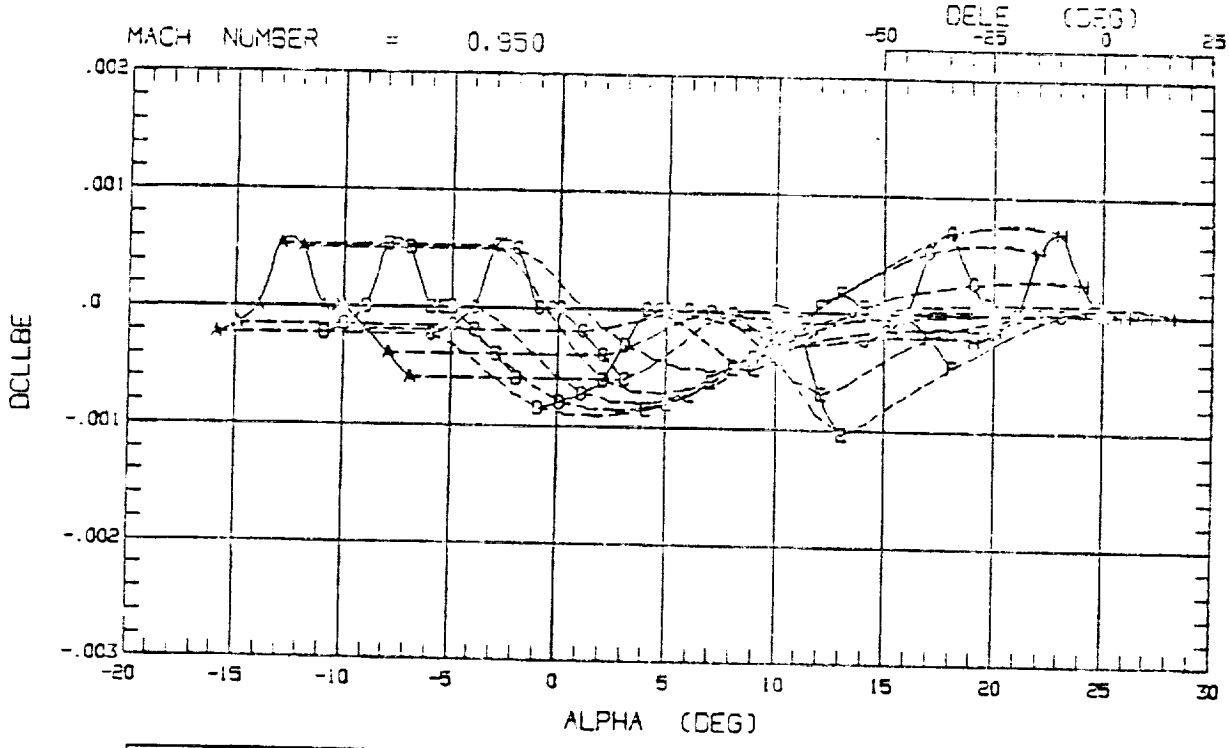
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00040	0.00040	0.00040	0.0	0.00077	-0.00044	0.0	0.0
-25.000	0.00008	0.00008	0.00008	-0.00030	0.00045	-0.00041	0.00008	0.00008
-20.000	-0.00023	-0.00023	-0.00023	-0.00058	0.00015	-0.00033	0.00013	0.00013
-15.000	-0.00050	-0.00050	-0.00050	-0.00065	-0.00015	-0.00023	0.00016	0.00016
-10.000	-0.00030	-0.00030	-0.00030	-0.00050	-0.00040	-0.00012	0.00013	0.00013
-5.000	-0.00015	-0.00015	-0.00015	-0.00025	-0.00040	-0.00002	0.00003	0.00003
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00065	-0.00065	-0.00065	-0.00022	-0.00020	0.0	-0.00012	-0.00012
10.000	-0.00095	-0.00095	-0.00095	-0.00045	-0.00040	0.0	-0.00024	-0.00024
15.000	-0.00142	-0.00142	-0.00142	-0.00067	-0.00060	0.0	-0.00039	-0.00039

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-34
EFFECT OF ELEVON



CONFIGURATION

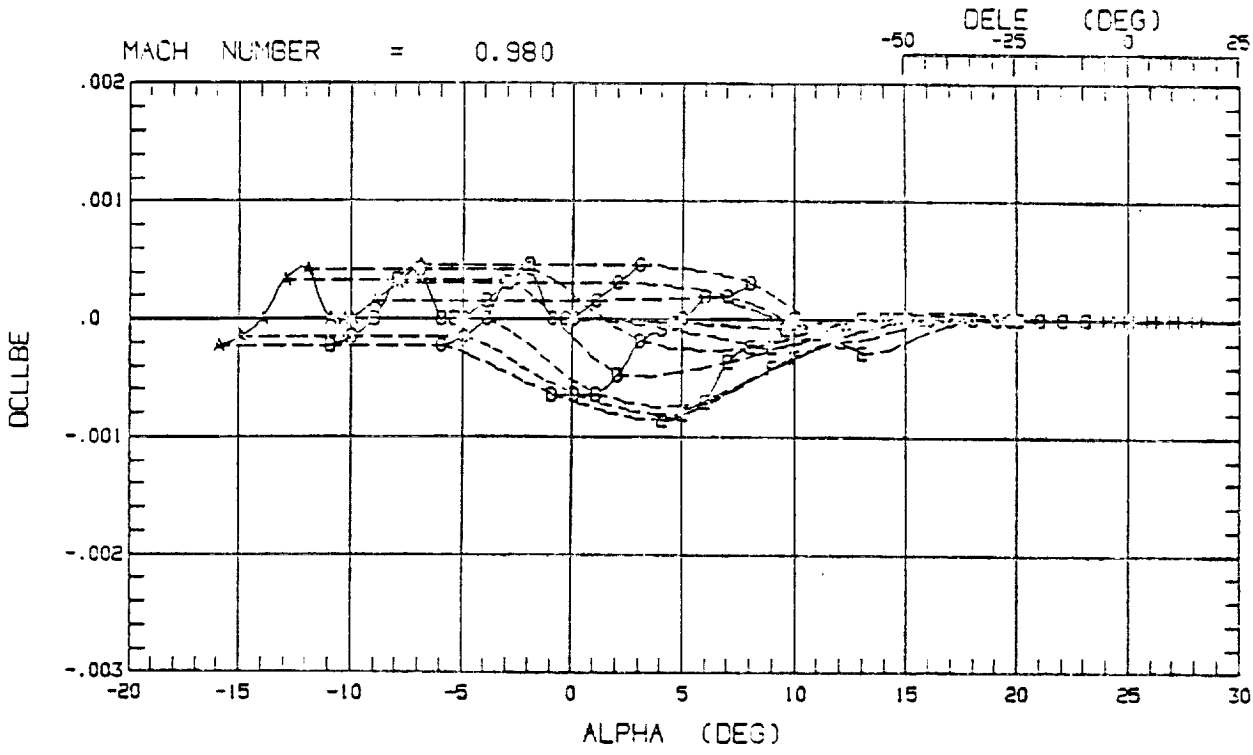
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	REFERENCE DIMENSIONS		
OR	YO = BL 0.0 IN.	WING AREA	SW = 2690.00	SQ.FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	WING SPAN	BW = 78.056	FT.
		M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	-0.00023	-0.00023	-0.00023	-0.00085	-0.00085	-0.00040	-0.00023	-0.00023
-25.000	-0.00016	-0.00016	-0.00016	-0.00080	-0.00080	-0.00034	-0.00016	-0.00016
-20.000	0.0	0.0	0.0	-0.00073	-0.00073	-0.00021	0.0	0.0
-15.000	0.00053	0.00053	0.00053	-0.00062	-0.00061	0.00005	0.00053	0.00053
-10.000	0.00050	0.00050	0.00050	-0.00031	-0.00050	0.00016	0.00069	0.00069
-5.000	0.0	0.0	0.0	0.0	-0.00050	0.00005	0.00025	0.00025
-2.000	0.0	0.0	0.0	0.0	-0.00019	0.00002	0.00008	0.00008
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00020	-0.00020	-0.00020	-0.00001	-0.00010	-0.00004	0.0	0.0
10.000	-0.00040	-0.00040	-0.00040	-0.00002	-0.00070	-0.00021	0.0	0.0
15.000	-0.00060	-0.00060	-0.00060	-0.00003	-0.00105	-0.00046	0.0	0.0

ENGINEER AP
DATE 9/25/72

FIGURE 4.2.1.3-35
EFFECT OF ELEVON



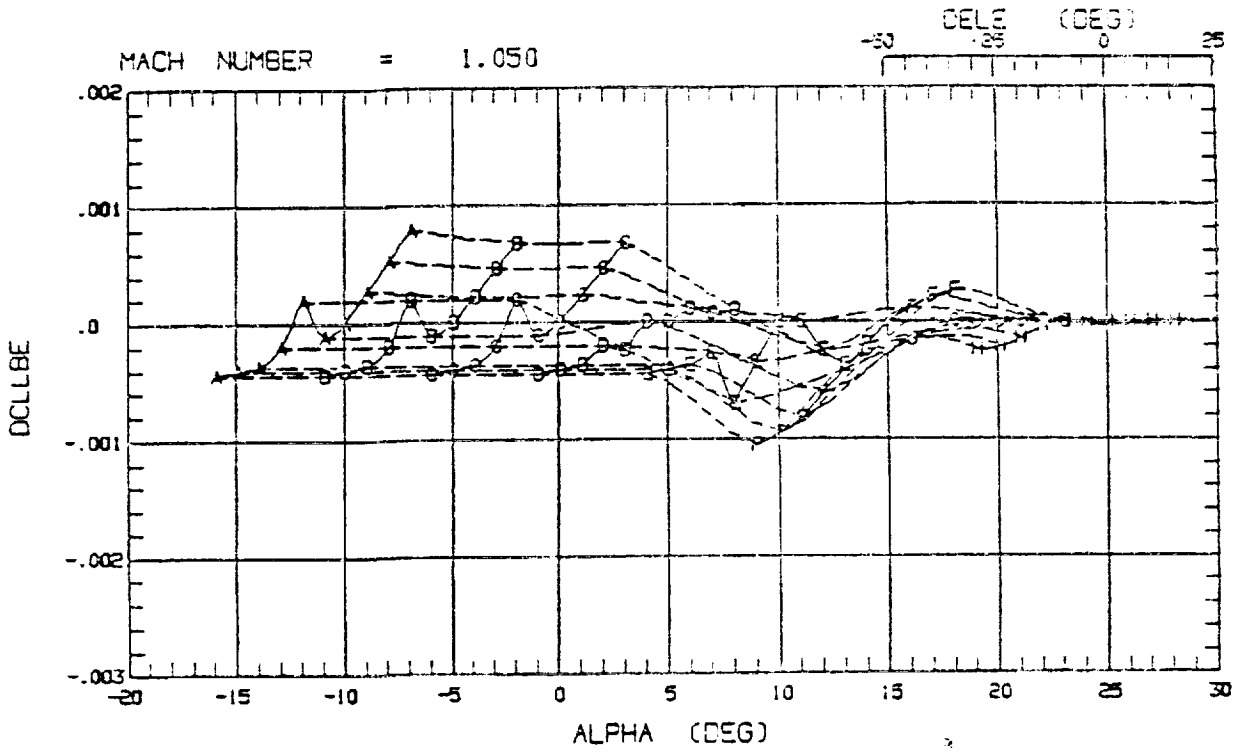
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	-0.00023	-0.00023	-0.00023	-0.00065	-0.00087	-0.00043	0.0	0.0
-25.000	-0.00016	-0.00016	-0.00016	-0.00065	-0.00082	-0.00033	0.0	0.0
-20.000	0.0	0.0	0.0	-0.00065	-0.00071	-0.00023	0.0	0.0
-15.000	0.00033	0.00033	0.00033	-0.00049	-0.00037	-0.00009	0.0	0.0
-10.000	0.00042	0.00042	0.00042	-0.00030	-0.00025	0.0	0.0	0.0
-5.000	0.0	0.0	0.0	-0.00009	-0.00025	0.0	0.0	0.0
-2.000	0.0	0.0	0.0	-0.00004	-0.00009	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00015	0.00015	0.00015	0.00018	-0.00010	0.0	0.0	0.0
10.000	0.00030	0.00030	0.00030	0.00019	-0.00020	0.0	0.0	0.0
15.000	0.00045	0.00045	0.00045	0.00030	-0.00030	0.0	0.0	0.0

ENGINEER
DATE 5/23/78

FIGURE 4.2.1.3-36
EFFECT OF ELEVON



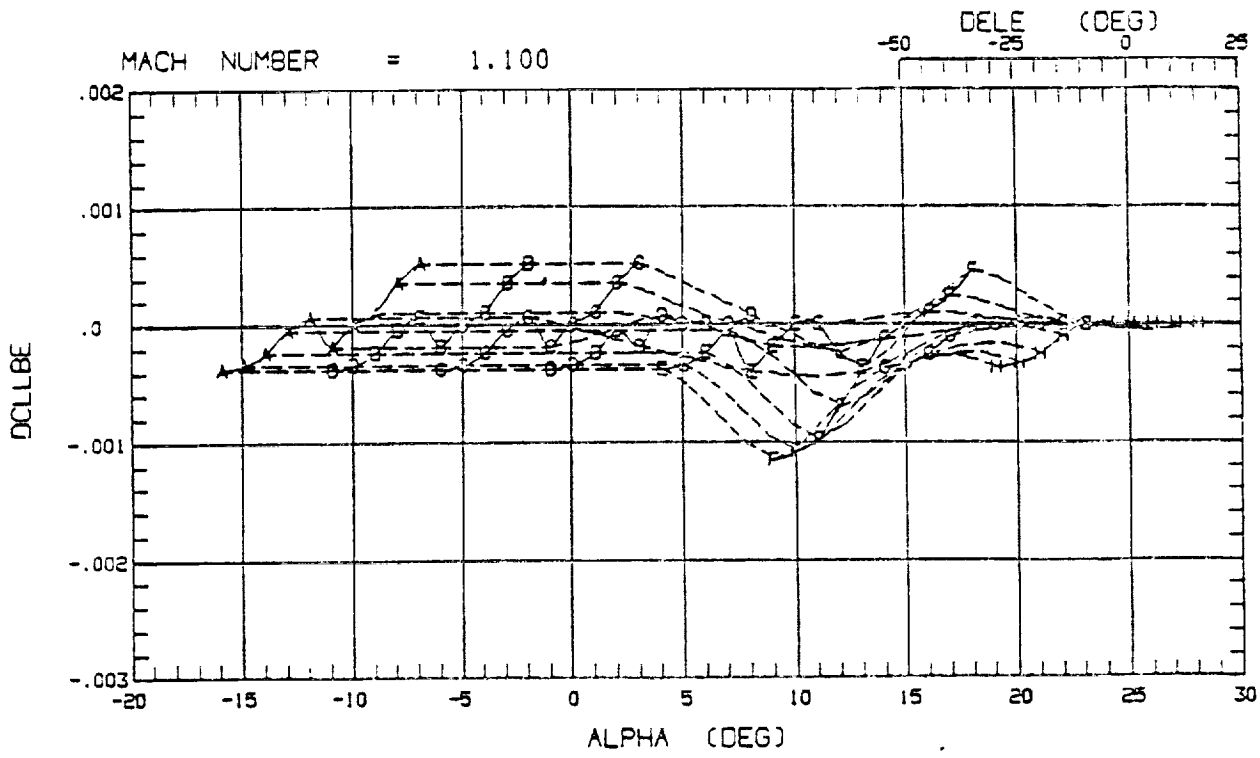
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	-0.00045	-0.00045	-0.00045	-0.00045	-0.00045	-0.00106	-0.00025	-0.00025
-25.000	-0.00041	-0.00041	-0.00041	-0.00041	-0.00041	-0.00096	-0.00022	-0.00022
-20.000	-0.00037	-0.00037	-0.00037	-0.00037	-0.00037	-0.00083	-0.00016	-0.00015
-15.000	-0.00021	-0.00021	-0.00021	-0.00021	-0.00027	-0.00062	-0.00004	-0.00004
-10.000	0.00018	0.00018	0.00018	-0.00025	-0.00070	-0.00041	0.0	0.0
-5.000	-0.00012	-0.00012	-0.00012	0.0	-0.00035	-0.00019	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00025	0.00021	0.00022	0.00011	0.0	0.00011	0.0	0.0
10.000	0.00052	0.00045	0.00045	0.00007	-0.00025	0.00021	0.0	0.0
15.000	0.00078	0.00067	0.00067	0.00010	-0.00037	0.00026	0.0	0.0

ENGINEER
DATE 10/3/73

FIGURE 4.2.1.3- 37
EFFECT OF ELEVON



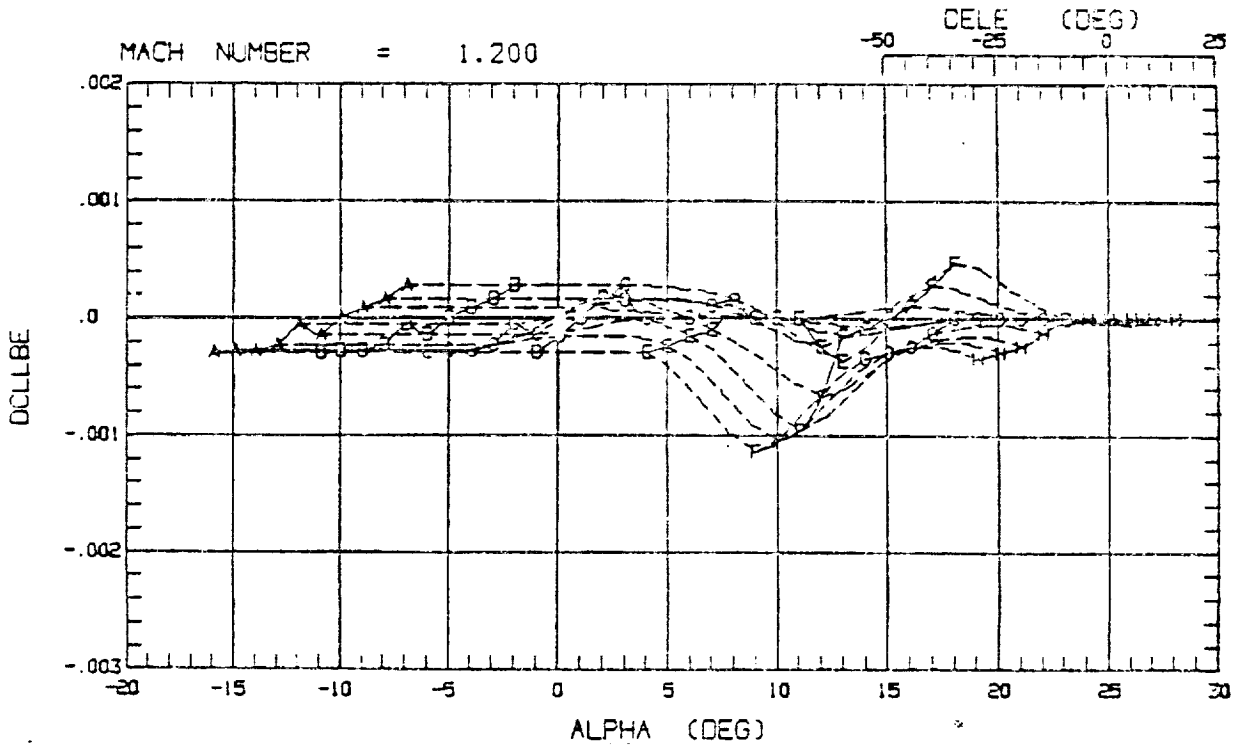
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	-0.00039	-0.00039	-0.00039	-0.00039	-0.00039	-0.00116	-0.00037	-0.00037
-25.000	-0.00035	-0.00035	-0.00035	-0.00035	-0.00035	-0.00109	-0.00034	-0.00034
-20.000	-0.00025	-0.00025	-0.00025	-0.00025	-0.00025	-0.00098	-0.00026	-0.00026
-15.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00070	-0.00011	-0.00011
-10.000	0.00006	0.00006	0.00006	-0.00020	-0.00041	-0.00041	0.0	0.0
-5.000	-0.00020	-0.00020	-0.00020	0.00007	-0.00020	-0.00013	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00010	0.00010	0.00010	0.0	0.0	0.00010	0.0	0.0
10.000	0.00035	0.00035	0.00035	0.0	-0.00025	0.00024	0.0	0.0
15.000	0.00052	0.00052	0.00052	0.00007	-0.00037	0.00045	0.0	0.0

ENGINEER HP
DATE 01/3/78

FIGURE 4.2.1.3-38
EFFECT OF ELEVON



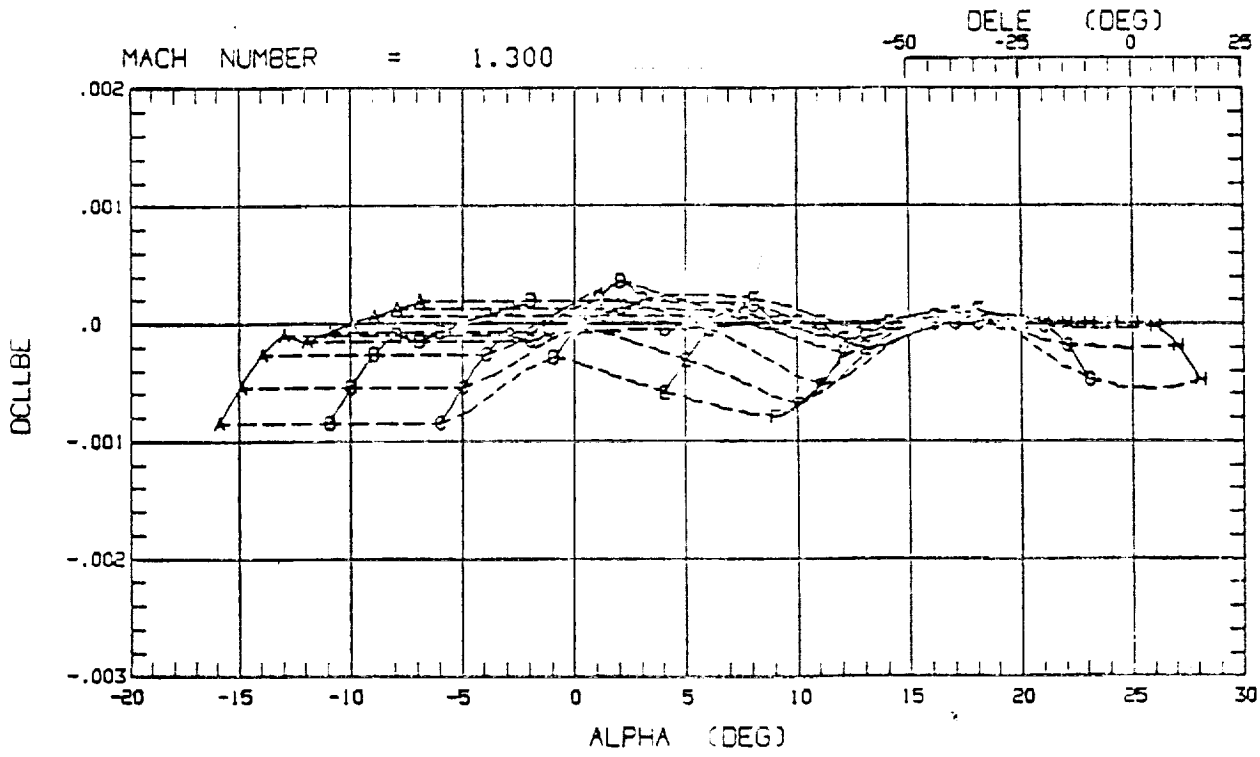
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	-0.00030	-0.00030	-0.00030	-0.00030	-0.00030	-0.00115	-0.00035	-0.00035
-25.000	-0.00029	-0.00029	-0.00029	-0.00016	-0.00024	-0.00106	-0.00030	-0.00030
-20.000	-0.00028	-0.00028	-0.00028	0.0	-0.00016	-0.00097	-0.00025	-0.00025
-15.000	-0.00023	-0.00023	-0.00023	0.00017	-0.00011	-0.00068	-0.00013	-0.00013
-10.000	-0.00006	-0.00006	-0.00006	0.00015	0.00008	-0.00016	-0.00001	-0.00001
-5.000	-0.00015	-0.00015	-0.00015	0.0	0.0	-0.00009	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00008	0.00008	0.00008	0.0	0.0	0.00010	0.0	0.0
10.000	0.00016	0.00016	0.00016	0.00010	-0.00025	0.00027	0.0	0.0
15.000	0.00029	0.00029	0.00029	0.00015	-0.00037	0.00047	0.0	0.0

ENGINEER
DATE 9/2/05

FIGURE 4.2.1.3-39
EFFECT OF ELEVON



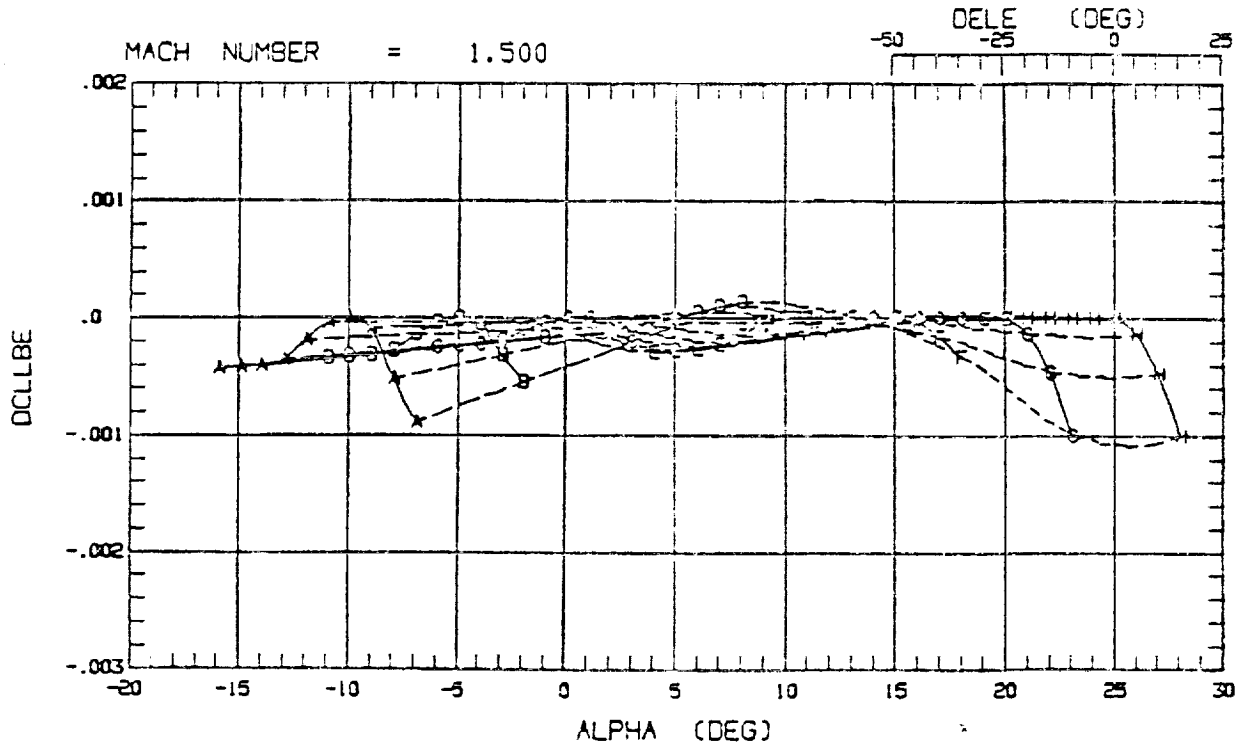
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1078.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	-0.00086	-0.00086	-0.00086	-0.00030	-0.00060	-0.00081	0.0	0.0
-25.000	-0.00055	-0.00055	-0.00055	-0.00006	-0.00032	-0.00070	0.0	0.0
-20.000	-0.00027	-0.00027	-0.00027	0.00020	-0.00006	-0.00054	0.0	0.0
-15.000	-0.00011	-0.00011	-0.00011	0.00035	0.00004	-0.00027	0.0	0.0
-10.000	-0.00016	-0.00016	-0.00016	0.00020	0.00020	-0.00007	0.0	0.0
-5.000	-0.00008	-0.00008	-0.00008	-0.00005	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00006	0.00006	0.00006	0.00005	0.0	0.00005	-0.00003	-0.00003
10.000	0.00012	0.00012	0.00012	0.00010	-0.00015	0.00007	-0.00019	-0.00019
15.000	0.00018	0.00018	0.00018	0.00015	-0.00022	0.00011	-0.00049	-0.00049

ENGINEER
DATE 10/23/73

FIGURE 4.2.1.3-40
EFFECT OF ELEVON



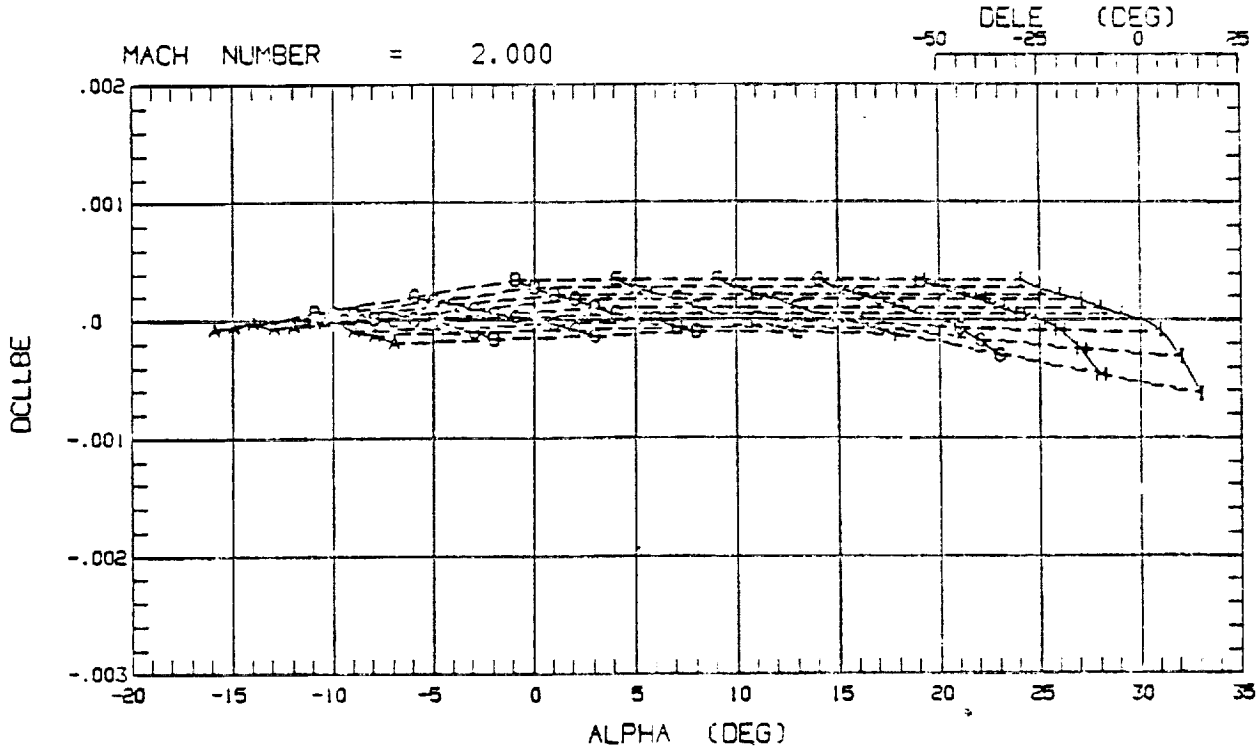
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	-0.00044	-0.00035	-0.00026	-0.00017	-0.00030	-0.00017	0.0	0.0
-25.000	-0.00042	-0.00033	-0.00024	-0.00015	-0.00029	-0.00015	0.0	0.0
-20.000	-0.00041	-0.00032	-0.00023	-0.00014	-0.00027	-0.00014	0.0	0.0
-15.000	-0.00036	-0.00029	-0.00020	-0.00012	-0.00023	-0.00012	0.0	0.0
-10.000	-0.00019	-0.00015	-0.00011	-0.00007	-0.00016	-0.00007	0.0	0.0
-5.000	-0.00004	-0.00004	-0.00004	-0.00004	-0.00004	-0.00004	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00010	-0.00005	0.0	0.00005	0.0	-0.00003	-0.00015	-0.00015
10.000	-0.00053	-0.00032	-0.00011	0.00010	0.0	-0.00017	-0.00047	-0.00047
15.000	-0.00089	-0.00055	-0.00021	0.00013	0.0	-0.00034	-0.00101	-0.00101

ENGINEER
DATE 10/20/81

FIGURE 4.2.1.3-41
EFFECT OF ELEVON



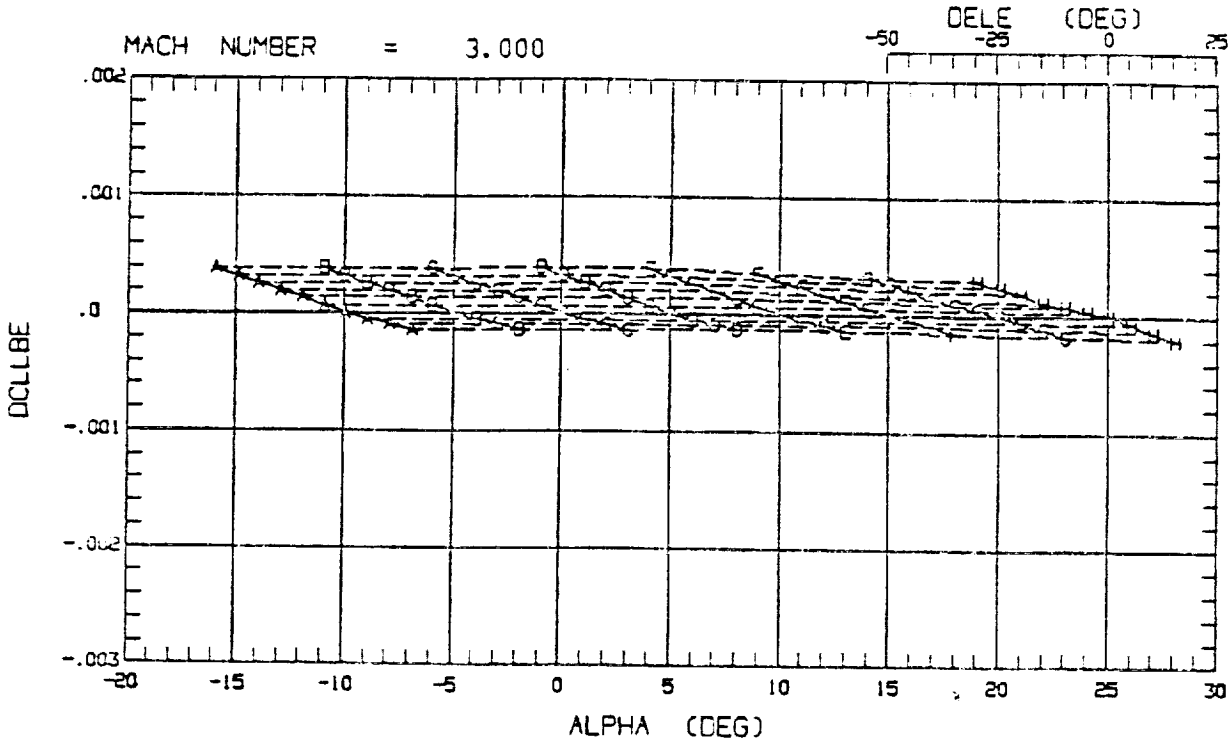
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT								
-30.000	-0.00008	0.00006	0.00020	0.00034	0.00034	0.00034	0.00034	0.00034	0.00034
-25.000	-0.00006	0.00005	0.00016	0.00027	0.00027	0.00027	0.00027	0.00027	0.00027
-20.000	-0.00003	0.00005	0.00013	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021
-15.000	-0.00007	0.00001	0.00009	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017
-10.000	-0.00005	0.0	0.00005	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
-5.000	-0.00002	0.0	0.00002	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00010	-0.00007	-0.00004	-0.00001	-0.00001	-0.00004	-0.00008	-0.00010	-0.00010
10.000	-0.00013	-0.00011	-0.00009	-0.00007	-0.00007	-0.00009	-0.00018	-0.00026	-0.00032
15.000	-0.00020	-0.00017	-0.00014	-0.00011	-0.00011	-0.00014	-0.00031	-0.00048	-0.00064

ENGINEER HP
DATE 10/13/73

FIGURE 4.2.1.3-42
EFFECT OF ELEVON



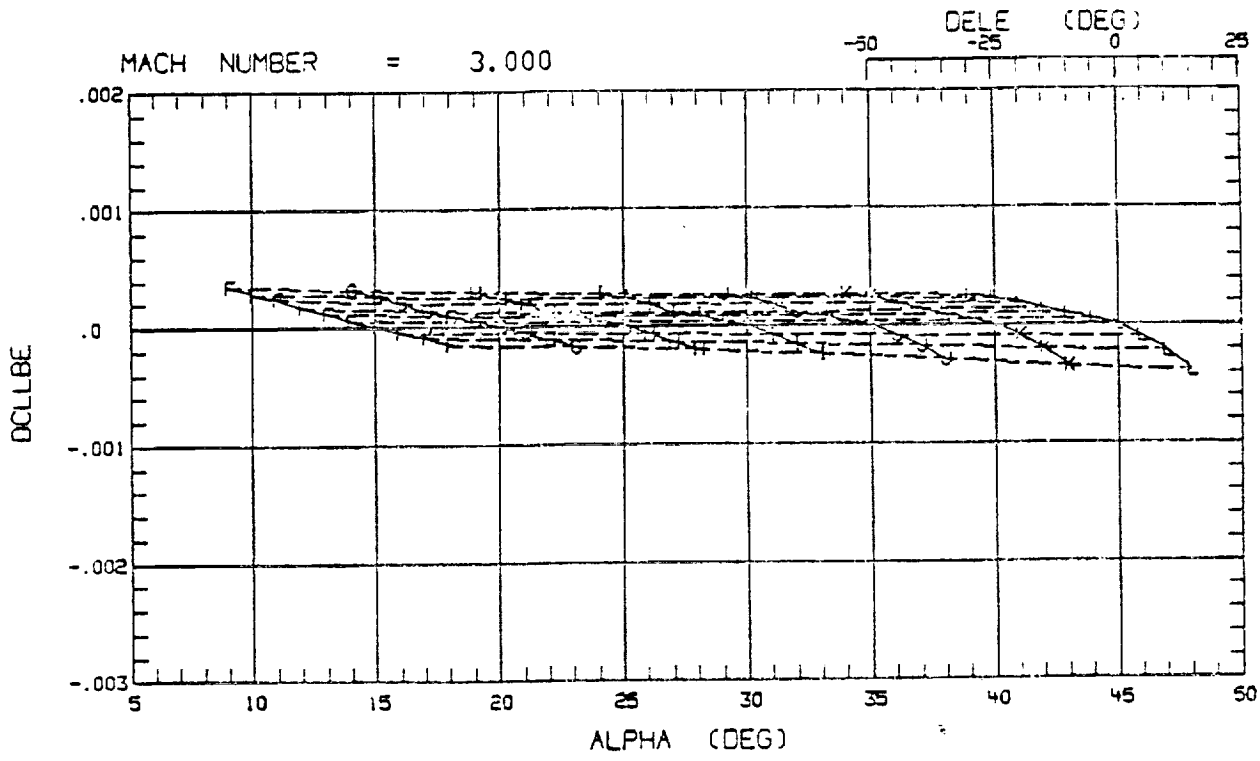
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00038	0.00038	0.00038	0.00039	0.00038	0.00034	0.00031	0.00029
-25.000	0.00031	0.00031	0.00031	0.00032	0.00031	0.00028	0.00026	0.00024
-20.000	0.00025	0.00025	0.00025	0.00026	0.00025	0.00023	0.00020	0.00019
-15.000	0.00019	0.00019	0.00019	0.00020	0.00019	0.00016	0.00013	0.00011
-10.000	0.00013	0.00013	0.00013	0.00013	0.00013	0.00011	0.00009	0.00008
-5.000	0.00006	0.00006	0.00006	0.00006	0.00006	0.00005	0.00004	0.00003
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00006	-0.00007
10.000	-0.00009	-0.00009	-0.00009	-0.00009	-0.00009	-0.00010	-0.00012	-0.00014
15.000	-0.00014	-0.00014	-0.00014	-0.00013	-0.00014	-0.00016	-0.00018	-0.00021

ENGINEER HP
DATE 10/3/79

FIGURE 4.2.1.3-43
EFFECT OF ELEVON

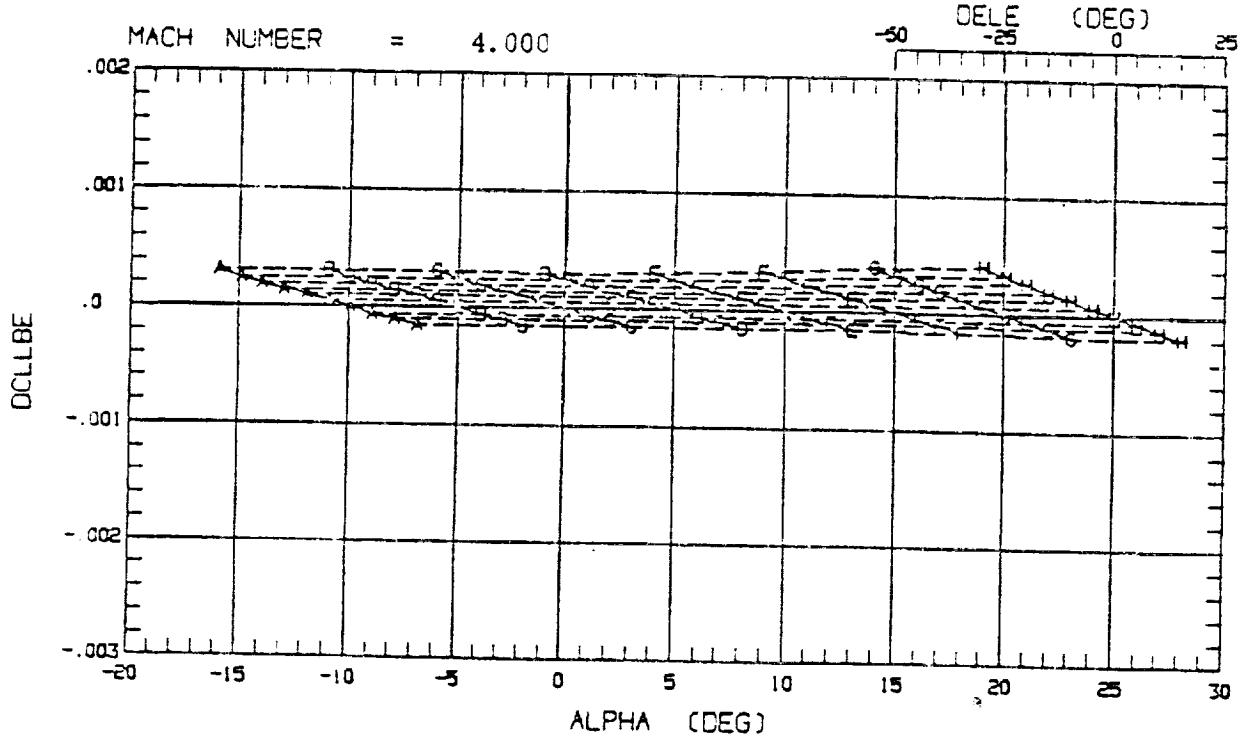


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT						
-30.000	0.00034	0.00031	0.00029	0.00027	0.00026	0.00025	0.00025
-25.000	0.00028	0.00026	0.00024	0.00023	0.00023	0.00023	0.00022
-20.000	0.00023	0.00020	0.00019	0.00018	0.00018	0.00019	0.00019
-15.000	0.00016	0.00013	0.00011	0.00011	0.00011	0.00013	0.00013
-10.000	0.00011	0.00009	0.00008	0.00008	0.00008	0.00009	0.00009
-5.000	0.00005	0.00004	0.00003	0.00003	0.00003	0.00004	0.00004
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00006	-0.00007	-0.00008	-0.00009	-0.00010	-0.00011
10.000	-0.00010	-0.00012	-0.00014	-0.00016	-0.00018	-0.00021	-0.00023
15.000	-0.00016	-0.00018	-0.00021	-0.00025	-0.00030	-0.00036	-0.00040

ENGINEER _____
DATE 10/2/73

FIGURE 4.2.1.3-44
EFFECT OF ELEVON



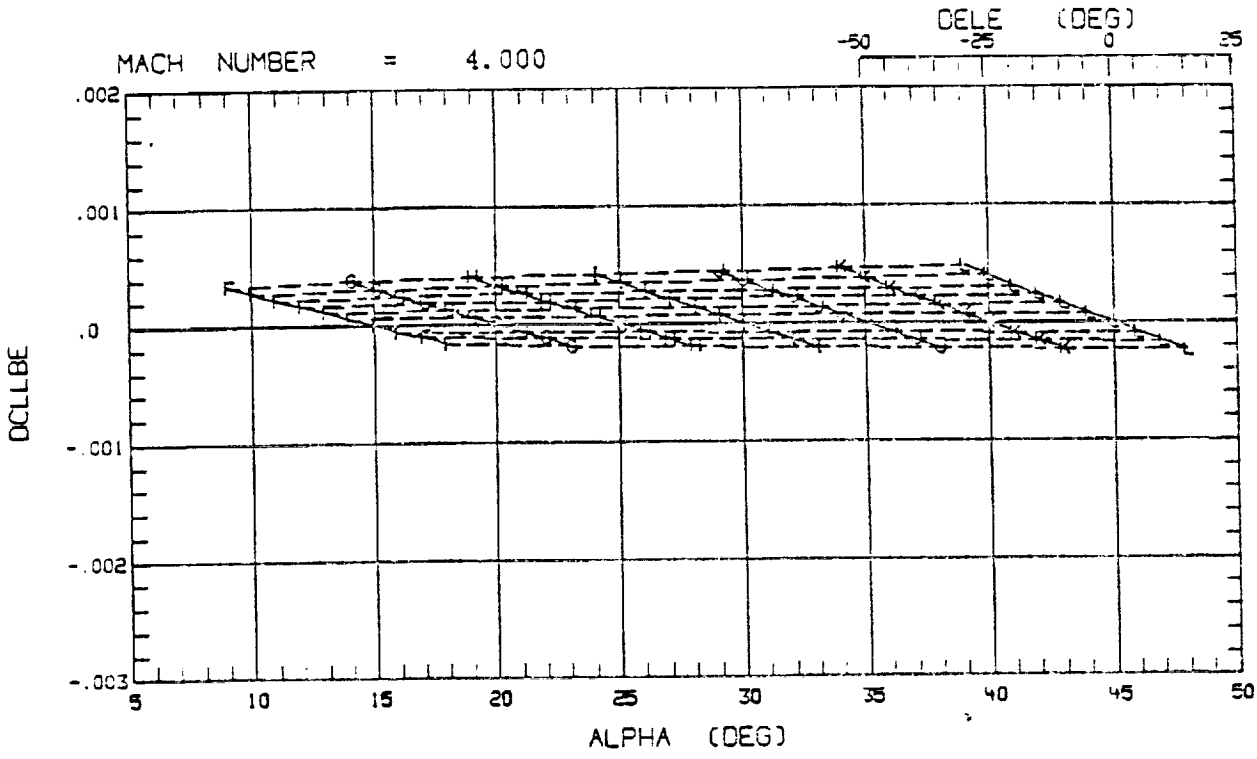
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00029	0.00030	0.00033	0.00037	0.00040
-25.000	0.00024	0.00024	0.00024	0.00023	0.00024	0.00027	0.00030	0.00032
-20.000	0.00019	0.00019	0.00019	0.00018	0.00019	0.00021	0.00024	0.00026
-15.000	0.00014	0.00014	0.00014	0.00013	0.00014	0.00016	0.00018	0.00019
-10.000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00011	0.00012	0.00013
-5.000	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00006	0.00006
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00007	-0.00007	-0.00007	-0.00007	-0.00007	-0.00007	-0.00007	-0.00007
10.000	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00011	-0.00012	-0.00013
15.000	-0.00016	-0.00016	-0.00016	-0.00016	-0.00016	-0.00017	-0.00019	-0.00020

ENGINEER MP
DATE 10/24/77

FIGURE 4.2.1.3- 45
EFFECT OF ELEVON

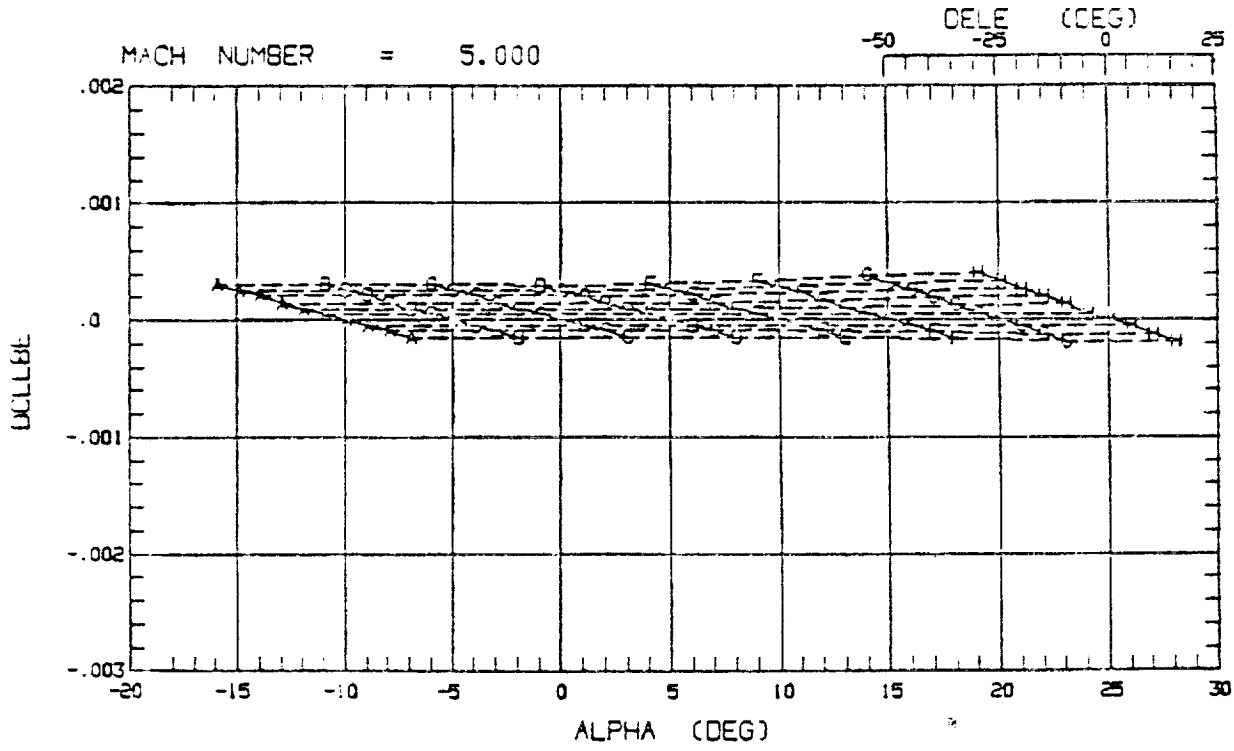


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT						
-30.000	0.00033	0.00037	0.00040	0.00042	0.00044	0.00046	0.00048
-25.000	0.00027	0.00030	0.00032	0.00035	0.00036	0.00038	0.00040
-20.000	0.00021	0.00024	0.00026	0.00027	0.00028	0.00029	0.00030
-15.000	0.00016	0.00018	0.00019	0.00021	0.00022	0.00022	0.00023
-10.000	0.00011	0.00012	0.00013	0.00014	0.00014	0.00015	0.00016
-5.000	0.00005	0.00006	0.00006	0.00007	0.00007	0.00007	0.00007
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00007	-0.00007	-0.00007	-0.00008	-0.00008	-0.00009	-0.00009
10.000	-0.00011	-0.00012	-0.00013	-0.00014	-0.00015	-0.00016	-0.00017
15.000	-0.00017	-0.00019	-0.00020	-0.00021	-0.00022	-0.00023	-0.00024

ENGINEER HP
DATE 10/2/73

FIGURE 4.2.1.3-46
EFFECT OF ELEVON



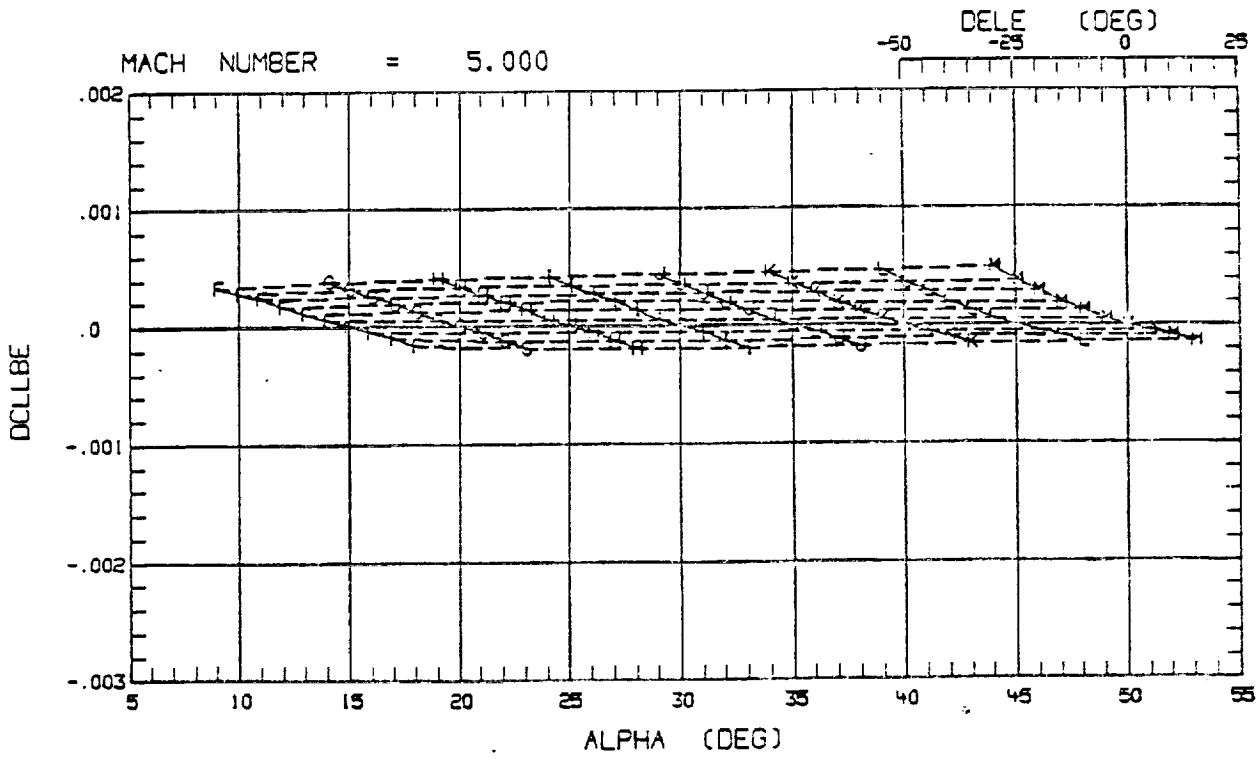
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00029	0.00030	0.00033	0.00037	0.00040
-25.000	0.00025	0.00025	0.00025	0.00024	0.00025	0.00028	0.00031	0.00033
-20.000	0.00021	0.00021	0.00021	0.00020	0.00021	0.00023	0.00025	0.00026
-15.000	0.00014	0.00014	0.00014	0.00013	0.00014	0.00016	0.00019	0.00020
-10.000	0.00009	0.00009	0.00009	0.00009	0.00009	0.00010	0.00012	0.00013
-5.000	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005
10.000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00011	-0.00013	-0.00013
15.000	-0.00016	-0.00016	-0.00016	-0.00016	-0.00016	-0.00017	-0.00019	-0.00019

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-47
EFFECT OF ELEVON



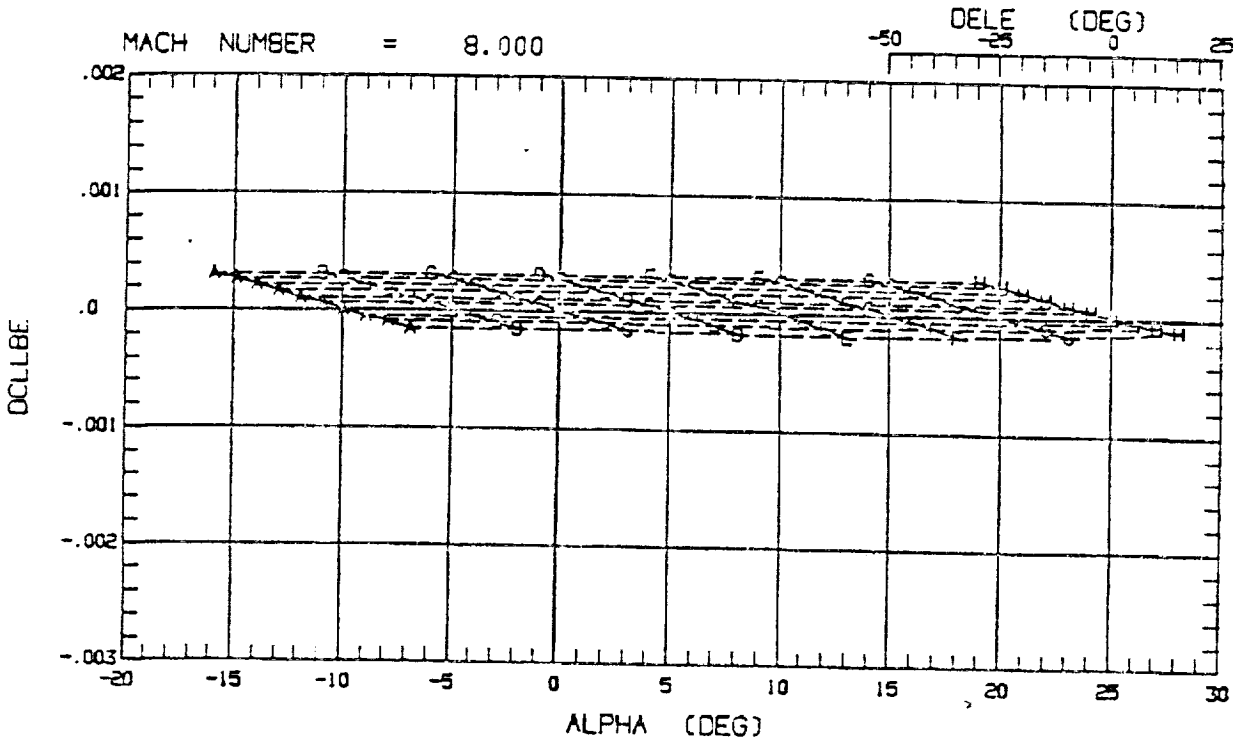
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00033	0.00037	0.00040	0.00042	0.00044	0.00045	0.00047	0.00049
-25.000	0.00028	0.00031	0.00033	0.00034	0.00035	0.00035	0.00036	0.00037
-20.000	0.00023	0.00025	0.00026	0.00027	0.00028	0.00029	0.00029	0.00029
-15.000	0.00016	0.00019	0.00020	0.00021	0.00020	0.00019	0.00019	0.00019
-10.000	0.00010	0.00012	0.00013	0.00013	0.00013	0.00012	0.00012	0.00012
-5.000	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005
10.000	-0.00011	-0.00013	-0.00013	-0.00013	-0.00012	-0.00010	-0.00009	-0.00009
15.000	-0.00017	-0.00019	-0.00019	-0.00019	-0.00018	-0.00016	-0.00015	-0.00014

ENGINEER HJ
DATE 10-3-73

FIGURE 4.2.1.3-48
EFFECT OF ELEVON



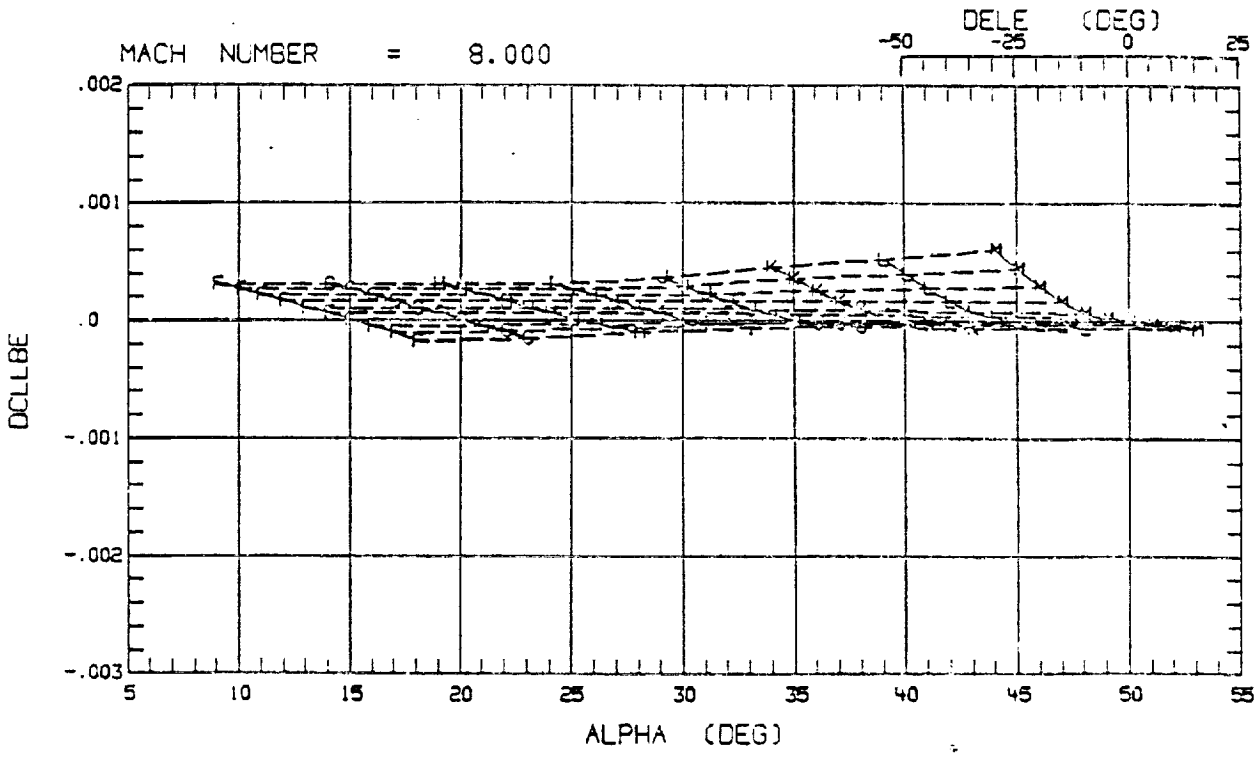
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030
-25.000	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
-20.000	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021
-15.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
-10.000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
-5.000	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00006	-0.00005	-0.00005	-0.00004
10.000	-0.00010	-0.00010	-0.00010	-0.00011	-0.00012	-0.00011	-0.00010	-0.00007
15.000	-0.00016	-0.00016	-0.00016	-0.00018	-0.00019	-0.00018	-0.00016	-0.00011

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-49
EFFECT OF ELEVON



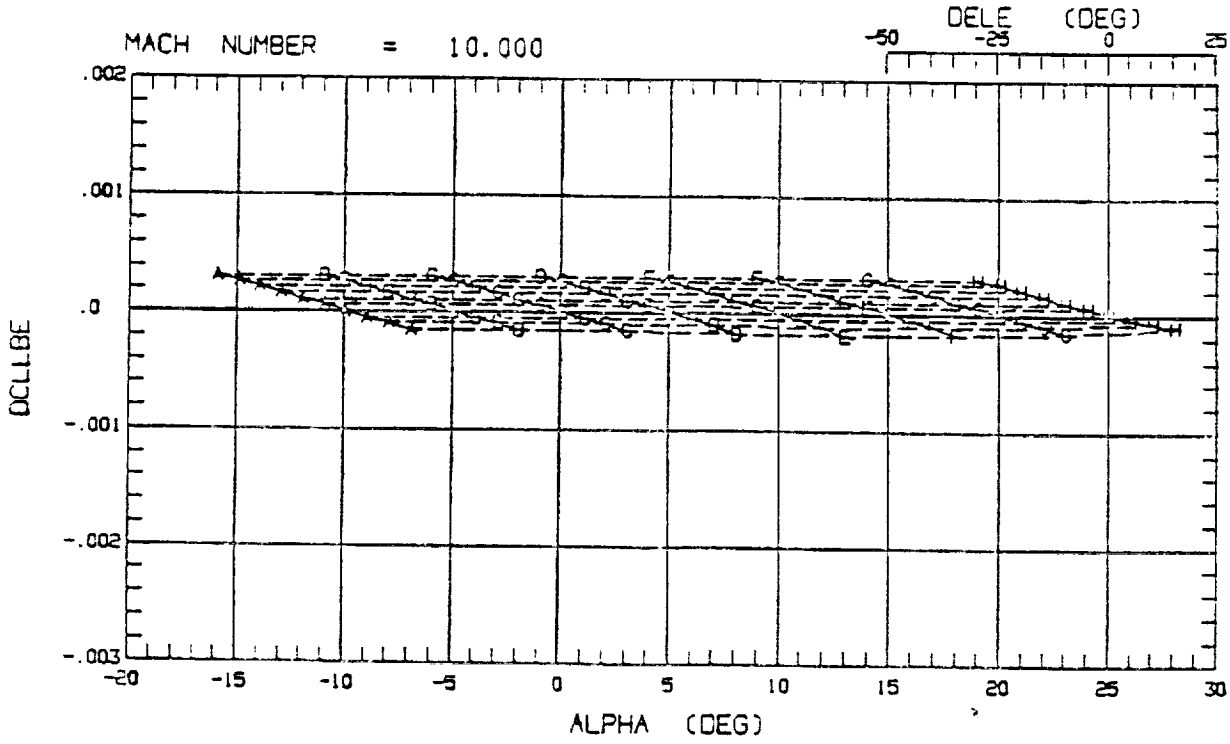
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00030	0.00036	0.00045	0.00052	0.00060
-25.000	0.00026	0.00026	0.00026	0.00026	0.00029	0.00035	0.00039	0.00044
-20.000	0.00021	0.00021	0.00021	0.00021	0.00022	0.00025	0.00027	0.00029
-15.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
-10.000	0.00010	0.00010	0.00010	0.00010	0.00009	0.00008	0.00007	0.00006
-5.000	0.00006	0.00006	0.00006	0.00006	0.00005	0.00004	0.00003	0.00002
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00004	-0.00003	-0.00003	-0.00003	-0.00003	-0.00003
10.000	-0.00011	-0.00010	-0.00007	-0.00004	-0.00003	-0.00004	-0.00004	-0.00004
15.000	-0.00018	-0.00016	-0.00011	-0.00007	-0.00006	-0.00007	-0.00007	-0.00007

ENGINEER MP
DATE 6/3/73

FIGURE 4.2.1.3-50
EFFECT OF ELEVON



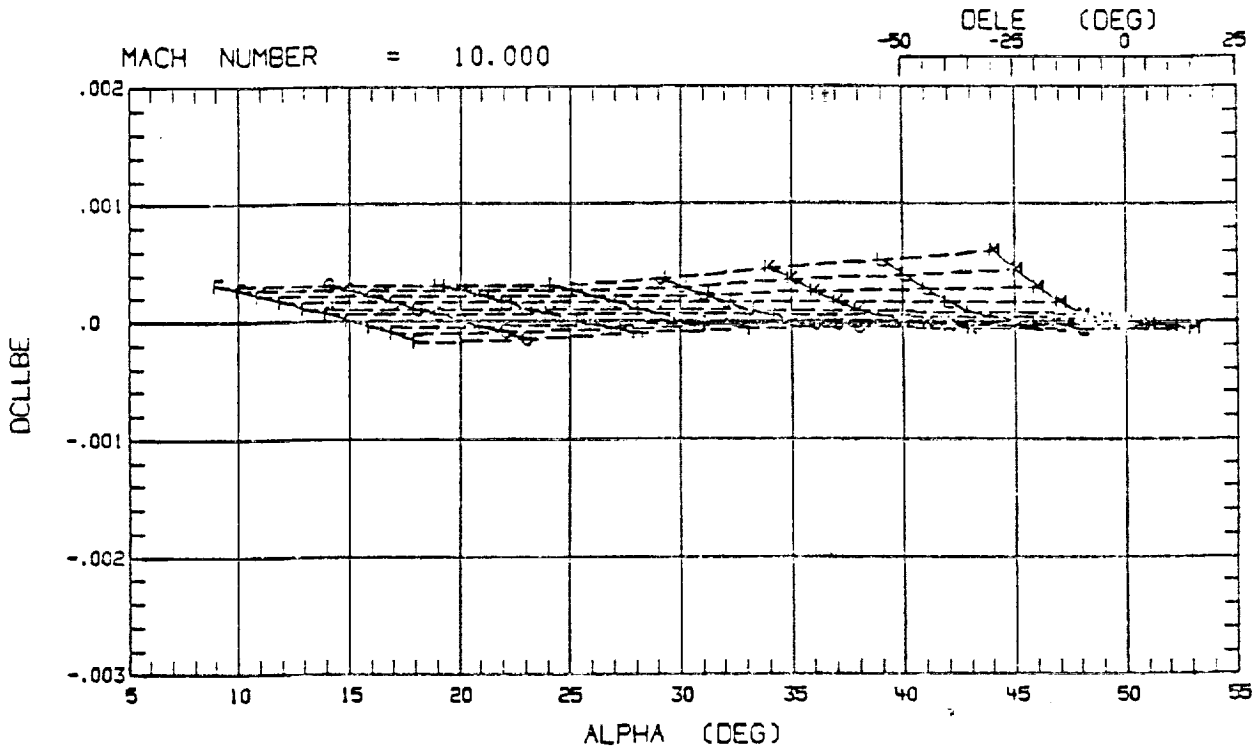
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030
-25.000	0.00026	0.00026	0.00026	0.00026	0.00026	0.00025	0.00026	0.00026
-20.000	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021
-15.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
-10.000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
-5.000	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00006	-0.00005	-0.00005	-0.00004
10.000	-0.00010	-0.00010	-0.00010	-0.00011	-0.00012	-0.00011	-0.00010	-0.00007
15.000	-0.00016	-0.00016	-0.00016	-0.00018	-0.00019	-0.00018	-0.00016	-0.00011

ENGINEER HP
DATE 12-7-73

FIGURE 4.2.1.3-51
EFFECT OF ELEVON



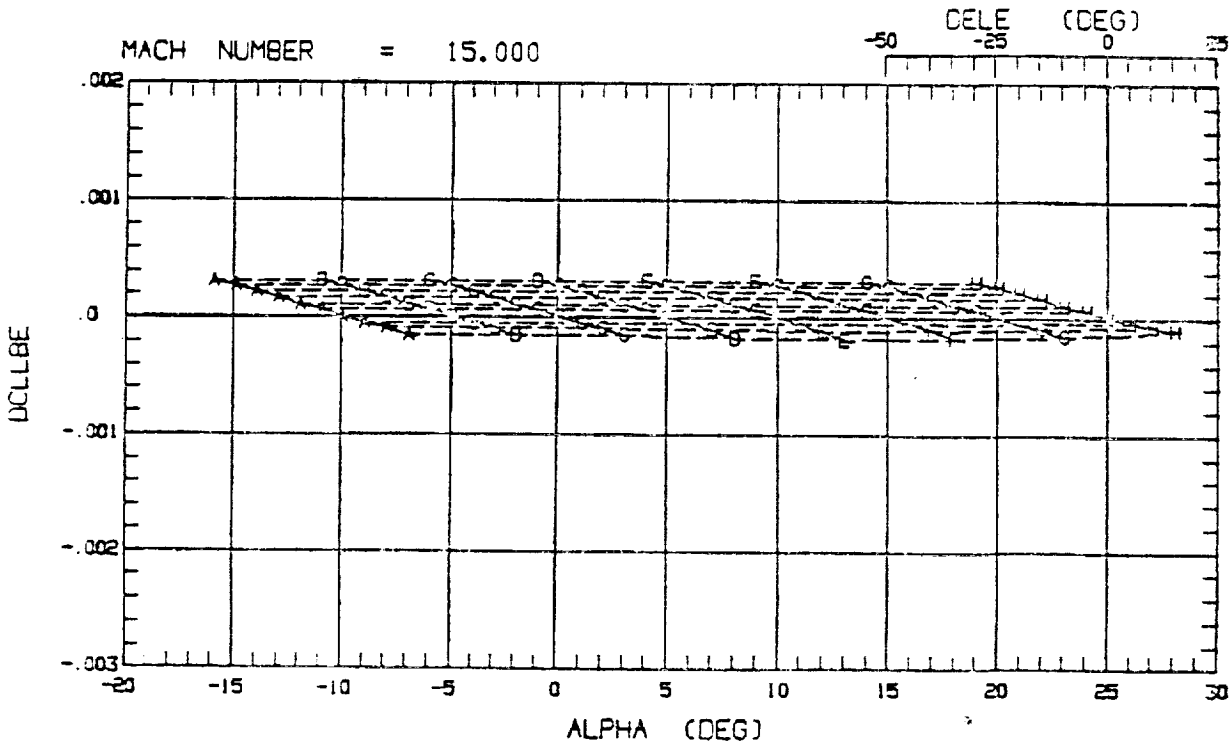
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00030	0.00036	0.00045	0.00052	0.00060
-25.000	0.00026	0.00026	0.00026	0.00025	0.00029	0.00035	0.00039	0.00044
-20.000	0.00021	0.00021	0.00021	0.00021	0.00022	0.00025	0.00027	0.00029
-15.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
-10.000	0.00010	0.00010	0.00010	0.00010	0.00009	0.00008	0.00007	0.00006
-5.000	0.00006	0.00006	0.00006	0.00006	0.00005	0.00004	0.00003	0.00002
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00004	-0.00003	-0.00003	-0.00003	-0.00003	-0.00003
10.000	-0.00011	-0.00010	-0.00007	-0.00004	-0.00003	-0.00004	-0.00004	-0.00004
15.000	-0.00018	-0.00016	-0.00011	-0.00007	-0.00006	-0.00007	-0.00007	-0.00007

ENGINEER HP
DATE 10/3/70

FIGURE 4.2.1.3-52
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

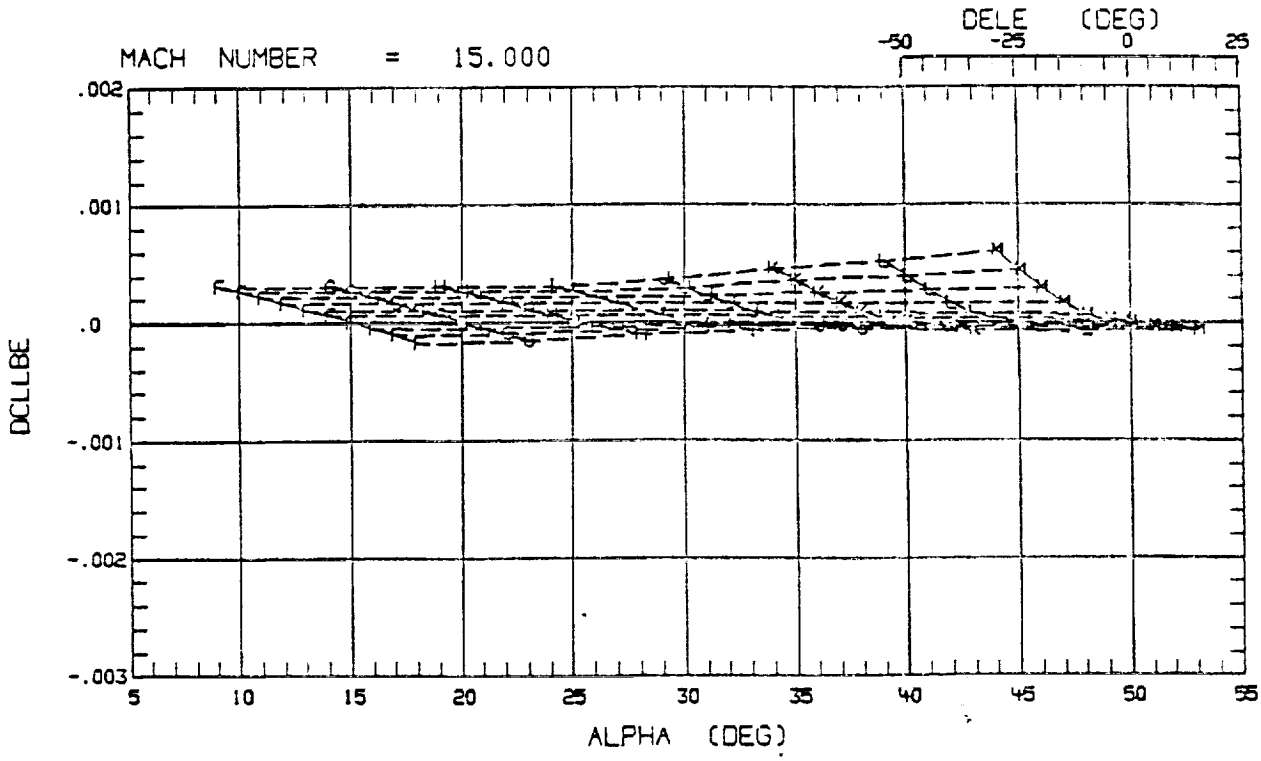
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030
-25.000	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00025
-20.000	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021
-15.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
-10.000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
-5.000	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00006	-0.00005	-0.00005	-0.00004
10.000	-0.00010	-0.00010	-0.00010	-0.00011	-0.00012	-0.00011	-0.00010	-0.00007
15.000	-0.00016	-0.00016	-0.00016	-0.00018	-0.00019	-0.00018	-0.00016	-0.00011

ENGINEER MP
DATE 01-30-13

FIGURE 4.2.1.3-53
EFFECT OF ELEVON



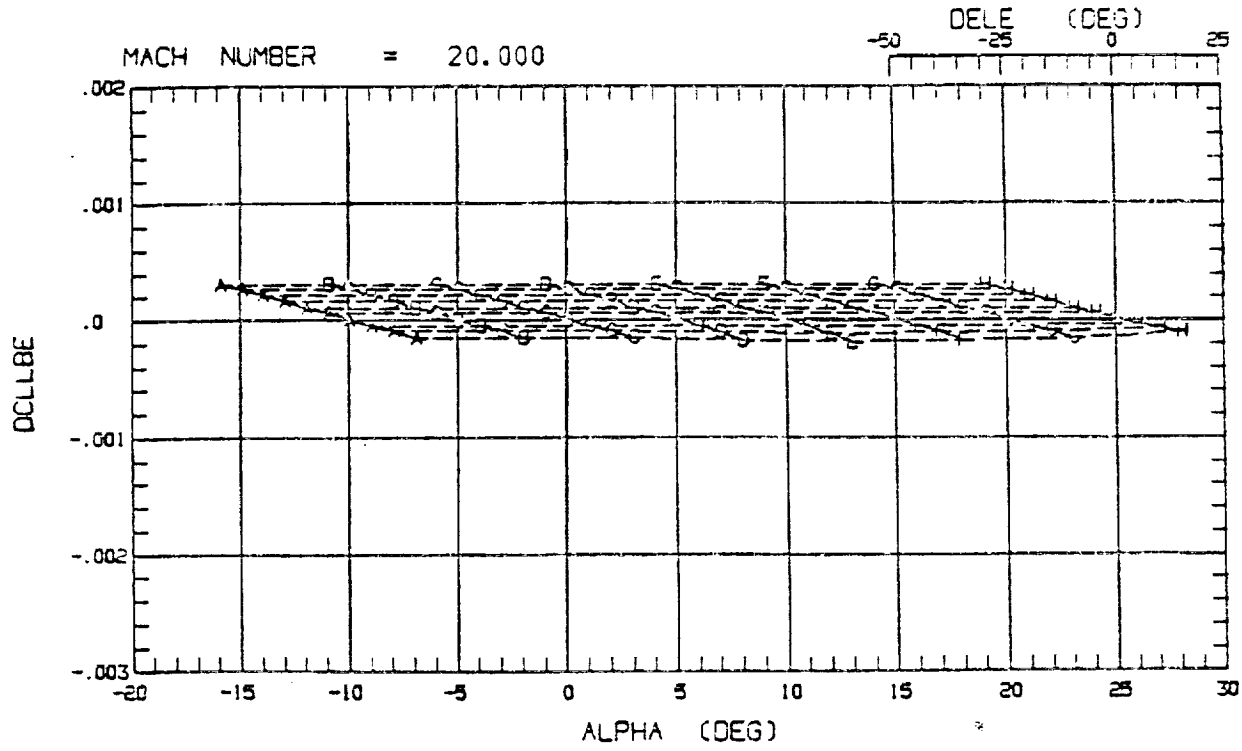
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00030	0.00036	0.00045	0.00052	0.00060
-25.000	0.00026	0.00026	0.00026	0.00026	0.00029	0.00035	0.00039	0.00044
-20.000	0.00021	0.00021	0.00021	0.00021	0.00022	0.00025	0.00027	0.00029
-15.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
-10.000	0.00010	0.00010	0.00010	0.00010	0.00009	0.00008	0.00007	0.00006
-5.000	0.00006	0.00006	0.00006	0.00006	0.00005	0.00004	0.00003	0.00002
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00004	-0.00003	-0.00003	-0.00003	-0.00003	-0.00003
10.000	-0.00011	-0.00010	-0.00007	-0.00004	-0.00003	-0.00004	-0.00004	-0.00004
15.000	-0.00018	-0.00016	-0.00011	-0.00007	-0.00006	-0.00007	-0.00007	-0.00007

ENGINEER
DATE 10/3/11

FIGURE 4.2.1.3-54
EFFECT OF ELEVON



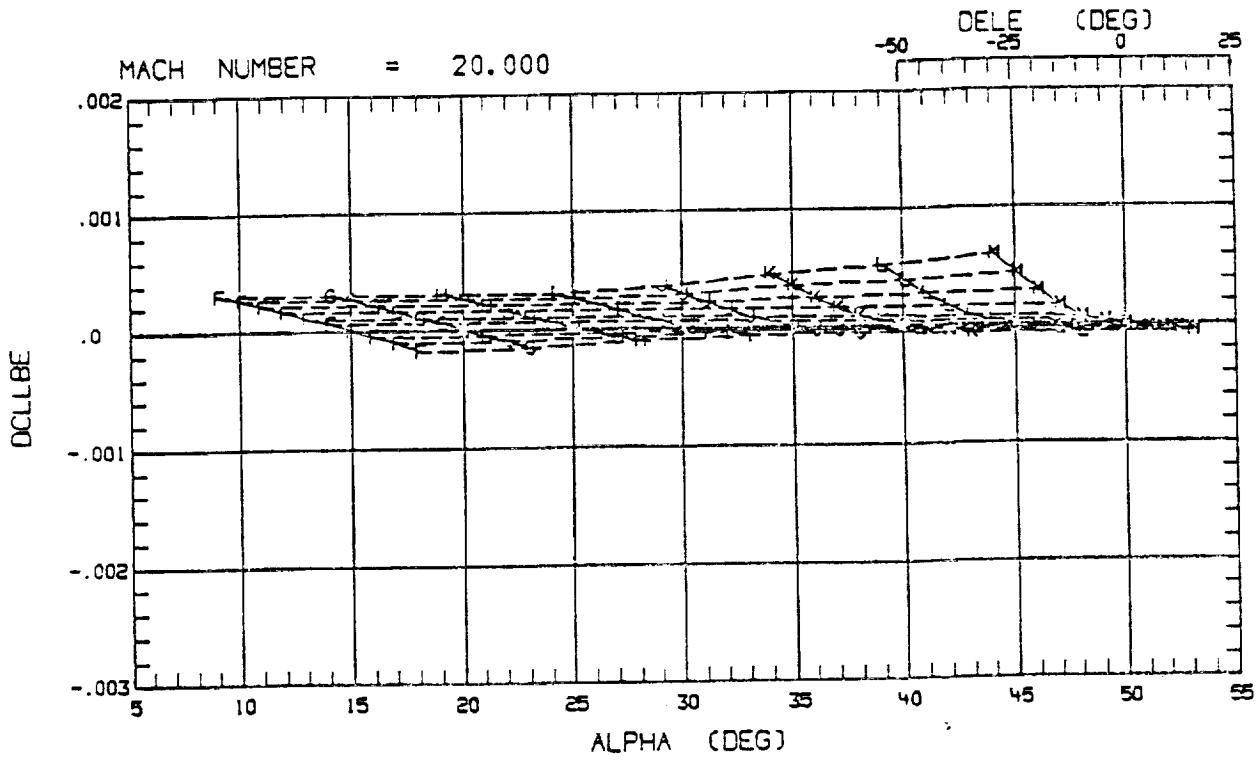
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030
-25.000	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
-20.000	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021
-15.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
-10.000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
-5.000	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00005	-0.00005	-0.00006	-0.00005	-0.00005	-0.00004
10.000	-0.00010	-0.00010	-0.00010	-0.00011	-0.00012	-0.00011	-0.00010	-0.00007
15.000	-0.00016	-0.00016	-0.00016	-0.00018	-0.00019	-0.00018	-0.00016	-0.00011

ENGINEER HP
DATE 10/2/12

FIGURE 4.2.1.3-55
EFFECT OF ELEVON



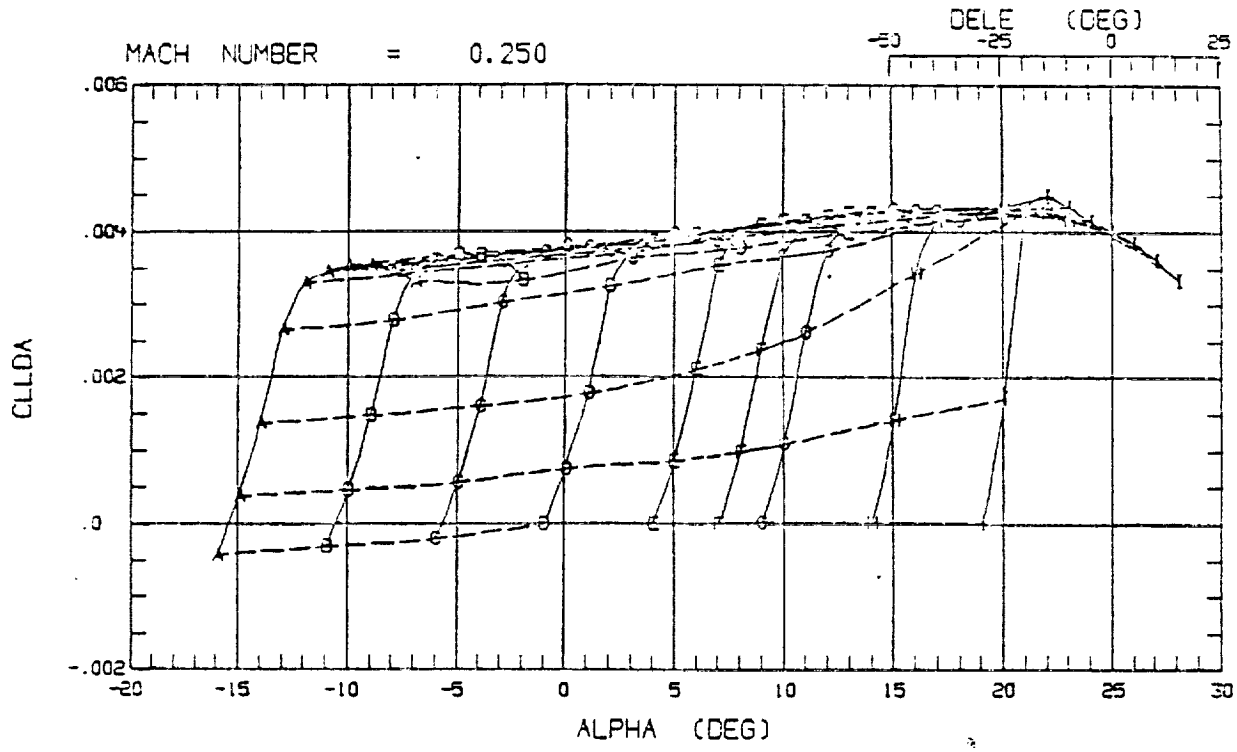
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON ROLLING MOMENT INCREMENT							
-30.000	0.00030	0.00030	0.00030	0.00030	0.00036	0.00045	0.00052	0.00060
-25.000	0.00026	0.00026	0.00026	0.00026	0.00029	0.00035	0.00039	0.00044
-20.000	0.00021	0.00021	0.00021	0.00021	0.00022	0.00025	0.00027	0.00029
-15.000	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016	0.00016
-10.000	0.00010	0.00010	0.00010	0.00010	0.00009	0.00008	0.00007	0.00006
-5.000	0.00006	0.00006	0.00006	0.00006	0.00005	0.00004	0.00003	0.00002
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00005	-0.00005	-0.00004	-0.00003	-0.00003	-0.00003	-0.00003	-0.00003
10.000	-0.00011	-0.00010	-0.00007	-0.00004	-0.00003	-0.00004	-0.00004	-0.00004
15.000	-0.00018	-0.00016	-0.00011	-0.00007	-0.00006	-0.00007	-0.00007	-0.00007

ENGINEER HP
DATE 10/2/81

FIGURE 4.2.1.3-56
EFFECT OF ELEVON



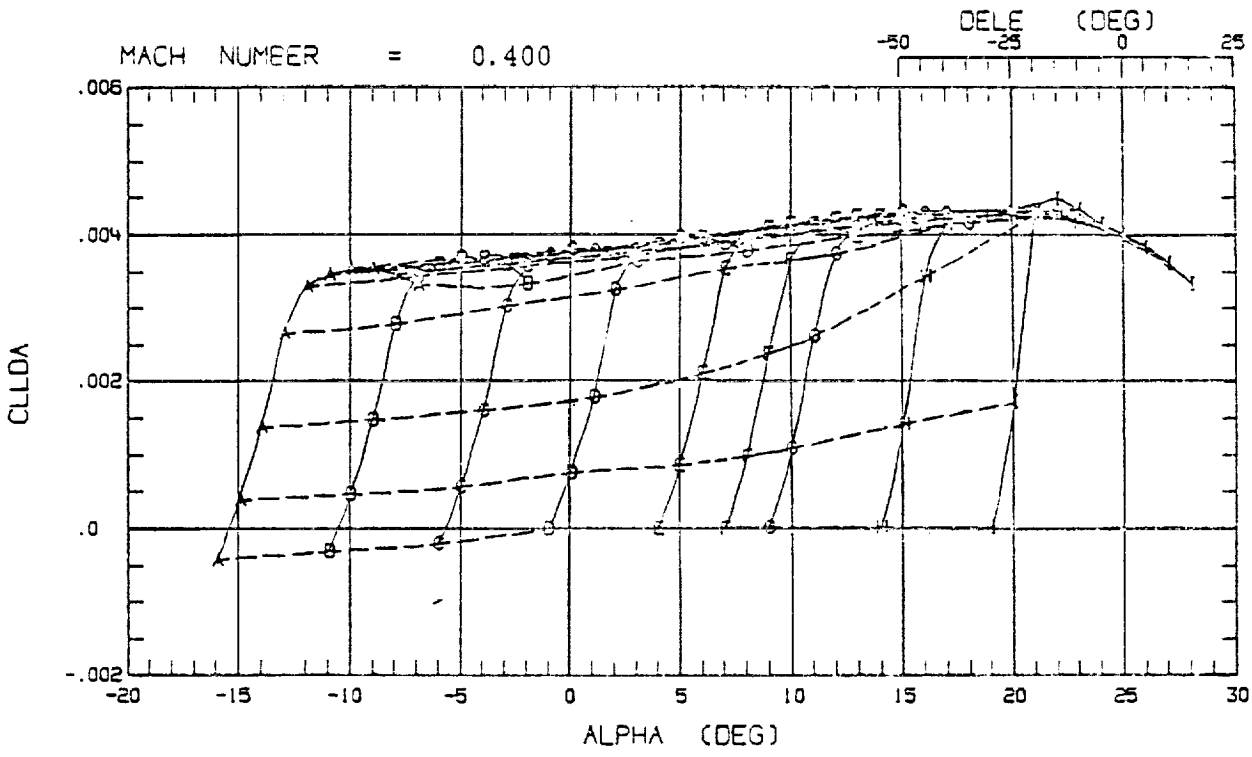
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-[illegible].000	-0.00043	-0.00032	-0.00022	-0.00002	-0.00001	0.0	0.00001	0.00001	0.00001
-25.000	0.00037	0.00046	0.00055	0.00075	0.00085	0.00097	0.00108	0.00142	0.00171
-20.000	0.00138	0.00147	0.00160	0.00177	0.00210	0.00237	0.00260	0.00342	0.00427
-15.000	0.00264	0.00278	0.00301	0.00324	0.00353	0.00384	0.00372	0.00413	0.00448
-10.000	0.00329	0.00342	0.00356	0.00371	0.00394	0.00404	0.00410	0.00424	0.00433
-5.000	0.00344	0.00358	0.00371	0.00385	0.00408	0.00419	0.00424	0.00425	0.00414
0.0	0.00352	0.00367	0.00378	0.00394	0.00414	0.00424	0.00429	0.00429	0.00399
5.000	0.00352	0.00366	0.00377	0.00395	0.00414	0.00424	0.00429	0.00429	0.00383
10.000	0.00344	0.00359	0.00373	0.00387	0.00408	0.00420	0.00429	0.00425	0.00361
15.000	0.00330	0.00331	0.00362	0.00377	0.00397	0.00409	0.00416	0.00416	0.00331

ENGINEER [signature]
DATE [illegible]

FIGURE 4.2.1.3-57
EFFECT OF AILERON



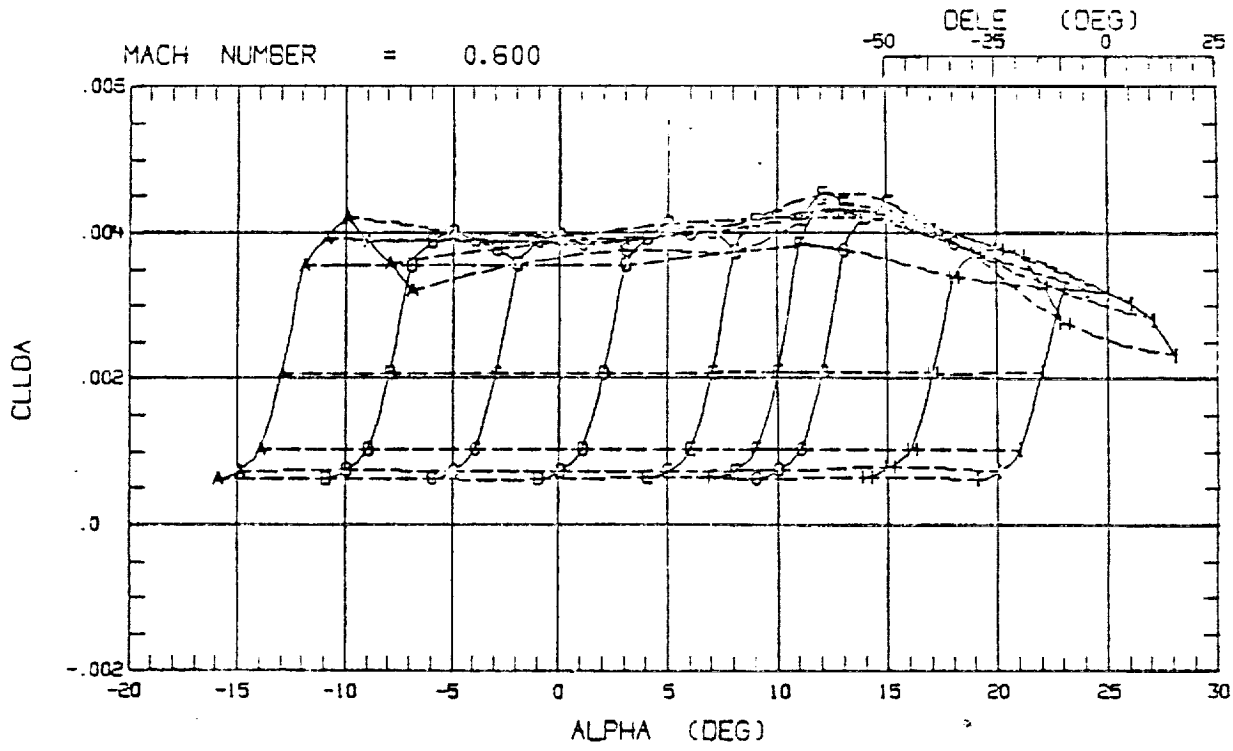
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	-0.00043	-0.00032	-0.00022	-0.00002	-0.00001	0.0	0.00001	0.00001	0.00001
-25.000	0.00037	0.00046	0.00055	0.00075	0.00085	0.00097	0.00108	0.00142	0.00171
-20.000	0.00138	0.00147	0.00160	0.00177	0.00210	0.00237	0.00260	0.00342	0.00427
-15.000	0.00294	0.00278	0.00301	0.00324	0.00353	0.00384	0.00372	0.00413	0.00448
-10.000	0.00328	0.00342	0.00356	0.00371	0.00394	0.00404	0.00410	0.00424	0.00433
-5.000	0.00344	0.00358	0.00371	0.00385	0.00408	0.00419	0.00424	0.00425	0.00414
0.0	0.00352	0.00367	0.00378	0.00394	0.00414	0.00424	0.00429	0.00429	0.00399
5.000	0.00352	0.00366	0.00377	0.00395	0.00414	0.00424	0.00428	0.00429	0.00383
10.000	0.00344	0.00359	0.00373	0.00387	0.00408	0.00420	0.00428	0.00425	0.00361
15.000	0.00330	0.00331	0.00362	0.00377	0.00397	0.00409	0.00416	0.00415	0.00331

ENGINEER [illegible]
DATE 9-13-74

FIGURE 4.2.1.3-58
EFFECT OF AILERON



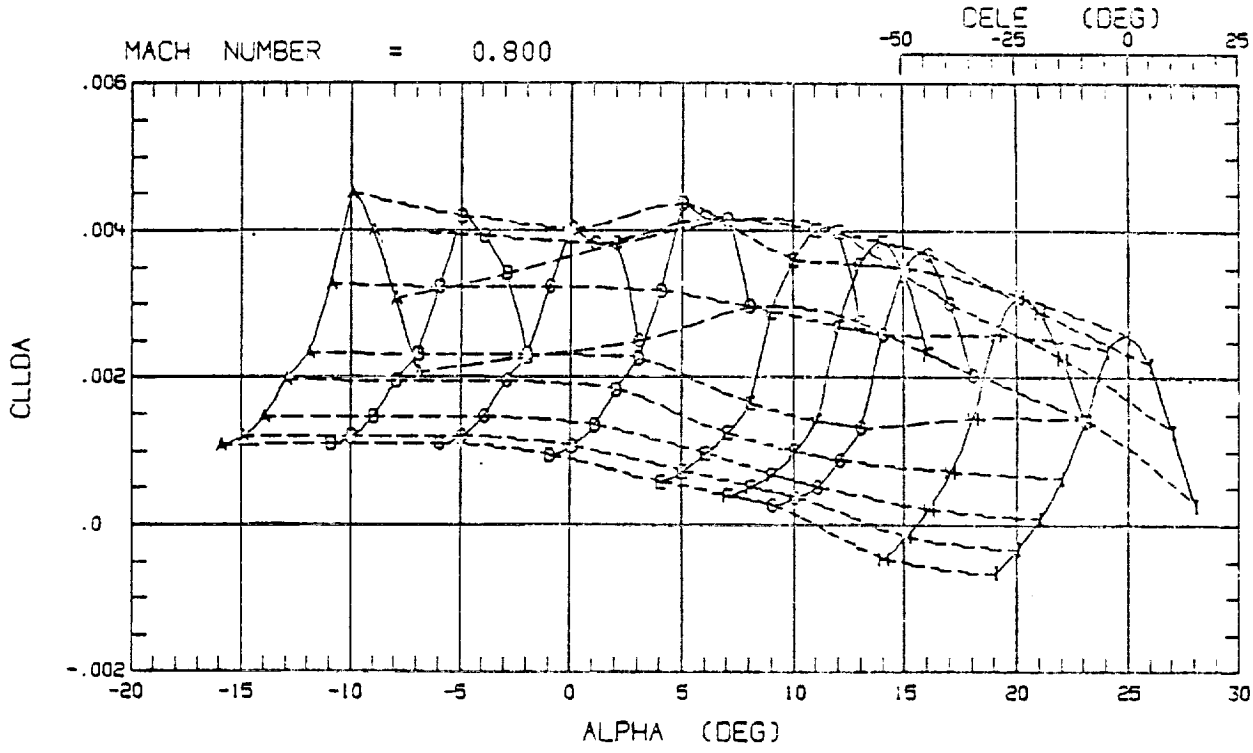
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00062	0.00062	0.00061	0.00061	0.00064	0.00063	0.00062	0.00064	0.00062
-25.000	0.00072	0.00074	0.00072	0.00072	0.00072	0.00073	0.00074	0.00078	0.00072
-20.000	0.00103	0.00103	0.00102	0.00102	0.00103	0.00103	0.00103	0.00103	0.00102
-15.000	0.00207	0.00207	0.00207	0.00206	0.00207	0.00208	0.00208	0.00207	0.00208
-10.000	0.00355	0.00355	0.00355	0.00355	0.00372	0.00382	0.00375	0.00338	0.00323
-5.000	0.00390	0.00387	0.00386	0.00391	0.00416	0.00430	0.00420	0.00372	0.00320
0.0	0.00420	0.00400	0.00394	0.00411	0.00420	0.00430	0.00422	0.00376	0.00316
5.000	0.00386	0.00389	0.00382	0.00397	0.00418	0.00418	0.00411	0.00368	0.00302
10.000	0.00357	0.00377	0.00391	0.00400	0.00452	0.00440	0.00402	0.00329	0.00279
15.000	0.00319	0.00356	0.00375	0.00372	0.00437	0.00414	0.00385	0.00276	0.00230

ENGINEER [signature]
DATE 9-3-87

FIGURE 4.2.1.3-59
EFFECT OF AILERON



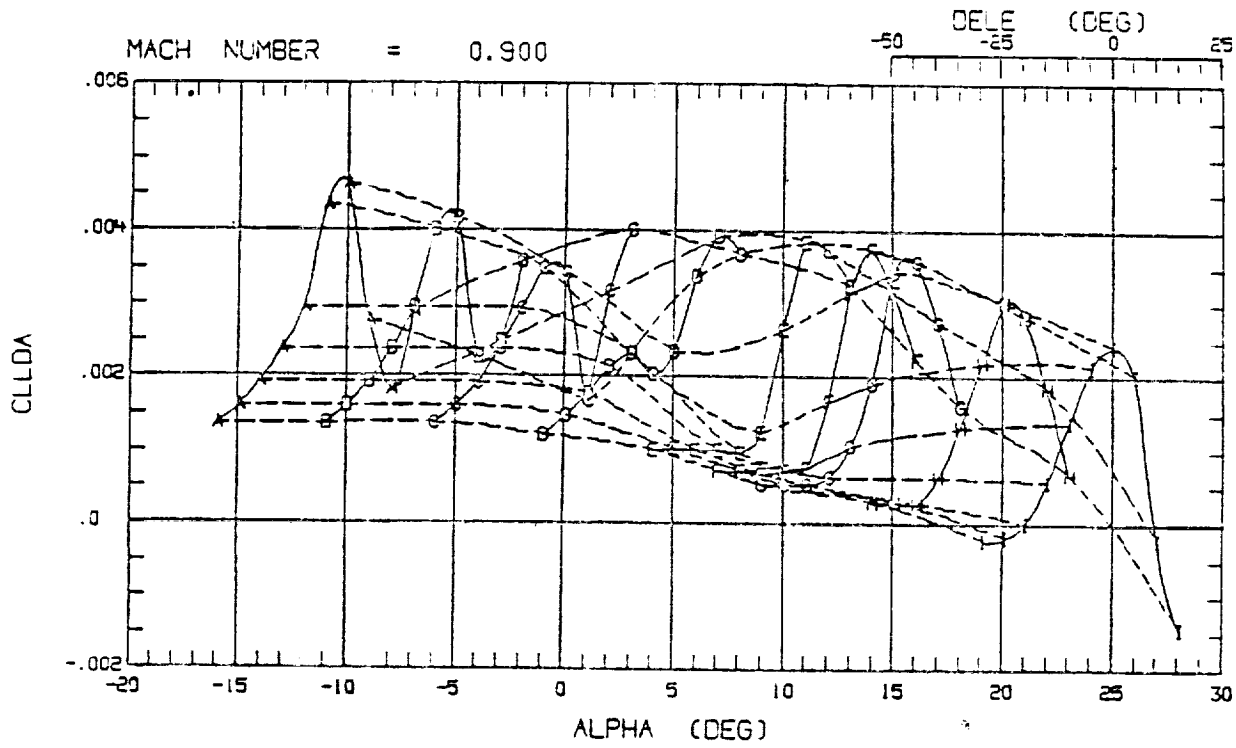
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
CR	YO = BL	0.0 IN.	WING SPAN	SW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.550	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00107	0.00108	0.00108	0.00093	0.00056	0.00038	0.00025	-0.00047	-0.00065
-25.000	0.00118	0.00118	0.00118	0.00105	0.00071	0.00050	0.00036	-0.00018	-0.00033
-20.000	0.00145	0.00146	0.00145	0.00132	0.00094	0.00067	0.00050	0.00020	0.00009
-15.000	0.00196	0.00194	0.00194	0.00182	0.00122	0.00098	0.00086	0.00070	0.00062
-10.000	0.00232	0.00231	0.00231	0.00225	0.00163	0.00139	0.00131	0.00144	0.00140
-5.000	0.00325	0.00322	0.00322	0.00316	0.00297	0.00268	0.00256	0.00256	0.00235
0.0	0.00449	0.00418	0.00402	0.00435	0.00359	0.00353	0.00348	0.00309	0.00255
5.000	0.00400	0.00390	0.00380	0.00415	0.00399	0.00383	0.00367	0.00297	0.00216
10.000	0.00305	0.00340	0.00380	0.00414	0.00397	0.00338	0.00300	0.00225	0.00124
15.000	0.00207	0.00227	0.00248	0.00295	0.00273	0.00231	0.00203	0.00141	0.00025

ENGINEER
DATE

FIGURE 4.2.1.3-60
EFFECT OF AILERON



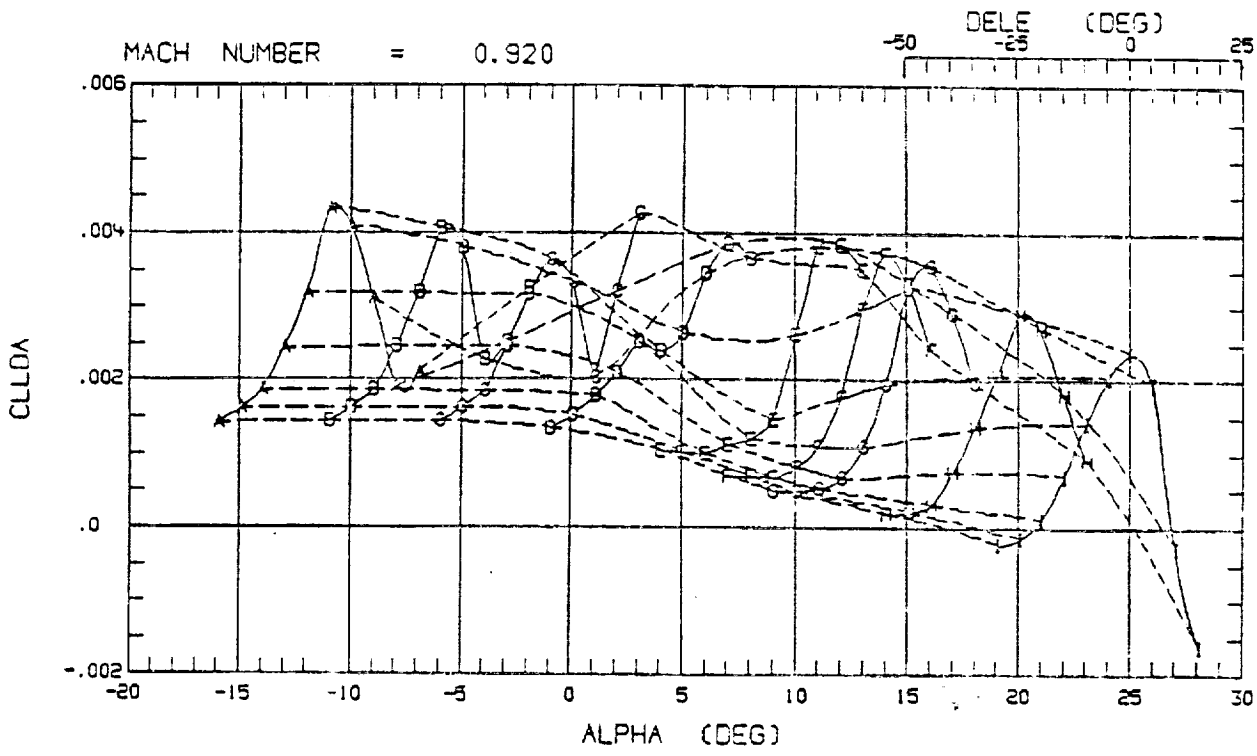
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00135	0.00136	0.00136	0.00119	0.00099	0.00070	0.00051	0.00028	-0.00024
-25.000	0.00159	0.00160	0.00160	0.00145	0.00100	0.00070	0.00051	0.00027	-0.00020
-20.000	0.00192	0.00192	0.00190	0.00175	0.00099	0.00067	0.00051	0.00025	0.0
-15.000	0.00236	0.00236	0.00237	0.00212	0.00099	0.00071	0.00062	0.00062	0.00055
-10.000	0.00293	0.00293	0.00292	0.00231	0.00095	0.00075	0.00104	0.00130	0.00137
-5.000	0.00433	0.00400	0.00347	0.00202	0.00123	0.00165	0.00190	0.00218	0.00213
0.0	0.00461	0.00416	0.00340	0.00232	0.00263	0.00313	0.00343	0.00301	0.00240
5.000	0.00275	0.00225	0.00165	0.00336	0.00383	0.00373	0.00356	0.00292	0.00201
10.000	0.00182	0.00246	0.00316	0.00391	0.00372	0.00313	0.00274	0.00184	-0.00023
15.000	0.00298	0.00357	0.00400	0.00367	0.00324	0.00223	0.00159	0.00067	-0.00146

ENGINEER [illegible]
DATE 9-3-75

FIGURE 4.2.1.3-61
EFFECT OF AILERON



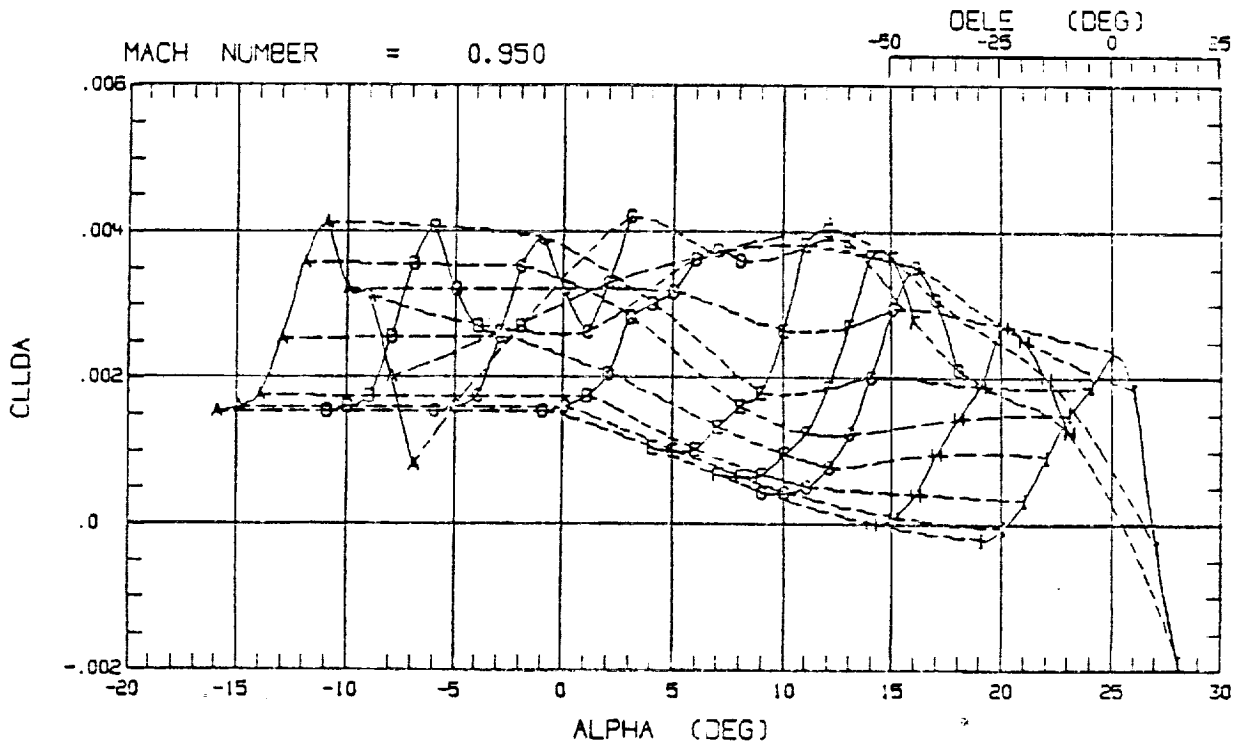
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00142	0.00143	0.00143	0.00132	0.00102	0.00069	0.00048	0.00018	-0.00023
-25.000	0.00161	0.00162	0.00162	0.00151	0.00101	0.00068	0.00048	0.00020	-0.00016
-20.000	0.00185	0.00185	0.00184	0.00177	0.00099	0.00067	0.00051	0.00029	0.00010
-15.000	0.00243	0.00244	0.00244	0.00209	0.00111	0.00080	0.00065	0.00074	0.00069
-10.000	0.00317	0.00317	0.00315	0.00250	0.00119	0.00109	0.00109	0.00135	0.00142
-5.000	0.00432	0.00406	0.00363	0.00238	0.00145	0.00176	0.00193	0.00206	0.00203
0.0	0.00408	0.00379	0.00331	0.00262	0.00260	0.00295	0.00324	0.00289	0.00237
5.000	0.00310	0.00227	0.00202	0.00345	0.00381	0.00371	0.00354	0.00270	0.00194
10.000	0.00189	0.00250	0.00320	0.00384	0.00383	0.00330	0.00290	0.00180	-0.00029
15.000	0.00210	0.00323	0.00425	0.00365	0.00348	0.00240	0.00195	0.00090	-0.00163

ENGINEER
DATE 9-13-73

FIGURE 4.2.1.3-62
EFFECT OF AILERON



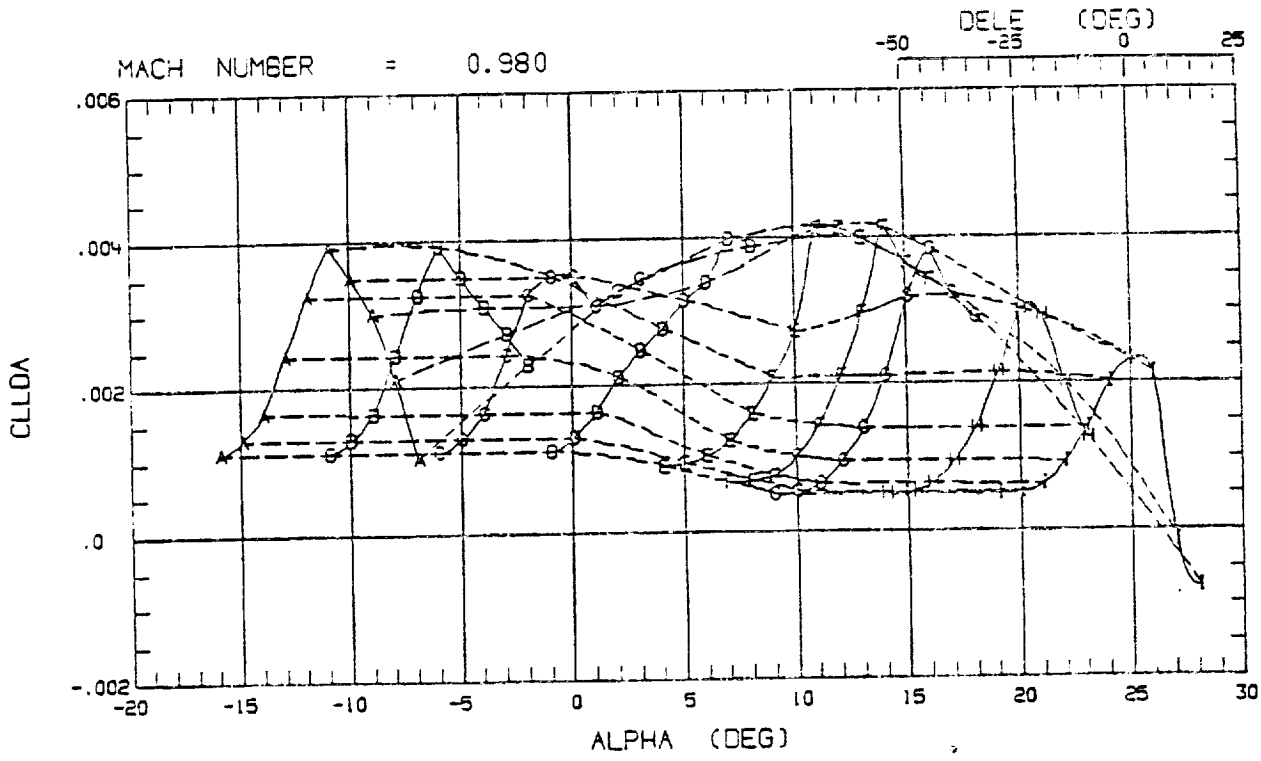
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00154	0.00154	0.00154	0.00154	0.00102	0.00066	0.00042	-0.00001	-0.00023
-25.000	0.00159	0.00159	0.00159	0.00159	0.00099	0.00064	0.00042	0.00008	-0.00008
-20.000	0.00175	0.00174	0.00174	0.00174	0.00100	0.00066	0.00050	0.00039	0.00032
-15.000	0.00253	0.00254	0.00254	0.00204	0.00131	0.00094	0.00076	0.00095	0.00091
-10.000	0.00356	0.00354	0.00350	0.00262	0.00160	0.00122	0.00122	0.00144	0.00150
-5.000	0.00411	0.00405	0.00389	0.00300	0.00177	0.00185	0.00201	0.00188	0.00187
0.0	0.00320	0.00319	0.00320	0.00315	0.00263	0.00270	0.00293	0.00270	0.00234
5.000	0.00310	0.00259	0.00260	0.00361	0.00380	0.00364	0.00350	0.00251	0.00182
10.000	0.00201	0.00260	0.00328	0.00373	0.00402	0.00362	0.00305	0.00200	-0.00034
15.000	0.00081	0.00270	0.00420	0.00359	0.00387	0.00275	0.00210	0.00125	-0.00189

ENGINEER 3
DATE 9-13-76

FIGURE 4.2.1.3-63
EFFECT OF AILERON



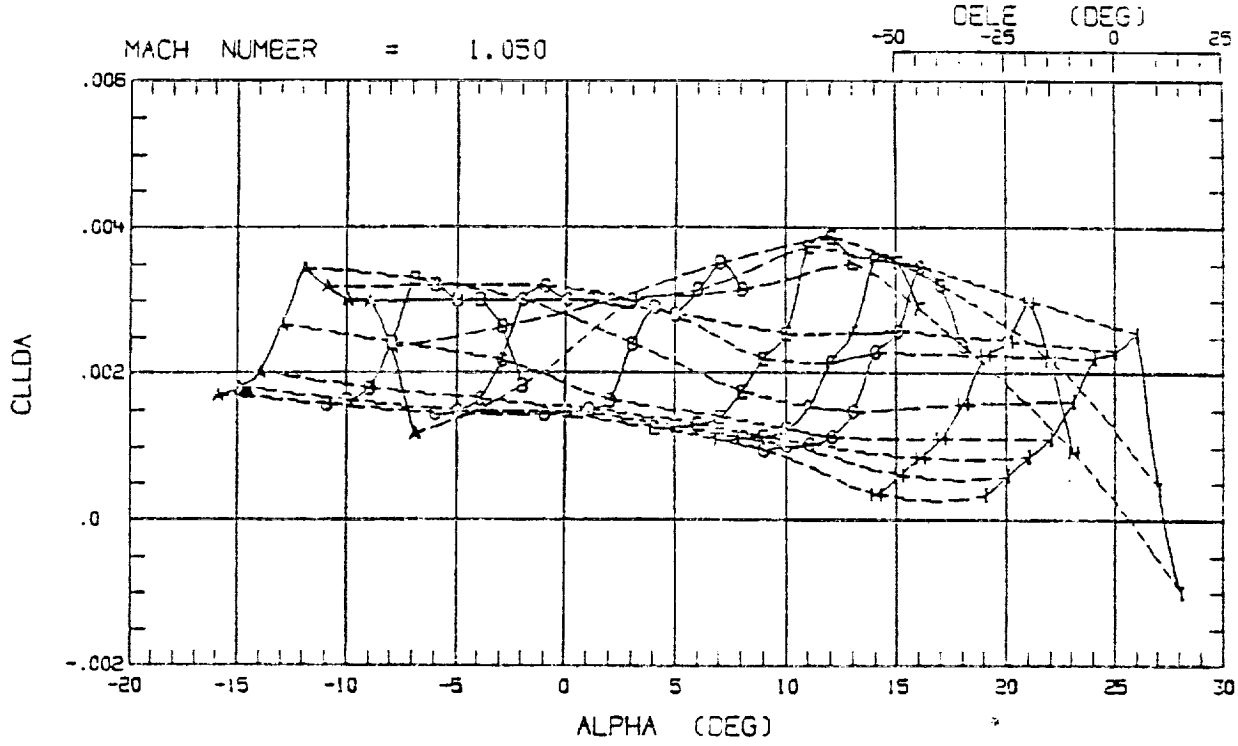
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00110	0.00110	0.00110	0.00110	0.00089	0.00065	0.00050	0.00049	0.00049
-25.000	0.00129	0.00129	0.00129	0.00129	0.00093	0.00069	0.00053	0.00051	0.00051
-20.000	0.00166	0.00164	0.00164	0.00164	0.00103	0.00075	0.00063	0.00063	0.00061
-15.000	0.00243	0.00242	0.00243	0.00211	0.00122	0.00101	0.00094	0.00094	0.00093
-10.000	0.00323	0.00323	0.00323	0.00246	0.00159	0.00144	0.00139	0.00140	0.00139
-5.000	0.00390	0.00390	0.00349	0.00276	0.00209	0.00210	0.00211	0.00214	0.00200
0.0	0.00349	0.00349	0.00349	0.00313	0.00271	0.00295	0.00317	0.00300	0.00231
5.000	0.00299	0.00308	0.00308	0.00339	0.00412	0.00412	0.00382	0.00292	0.00213
10.000	0.00211	0.00271	0.00327	0.00396	0.00411	0.00362	0.00321	0.00200	-0.00015
15.000	0.00103	0.00229	0.00344	0.00387	0.00398	0.00340	0.00269	0.00124	-0.00078

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-64
EFFECT OF AILERON



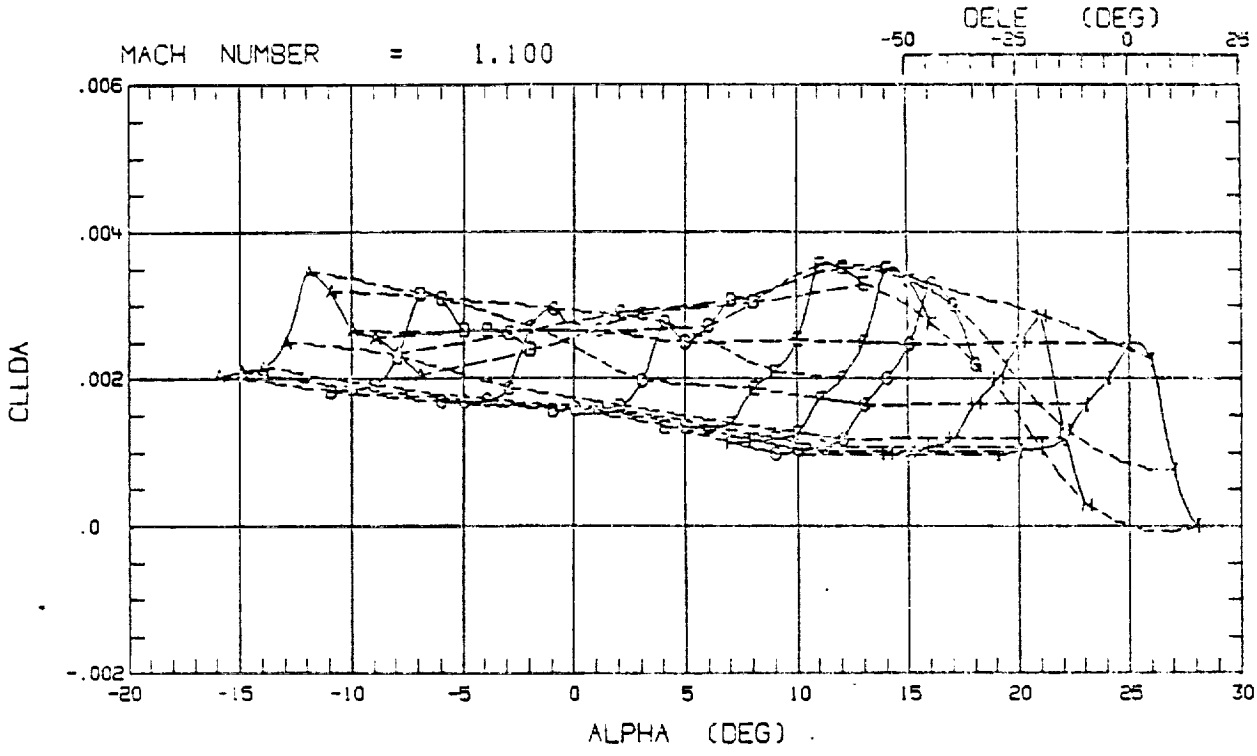
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00170	0.00157	0.00143	0.00143	0.00124	0.00108	0.00094	0.00033	0.00033
-25.000	0.00180	0.00161	0.00148	0.00147	0.00126	0.00111	0.00100	0.00059	0.00060
-20.000	0.00200	0.00178	0.00163	0.00149	0.00129	0.00113	0.00102	0.00084	0.00086
-15.000	0.00265	0.00240	0.00217	0.00161	0.00139	0.00123	0.00112	0.00111	0.00111
-10.000	0.00343	0.00327	0.00299	0.00239	0.00173	0.00154	0.00148	0.00158	0.00161
-5.000	0.00318	0.00319	0.00318	0.00289	0.00219	0.00215	0.00229	0.00224	0.00220
0.0	0.00300	0.00300	0.00299	0.00279	0.00252	0.00255	0.00256	0.00243	0.00229
5.000	0.00298	0.00299	0.00299	0.00313	0.00372	0.00355	0.00345	0.00298	0.00252
10.000	0.00234	0.00262	0.00300	0.00350	0.00384	0.00351	0.00319	0.00217	0.00041
15.000	0.00117	0.00162	0.00299	0.00314	0.00351	0.00287	0.00235	0.00093	-0.00100

ENGINEER_____
DATE_____

FIGURE 4.2.1.3-65
EFFECT OF AILERON



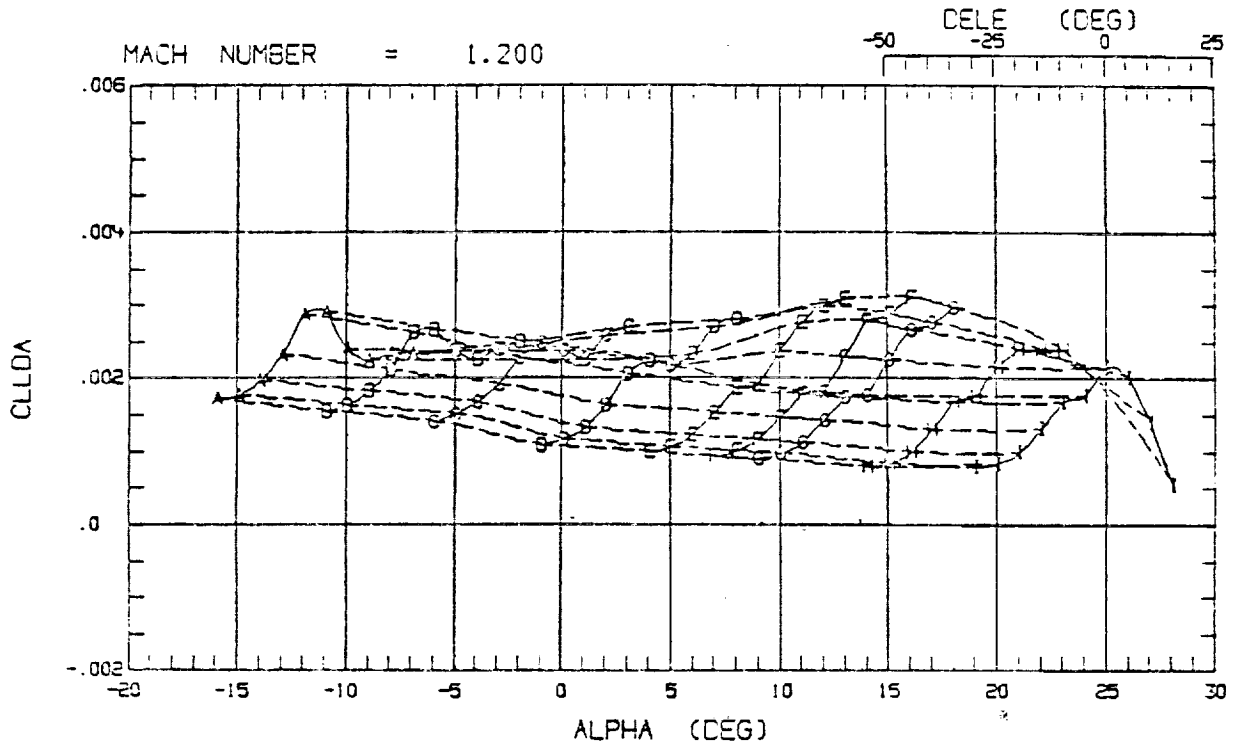
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
ENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00204	0.00181	0.00167	0.00156	0.00134	0.00111	0.00096	0.00096	0.00096
-25.000	0.00209	0.00185	0.00167	0.00157	0.00134	0.00114	0.00102	0.00101	0.00101
-20.000	0.00214	0.00189	0.00169	0.00159	0.00134	0.00117	0.00106	0.00106	0.00105
-15.000	0.00248	0.00229	0.00186	0.00161	0.00138	0.00125	0.00117	0.00119	0.00117
-10.000	0.00345	0.00313	0.00269	0.00195	0.00185	0.00172	0.00154	0.00166	0.00164
-5.000	0.00318	0.00307	0.00294	0.00276	0.00209	0.00201	0.00199	0.00199	0.00199
0.0	0.00264	0.00264	0.00265	0.00248	0.00252	0.00249	0.00247	0.00248	0.00248
5.000	0.00255	0.00255	0.00265	0.00272	0.00354	0.00348	0.00329	0.00285	0.00224
10.000	0.00235	0.00250	0.00289	0.00306	0.00350	0.00332	0.00299	0.00129	0.00074
15.000	0.00205	0.00238	0.00288	0.00303	0.00327	0.00274	0.00219	0.00029	-0.00002

ENGINEER [signature]
DATE 9-13-83

FIGURE 4.2.1.3-66
EFFECT OF AILERON



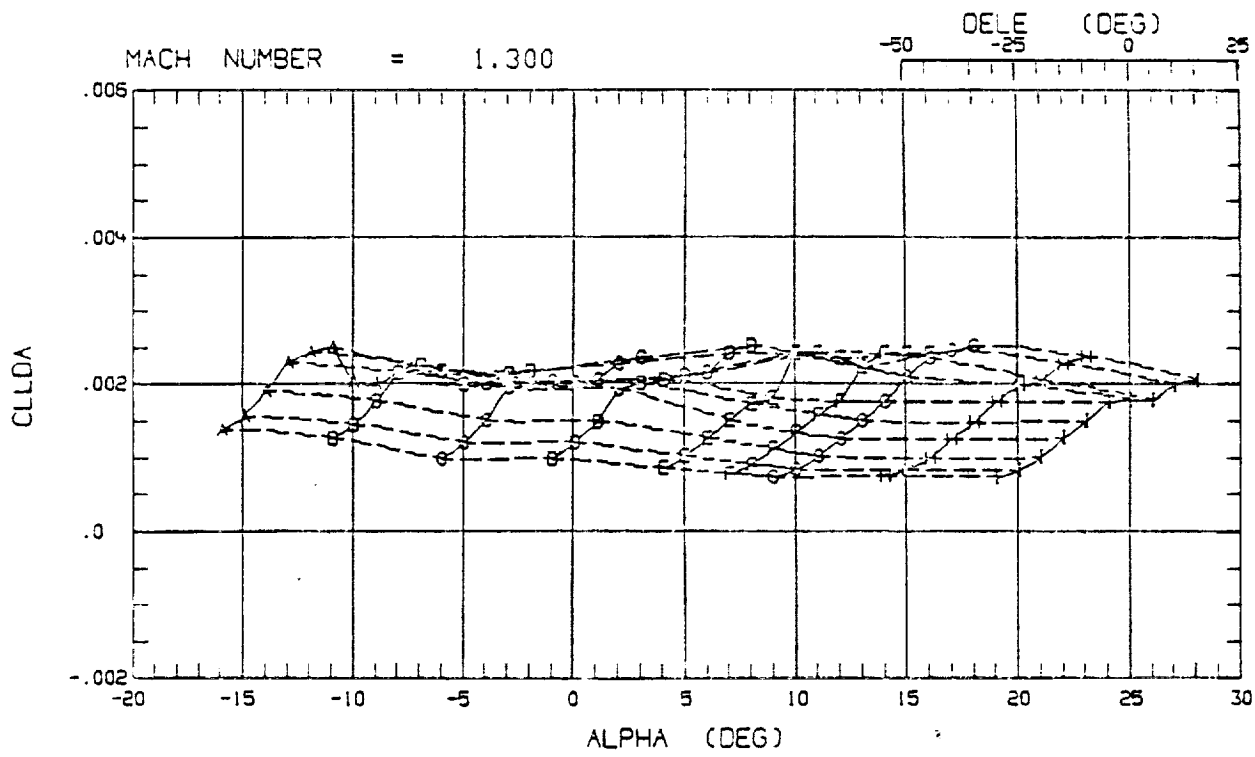
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00171	0.00154	0.00140	0.00106	0.00098	0.00092	0.00088	0.00079	0.00079
-25.000	0.00176	0.00162	0.00150	0.00115	0.00105	0.00100	0.00096	0.00082	0.00083
-20.000	0.00195	0.00181	0.00166	0.00130	0.00121	0.00115	0.00110	0.00098	0.00098
-15.000	0.00231	0.00210	0.00190	0.00162	0.00152	0.00146	0.00142	0.00129	0.00130
-10.000	0.00295	0.00260	0.00227	0.00205	0.00185	0.00177	0.00173	0.00167	0.00167
-5.000	0.00299	0.00265	0.00246	0.00223	0.00189	0.00180	0.00176	0.00176	0.00176
0.0	0.00238	0.00237	0.00237	0.00217	0.00236	0.00229	0.00224	0.00214	0.00215
5.000	0.00224	0.00224	0.00224	0.00232	0.00275	0.00277	0.00265	0.00239	0.00200
10.000	0.00233	0.00239	0.00257	0.00270	0.00298	0.00287	0.00275	0.00239	0.00139
15.000	0.00233	0.00248	0.00269	0.00290	0.00307	0.00310	0.00295	0.00239	0.00053

ENGINEER [illegible]
DATE 2-3-77

FIGURE 4.2.1.3-67
EFFECT OF AILERON



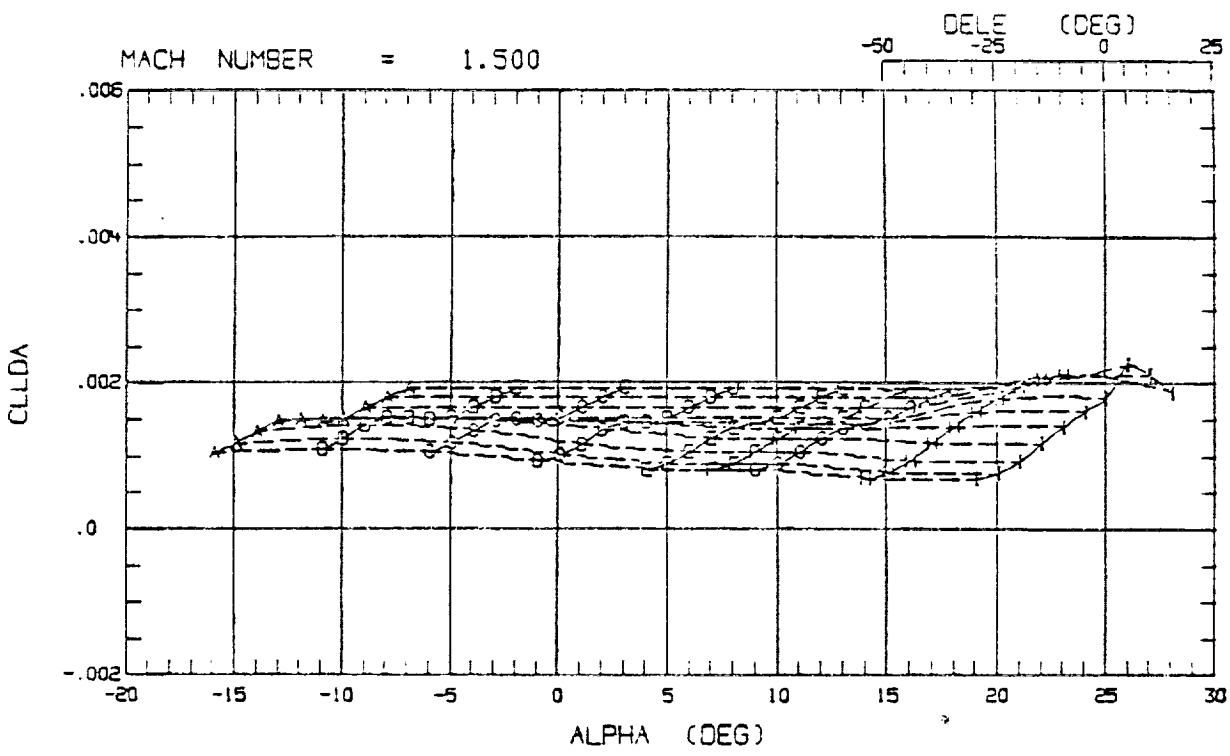
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00138	0.00125	0.00097	0.00097	0.00084	0.00077	0.00073	0.00074	0.00073
-25.000	0.00156	0.00144	0.00119	0.00119	0.00100	0.00089	0.00083	0.00083	0.00082
-20.000	0.00169	0.00175	0.00149	0.00148	0.00125	0.00110	0.00100	0.00098	0.00100
-15.000	0.00228	0.00214	0.00194	0.00191	0.00149	0.00132	0.00125	0.00125	0.00126
-10.000	0.00242	0.00225	0.00197	0.00199	0.00172	0.00157	0.00149	0.00148	0.00149
-5.000	0.00248	0.00217	0.00203	0.00204	0.00180	0.00176	0.00176	0.00176	0.00175
0.0	0.00203	0.00197	0.00199	0.00211	0.00241	0.00221	0.00209	0.00197	0.00179
5.000	0.00200	0.00200	0.00205	0.00214	0.00241	0.00240	0.00234	0.00205	0.00178
10.000	0.00214	0.00213	0.00227	0.00241	0.00234	0.00240	0.00244	0.00227	0.00198
15.000	0.00217	0.00217	0.00234	0.00250	0.00222	0.00240	0.00250	0.00236	0.00205

ENGINEER
DATE 9-25-78

FIGURE 4.2.1.3-68
EFFECT OF AILERON



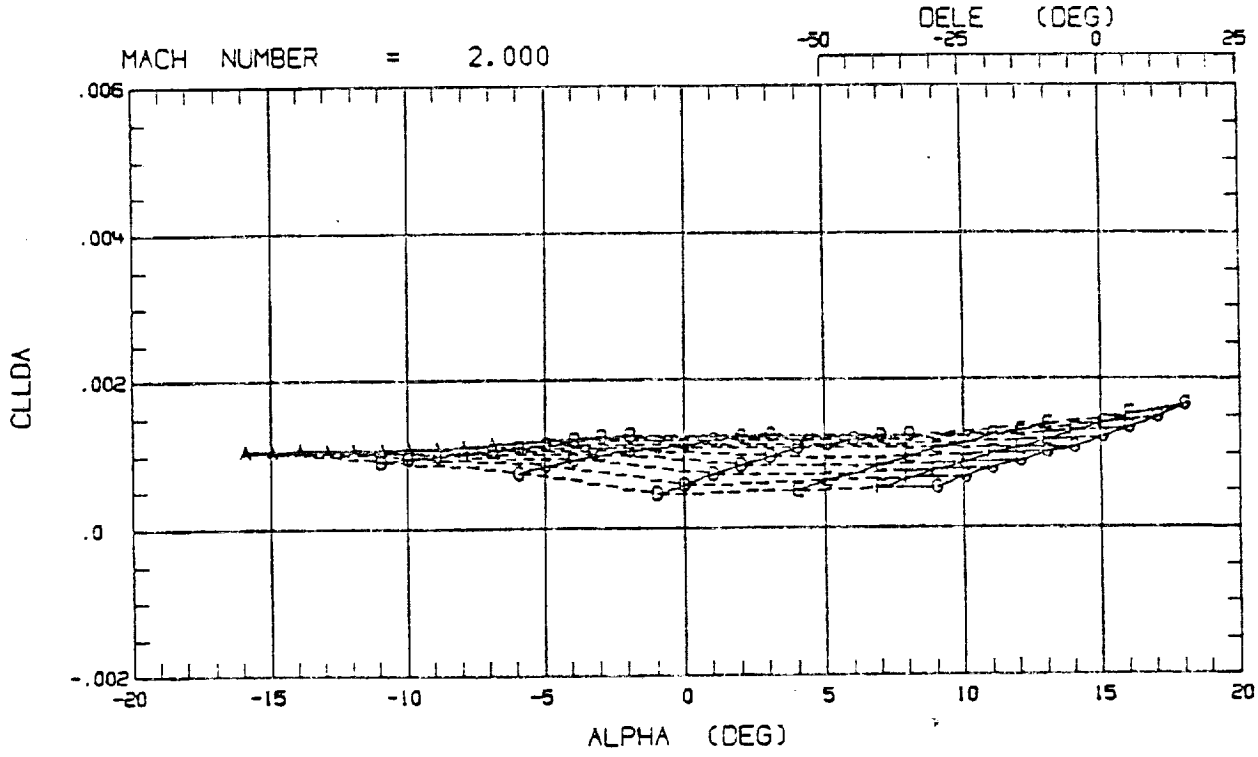
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00104	0.00108	0.00104	0.00092	0.00081	0.00081	0.00081	0.00069	0.00069
-25.000	0.00117	0.00123	0.00117	0.00100	0.00089	0.00089	0.00089	0.00077	0.00077
-20.000	0.00134	0.00141	0.00134	0.00114	0.00105	0.00105	0.00105	0.00093	0.00093
-15.000	0.00148	0.00152	0.00148	0.00135	0.00123	0.00123	0.00123	0.00117	0.00117
-10.000	0.00150	0.00152	0.00150	0.00145	0.00137	0.00137	0.00137	0.00140	0.00140
-5.000	0.00148	0.00149	0.00148	0.00145	0.00144	0.00144	0.00144	0.00160	0.00160
0.0	0.00151	0.00151	0.00151	0.00151	0.00151	0.00151	0.00151	0.00178	0.00178
5.000	0.00165	0.00165	0.00165	0.00165	0.00165	0.00165	0.00165	0.00194	0.00224
10.000	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	0.00204	0.00211
15.000	0.00191	0.00191	0.00191	0.00191	0.00191	0.00191	0.00191	0.00211	0.00185

ENGINEER [signature]
DATE 9-3-78

FIGURE 4.2.1.3-69
EFFECT OF AILERON

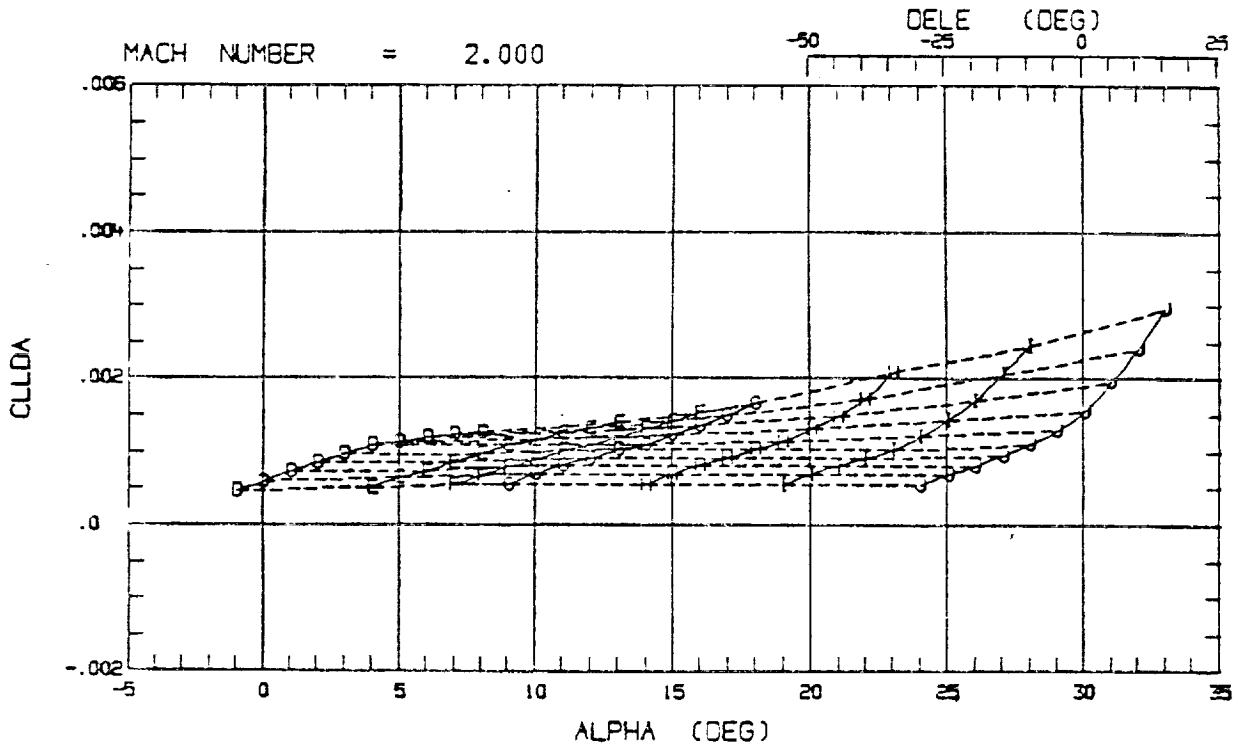


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G
DELE (DEG)	AILERON EFFECTIVENESS						
-30.000	0.00105	0.00091	0.00075	0.00045	0.00050	0.00053	0.00054
-25.000	0.00105	0.00095	0.00085	0.00058	0.00063	0.00067	0.00069
-20.000	0.00106	0.00098	0.00092	0.00073	0.00073	0.00078	0.00081
-15.000	0.00106	0.00101	0.00099	0.00085	0.00085	0.00088	0.00090
-10.000	0.00107	0.00105	0.00104	0.00096	0.00096	0.00100	0.00102
-5.000	0.00107	0.00108	0.00108	0.00108	0.00108	0.00108	0.00109
0.0	0.00108	0.00112	0.00112	0.00112	0.00115	0.00119	0.00122
5.000	0.00109	0.00118	0.00118	0.00118	0.00124	0.00130	0.00135
10.000	0.00110	0.00122	0.00122	0.00122	0.00130	0.00141	0.00149
15.000	0.00115	0.00125	0.00135	0.00125	0.00140	0.00153	0.00165

ENGINEER
DATE

FIGURE 4.2.1.3-70
EFFECT OF AILERON



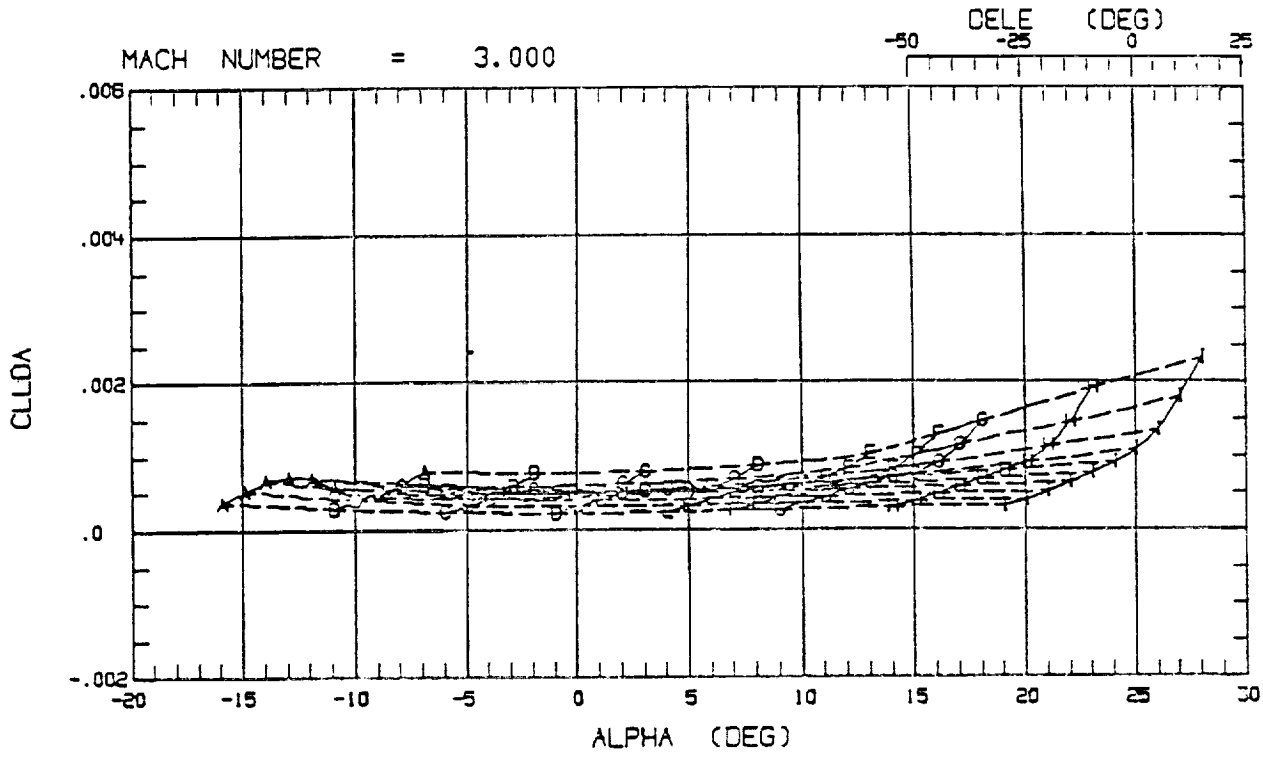
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I	30.000 J
DELE (DEG)	AILERON EFFECTIVENESS						
-30.000	0.00045	0.00050	0.00053	0.00054	0.00054	0.00054	0.00054
-25.000	0.00058	0.00063	0.00067	0.00069	0.00069	0.00069	0.00069
-20.000	0.00073	0.00073	0.00078	0.00081	0.00081	0.00081	0.00081
-15.000	0.00085	0.00085	0.00088	0.00090	0.00090	0.00090	0.00095
-10.000	0.00096	0.00096	0.00100	0.00102	0.00102	0.00102	0.00110
-5.000	0.00108	0.00108	0.00108	0.00109	0.00113	0.00120	0.00129
0.0	0.00112	0.00115	0.00119	0.00122	0.00130	0.00143	0.00155
5.000	0.00118	0.00124	0.00130	0.00135	0.00148	0.00170	0.00195
10.000	0.00122	0.00130	0.00141	0.00149	0.00172	0.00206	0.00240
15.000	0.00125	0.00140	0.00153	0.00165	0.00208	0.00245	0.00295

ENGINEER JP 3
DATE 2-15-74

FIGURE 4.2.1.3-71
EFFECT OF AILERON



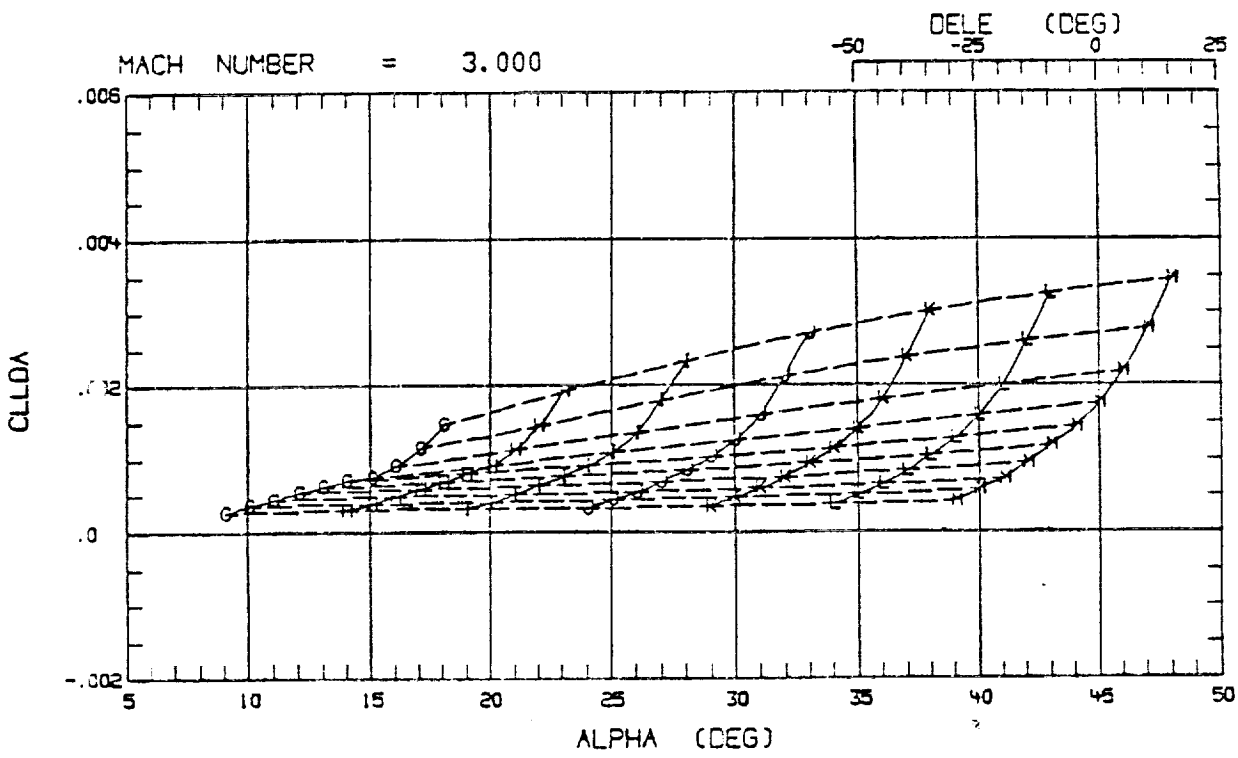
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00035	0.00027	0.00023	0.00022	0.00023	0.00025	0.00026	0.00030	0.00031
-25.000	0.00051	0.00039	0.00032	0.00031	0.00032	0.00034	0.00035	0.00038	0.00040
-20.000	0.00065	0.00050	0.00041	0.00040	0.00041	0.00043	0.00044	0.00048	0.00051
-15.000	0.00071	0.00058	0.00050	0.00049	0.00050	0.00052	0.00054	0.00058	0.00063
-10.000	0.00069	0.00059	0.00053	0.00052	0.00055	0.00058	0.00061	0.00068	0.00076
-5.000	0.00056	0.00051	0.00050	0.00053	0.00060	0.00066	0.00070	0.00080	0.00091
0.0	0.00044	0.00042	0.00044	0.00051	0.00061	0.00069	0.00075	0.00091	0.00108
5.000	0.00050	0.00047	0.00050	0.00058	0.00071	0.00082	0.00090	0.00112	0.00136
10.000	0.00061	0.00058	0.00061	0.00068	0.00083	0.00101	0.00114	0.00146	0.00179
15.000	0.00079	0.00076	0.00079	0.00087	0.00103	0.00129	0.00147	0.00191	0.00233

ENGINEER
DATE 9-3-78

FIGURE 4.2.1.3-72
EFFECT OF AILERON



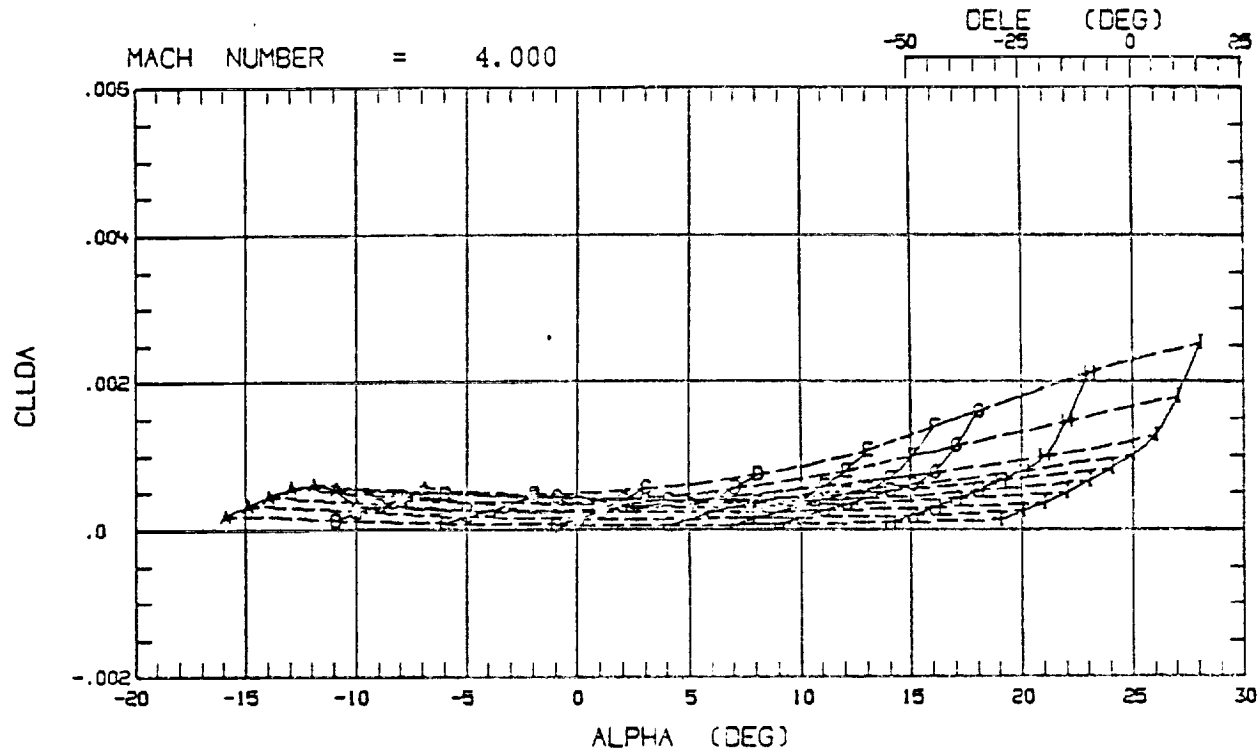
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M
DELE (DEG)	AILERON EFFECTIVENESS						
-30.000	0.00026	0.00030	0.00031	0.00032	0.00034	0.00037	0.00041
-25.000	0.00035	0.00038	0.00040	0.00043	0.00047	0.00051	0.00057
-20.000	0.00044	0.00048	0.00051	0.00054	0.00059	0.00065	0.00073
-15.000	0.00054	0.00058	0.00063	0.00068	0.00075	0.00084	0.00095
-10.000	0.00061	0.00068	0.00076	0.00084	0.00094	0.00105	0.00118
-5.000	0.00070	0.00080	0.00091	0.00102	0.00115	0.00129	0.00144
0.0	0.00075	0.00091	0.00108	0.00125	0.00142	0.00159	0.00175
5.000	0.00090	0.00112	0.00136	0.00160	0.00181	0.00201	0.00219
10.000	0.00114	0.00146	0.00179	0.00212	0.00238	0.00260	0.00278
15.000	0.00147	0.00191	0.00233	0.00271	0.00302	0.00325	0.00345

ENGINEER
DATE 9-3-74

FIGURE 4.2.1.3-73
EFFECT OF AILERON



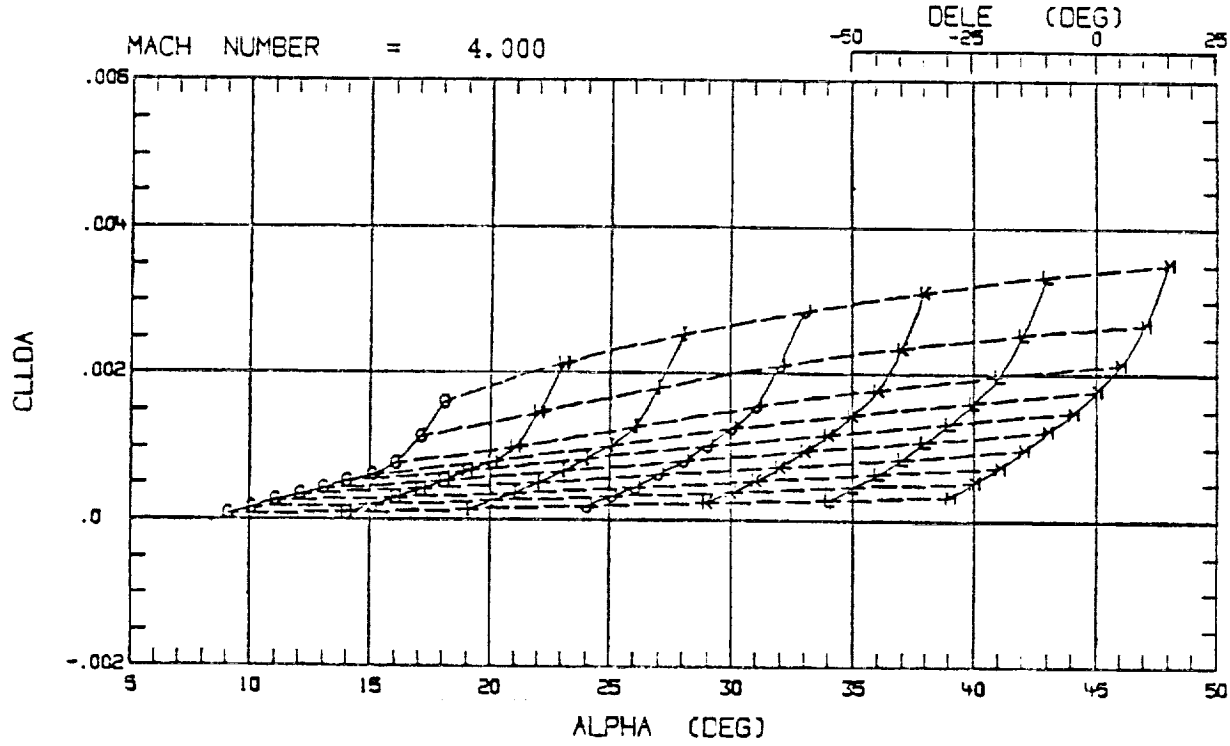
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00018	0.00012	0.00008	0.00006	0.00006	0.00006	0.00007	0.00009	0.00013
-25.000	0.00031	0.00023	0.00017	0.00014	0.00014	0.00015	0.00016	0.00019	0.00025
-20.000	0.00044	0.00032	0.00025	0.00023	0.00023	0.00024	0.00025	0.00029	0.00036
-15.000	0.00055	0.00043	0.00035	0.00031	0.00030	0.00032	0.00034	0.00041	0.00050
-10.000	0.00059	0.00050	0.00043	0.00038	0.00036	0.00039	0.00042	0.00052	0.00066
-5.000	0.00053	0.00047	0.00043	0.00040	0.00041	0.00047	0.00052	0.00066	0.00083
0.0	0.00032	0.00025	0.00025	0.00033	0.00045	0.00054	0.00060	0.00079	0.00101
5.000	0.00031	0.00025	0.00027	0.00041	0.00058	0.00069	0.00077	0.00098	0.00126
10.000	0.00040	0.00035	0.00040	0.00055	0.00079	0.00099	0.00112	0.00146	0.00179
15.000	0.00055	0.00048	0.00055	0.00074	0.00107	0.00139	0.00160	0.00213	0.00252

ENGINEER [signature]
DATE 9-13-93

FIGURE 4.2.1.3-74
EFFECT OF AILERON



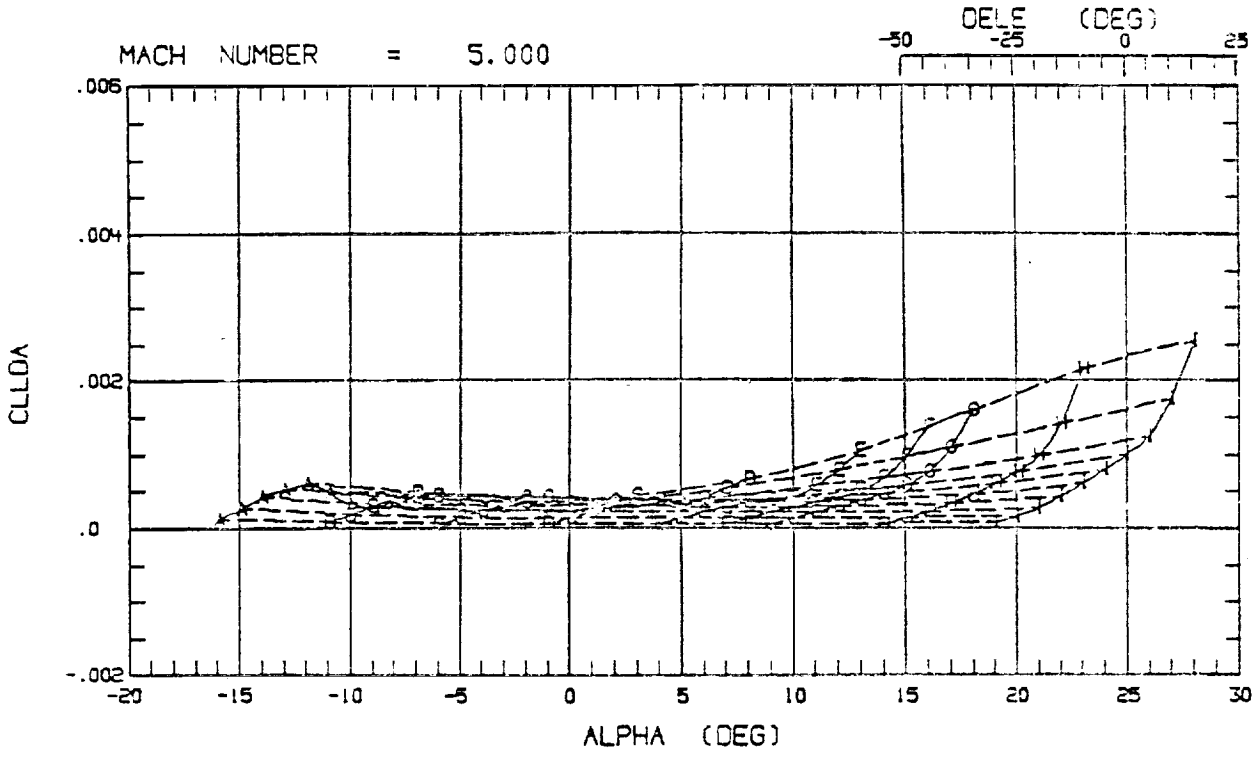
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M
DELE (DEG)	AILERON EFFECTIVENESS						
-30.000	0.00007	0.00009	0.00013	0.00018	0.00023	0.00027	0.00032
-25.000	0.00016	0.00019	0.00025	0.00031	0.00038	0.00045	0.00052
-20.000	0.00025	0.00029	0.00036	0.00044	0.00053	0.00063	0.00073
-15.000	0.00034	0.00041	0.00050	0.00061	0.00072	0.00084	0.00097
-10.000	0.00042	0.00052	0.00066	0.00080	0.00094	0.00108	0.00122
-5.000	0.00052	0.00066	0.00083	0.00101	0.00117	0.00133	0.00148
0.0	0.00060	0.00079	0.00101	0.00124	0.00144	0.00161	0.00177
5.000	0.00077	0.00098	0.00125	0.00155	0.00178	0.00197	0.00213
10.000	0.00112	0.00146	0.00179	0.00211	0.00235	0.00254	0.00268
15.000	0.00160	0.00213	0.00252	0.00295	0.00312	0.00334	0.00350

ENGINEER
DATE 9-3-78

FIGURE 4.2.1.3-75
EFFECT OF AILERON



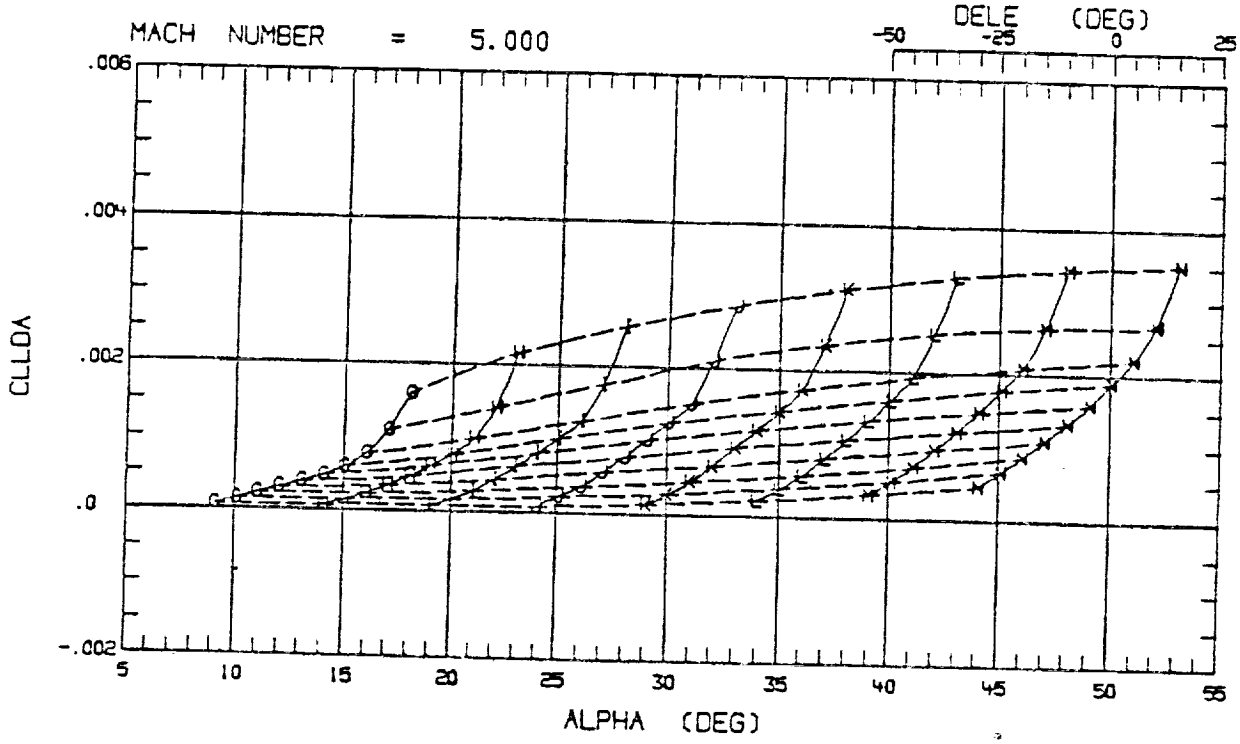
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	13.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H	I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00012	0.00008	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00007
-25.000	0.00026	0.00018	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00016
-20.000	0.00042	0.00030	0.00023	0.00022	0.00022	0.00022	0.00022	0.00022	0.00027
-15.000	0.00052	0.00041	0.00033	0.00029	0.00029	0.00029	0.00029	0.00033	0.00043
-10.000	0.00059	0.00048	0.00041	0.00036	0.00035	0.00036	0.00038	0.00045	0.00061
-5.000	0.00048	0.00044	0.00041	0.00038	0.00037	0.00042	0.00046	0.00060	0.00080
0.0	0.00029	0.00024	0.00024	0.00031	0.00042	0.00051	0.00057	0.00076	0.00100
5.000	0.00029	0.00023	0.00026	0.00040	0.00057	0.00068	0.00076	0.00098	0.00125
10.000	0.00035	0.00029	0.00035	0.00054	0.00079	0.00097	0.00109	0.00141	0.00176
15.000	0.00043	0.00035	0.00043	0.00067	0.00105	0.00138	0.00160	0.00216	0.00265

ENGINEER
DATE 9-13-76

FIGURE 4.2.1.3-76
EFFECT OF AILERON



CONFIGURATION

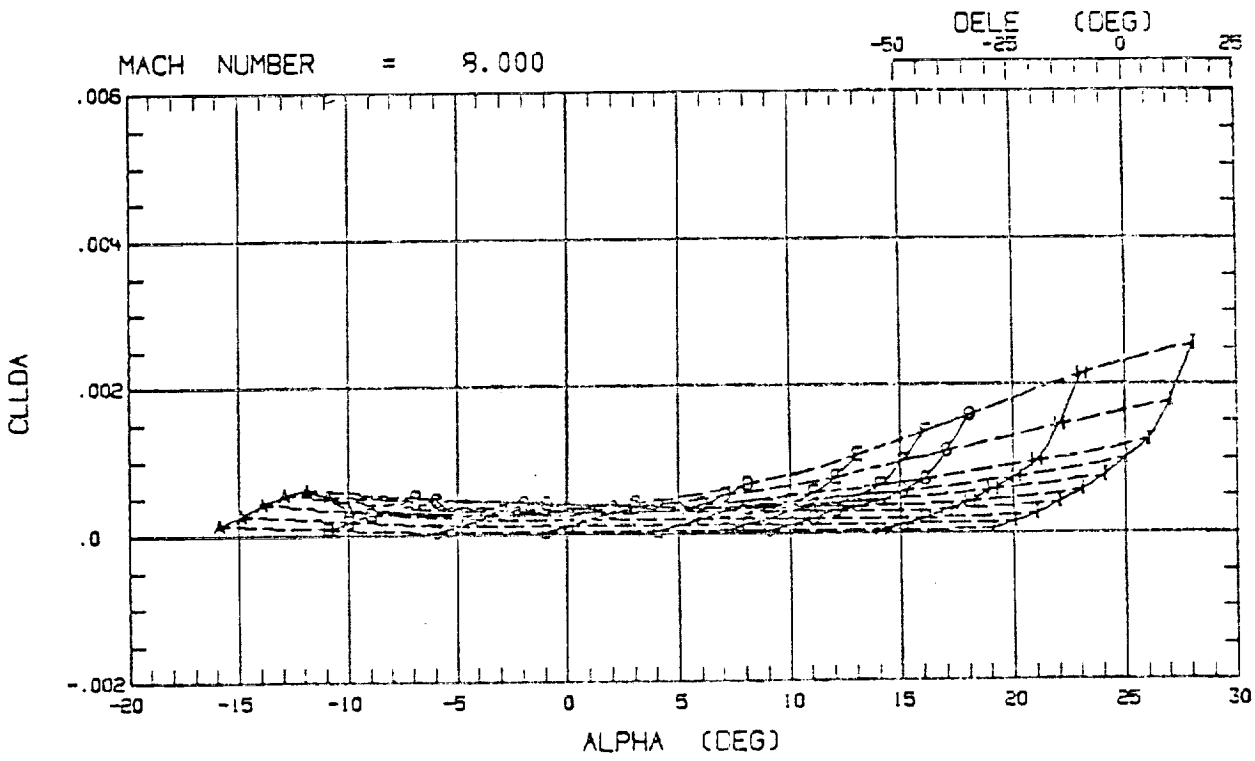
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	REFERENCE DIMENSIONS	
OR	YO = BL 0.0 IN.	WING AREA	SW = 2690.00 SQ.FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	WING SPAN	BW = 78.056 FT.
		M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON EFFECTIVENESS							
-30.000	0.00006	0.00006	0.00007	0.00008	0.00013	0.00021	0.00032	0.00046
-25.000	0.00014	0.00014	0.00016	0.00021	0.00028	0.00038	0.00050	0.00065
-20.000	0.00022	0.00022	0.00027	0.00035	0.00045	0.00056	0.00070	0.00086
-15.000	0.00029	0.00033	0.00043	0.00055	0.00067	0.00080	0.00094	0.00109
-10.000	0.00038	0.00045	0.00061	0.00077	0.00092	0.00106	0.00119	0.00132
-5.000	0.00046	0.00060	0.00080	0.00100	0.00117	0.00133	0.00147	0.00159
0.0	0.00057	0.00076	0.00100	0.00124	0.00144	0.00162	0.00177	0.00189
5.000	0.00076	0.00098	0.00125	0.00152	0.00174	0.00193	0.00208	0.00220
10.000	0.00109	0.00141	0.00176	0.00211	0.00235	0.00253	0.00263	0.00266
15.000	0.00160	0.00216	0.00255	0.00296	0.00311	0.00331	0.00343	0.00350

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-77
EFFECT OF AILERON



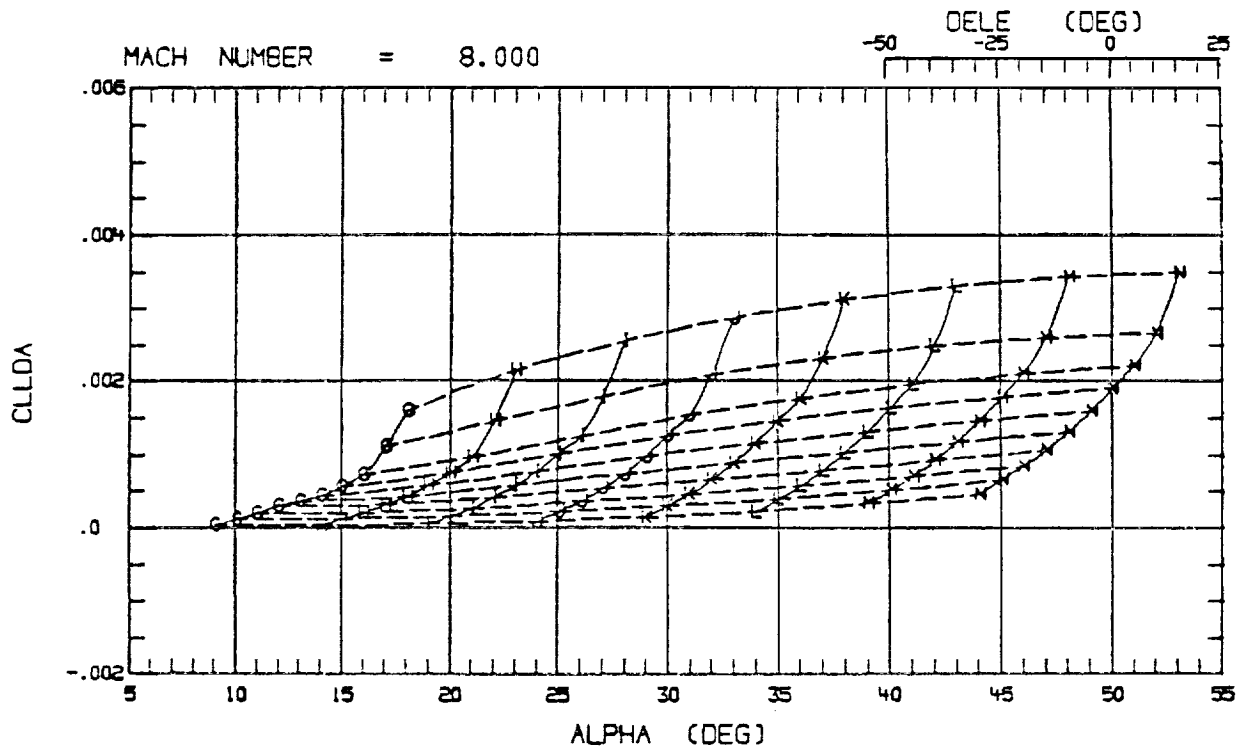
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00013	0.00007	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00005
-25.000	0.00026	0.00017	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00015
-20.000	0.00042	0.00028	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00026
-15.000	0.00053	0.00035	0.00031	0.00029	0.00029	0.00029	0.00029	0.00031	0.00041
-10.000	0.00060	0.00050	0.00042	0.00036	0.00034	0.00035	0.00036	0.00042	0.00057
-5.000	0.00051	0.00045	0.00041	0.00037	0.00036	0.00040	0.00044	0.00057	0.00077
0.0	0.00034	0.00025	0.00025	0.00031	0.00042	0.00050	0.00056	0.00075	0.00100
5.000	0.00030	0.00027	0.00030	0.00039	0.00053	0.00064	0.00072	0.00096	0.00124
10.000	0.00035	0.00030	0.00035	0.00051	0.00075	0.00096	0.00110	0.00145	0.00178
15.000	0.00042	0.00034	0.00042	0.00066	0.00104	0.00137	0.00159	0.00215	0.00264

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3- 78
EFFECT OF AILERON



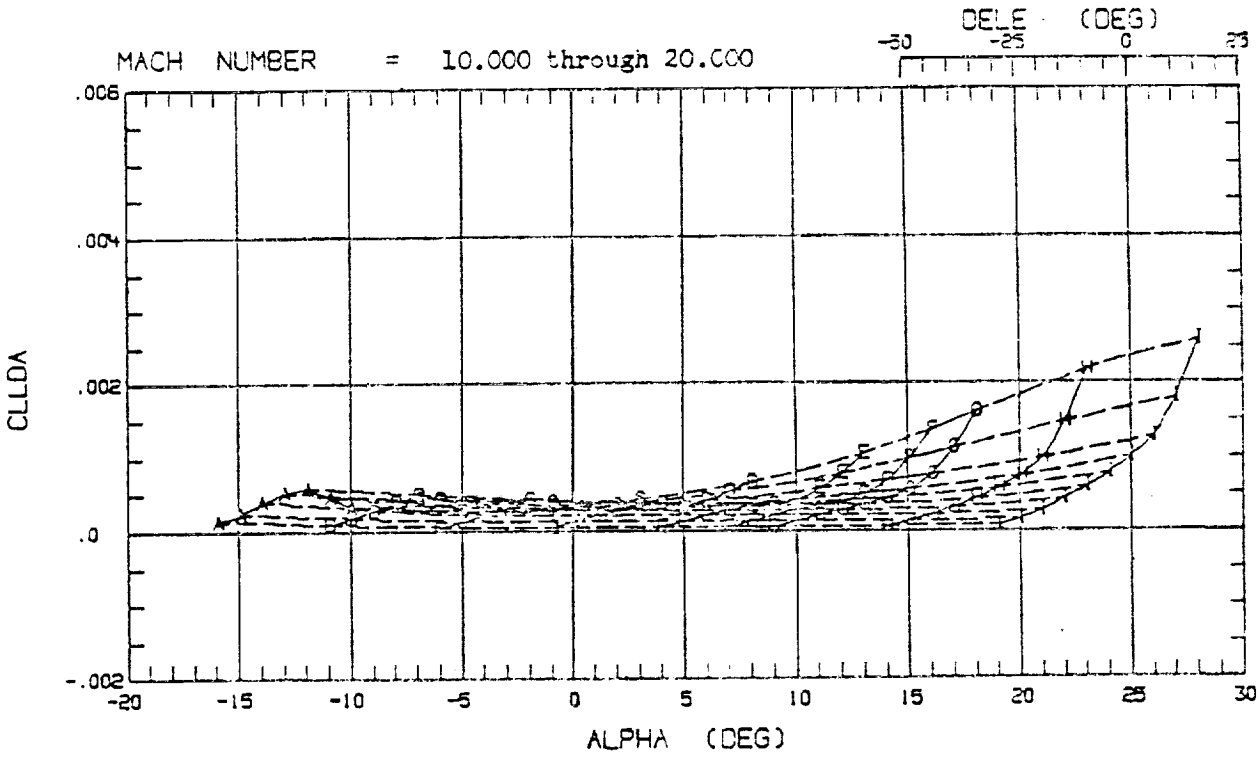
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON EFFECTIVENESS							
-30.000	0.00003	0.00003	0.00005	0.00008	0.00014	0.00022	0.00033	0.00046
-25.000	0.00012	0.00012	0.00015	0.00021	0.00029	0.00039	0.00051	0.00066
-20.000	0.00020	0.00020	0.00026	0.00035	0.00045	0.00057	0.00070	0.00085
-15.000	0.00029	0.00031	0.00041	0.00053	0.00065	0.00078	0.00092	0.00105
-10.000	0.00036	0.00042	0.00057	0.00073	0.00088	0.00103	0.00117	0.00131
-5.000	0.00044	0.00057	0.00077	0.00097	0.00115	0.00131	0.00146	0.00159
0.0	0.00056	0.00075	0.00100	0.00125	0.00146	0.00163	0.00178	0.00190
5.000	0.00072	0.00096	0.00124	0.00153	0.00176	0.00195	0.00210	0.00221
10.000	0.00110	0.00145	0.00178	0.00208	0.00231	0.00248	0.00259	0.00265
15.000	0.00159	0.00215	0.00254	0.00286	0.00311	0.00330	0.00342	0.00348

ENGINEER [illegible]
DATE 4-3-73

FIGURE 4.2.1.3-79
EFFECT OF AILERON



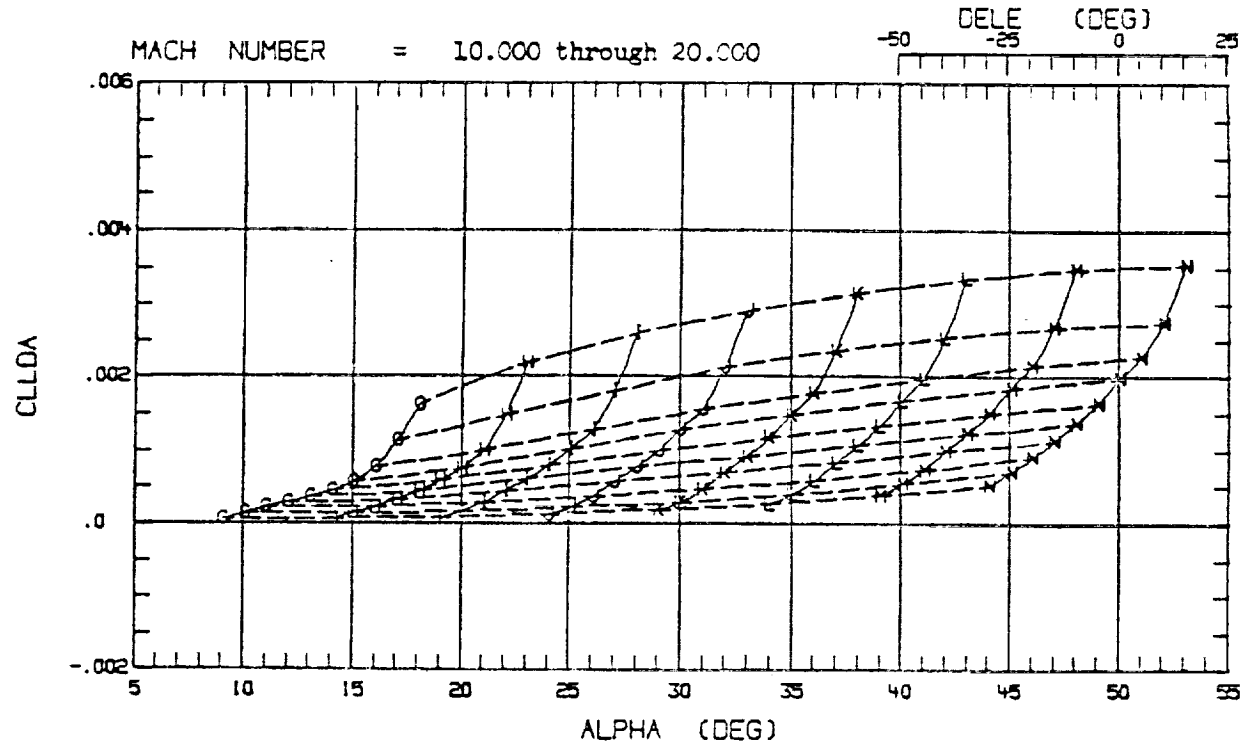
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	13.000 F	15.000 G	20.000 H	25.000 I
DELE (DEG)	AILERON EFFECTIVENESS								
-30.000	0.00014	0.00009	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00008
-25.000	0.00023	0.00017	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00016
-20.000	0.00039	0.00029	0.00022	0.00022	0.00022	0.00022	0.00022	0.00022	0.00028
-15.000	0.00052	0.00039	0.00031	0.00028	0.00029	0.00028	0.00029	0.00031	0.00043
-10.000	0.00058	0.00050	0.00043	0.00037	0.00034	0.00035	0.00036	0.00043	0.00059
-5.000	0.00046	0.00043	0.00040	0.00033	0.00036	0.00040	0.00044	0.00058	0.00078
0.0	0.00033	0.00027	0.00027	0.00032	0.00042	0.00050	0.00056	0.00075	0.00101
5.000	0.00032	0.00027	0.00030	0.00041	0.00057	0.00068	0.00076	0.00099	0.00127
10.000	0.00036	0.00031	0.00036	0.00053	0.00078	0.00098	0.00112	0.00147	0.00180
15.000	0.00045	0.00036	0.00043	0.00067	0.00105	0.00138	0.00161	0.00218	0.00258

ENGINEER [illegible]
DATE 9-23-78

FIGURE 4.2.1.3-80
EFFECT OF AILERON



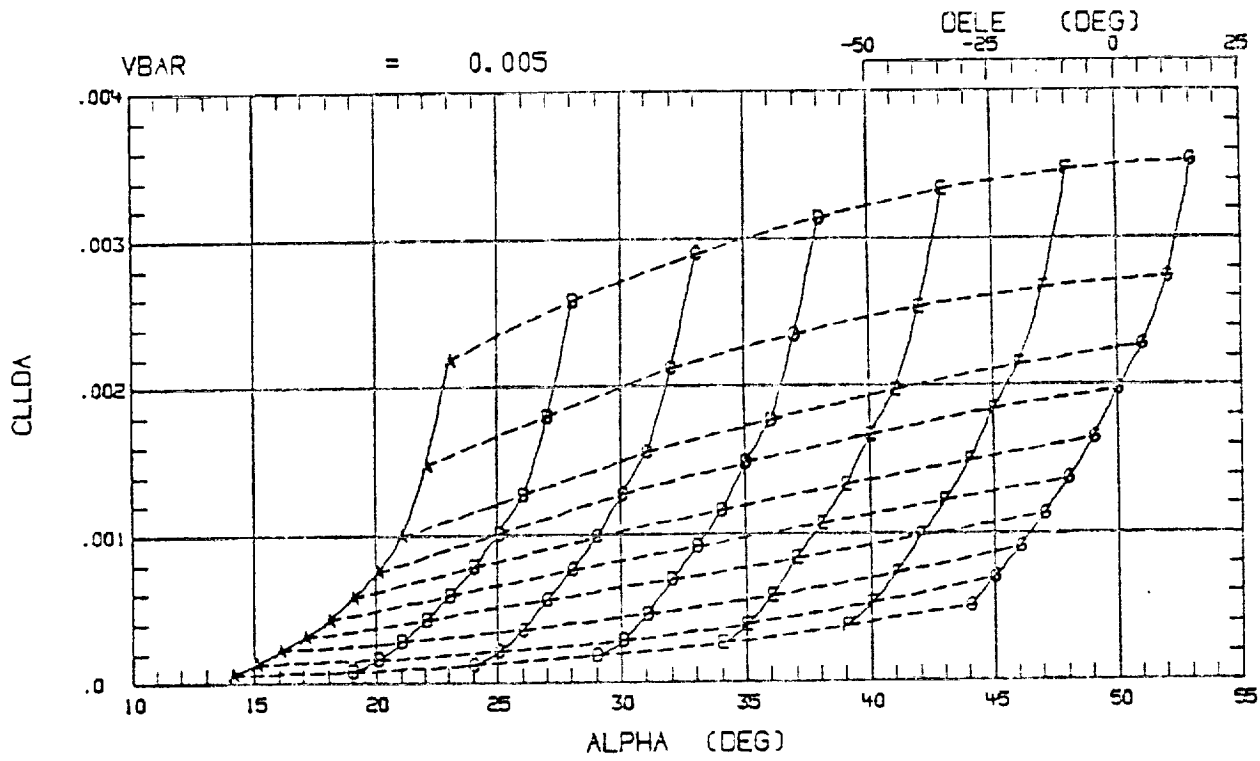
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 G	20.000 H	25.000 I	30.000 J	35.000 K	40.000 L	45.000 M	50.000 N
DELE (DEG)	AILERON EFFECTIVENESS							
-30.000	0.00006	0.00006	0.00008	0.00012	0.00018	0.00025	0.00038	0.00051
-25.000	0.00013	0.00013	0.00016	0.00021	0.00028	0.00039	0.00053	0.00070
-20.000	0.00022	0.00022	0.00028	0.00036	0.00046	0.00058	0.00073	0.00090
-15.000	0.00029	0.00031	0.00043	0.00056	0.00069	0.00083	0.00098	0.00113
-10.000	0.00036	0.00043	0.00059	0.00076	0.00091	0.00107	0.00122	0.00137
-5.000	0.00044	0.00058	0.00078	0.00098	0.00116	0.00133	0.00149	0.00164
0.0	0.00056	0.00075	0.00101	0.00127	0.00148	0.00167	0.00184	0.00197
5.000	0.00076	0.00099	0.00127	0.00155	0.00177	0.00197	0.00214	0.00227
10.000	0.00112	0.00147	0.00180	0.00212	0.00235	0.00253	0.00266	0.00273
15.000	0.00161	0.00218	0.00258	0.00289	0.00314	0.00333	0.00346	0.00352

ENGINEER Wm L
DATE 10-3-79

FIGURE 4.2.1.3-81
EFFECT OF AILERON



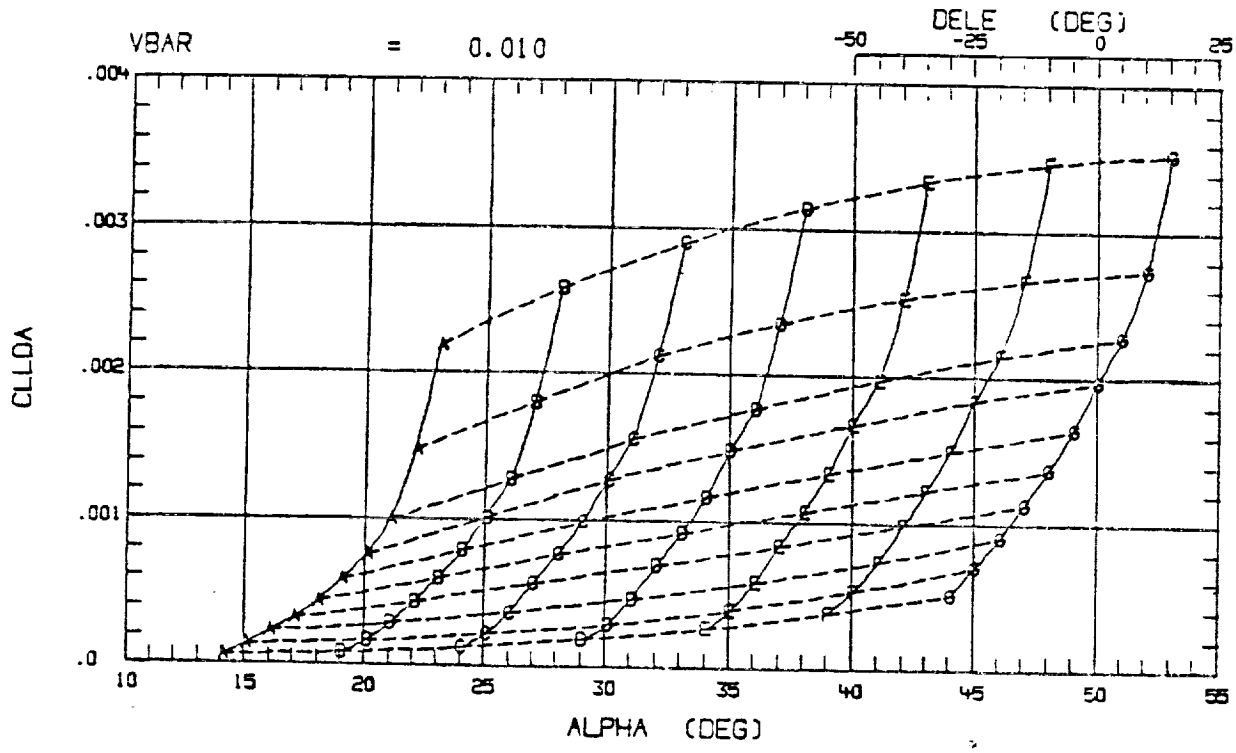
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON ROLLING MOMENT DERIVATIV						
-30.000	0.00006	0.00008	0.00012	0.00018	0.00026	0.00038	0.00051
-25.000	0.00013	0.00016	0.00021	0.00029	0.00039	0.00053	0.00070
-20.000	0.00022	0.00028	0.00036	0.00046	0.00058	0.00073	0.00090
-15.000	0.00031	0.00043	0.00056	0.00069	0.00083	0.00098	0.00113
-10.000	0.00043	0.00059	0.00076	0.00091	0.00107	0.00122	0.00137
-5.000	0.00058	0.00078	0.00098	0.00116	0.00133	0.00149	0.00164
0.0	0.00075	0.00101	0.00127	0.00148	0.00167	0.00184	0.00197
5.000	0.00099	0.00127	0.00155	0.00177	0.00197	0.00214	0.00227
10.000	0.00147	0.00180	0.00212	0.00235	0.00253	0.00266	0.00273
15.000	0.00218	0.00268	0.00299	0.00314	0.00333	0.00346	0.00352

ENGINEER [illegible]
DATE 10-3-78

FIGURE 4.2.1.3- 82
EFFECT OF AILERON



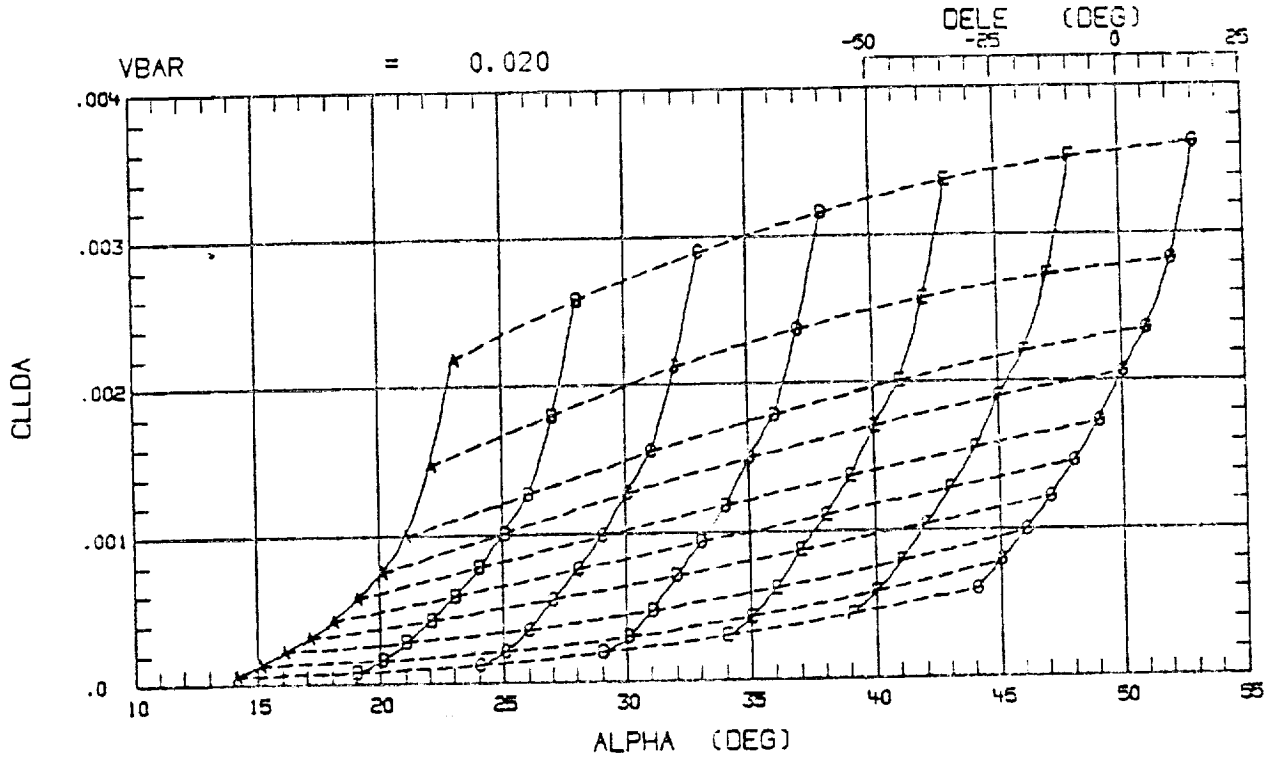
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON ROLLING MOMENT DERIVATIV						
-30.000	0.00006	0.00008	0.00012	0.00018	0.00026	0.00038	0.00051
-25.000	0.00013	0.00016	0.00021	0.00028	0.00039	0.00053	0.00070
-20.000	0.00022	0.00028	0.00036	0.00046	0.00058	0.00073	0.00090
-15.000	0.00031	0.00043	0.00056	0.00069	0.00083	0.00098	0.00113
-10.000	0.00043	0.00059	0.00076	0.00091	0.00107	0.00122	0.00137
-5.000	0.00058	0.00078	0.00098	0.00116	0.00133	0.00149	0.00164
0.0	0.00075	0.00101	0.00127	0.00148	0.00167	0.00184	0.00197
5.000	0.00098	0.00127	0.00155	0.00177	0.00197	0.00214	0.00227
10.000	0.00147	0.00180	0.00212	0.00235	0.00253	0.00266	0.00273
15.000	0.00218	0.00258	0.00299	0.00314	0.00333	0.00346	0.00352

ENGINEER [illegible]
DATE [illegible]-78

FIGURE 4.2.1.3-83
EFFECT OF AILERON



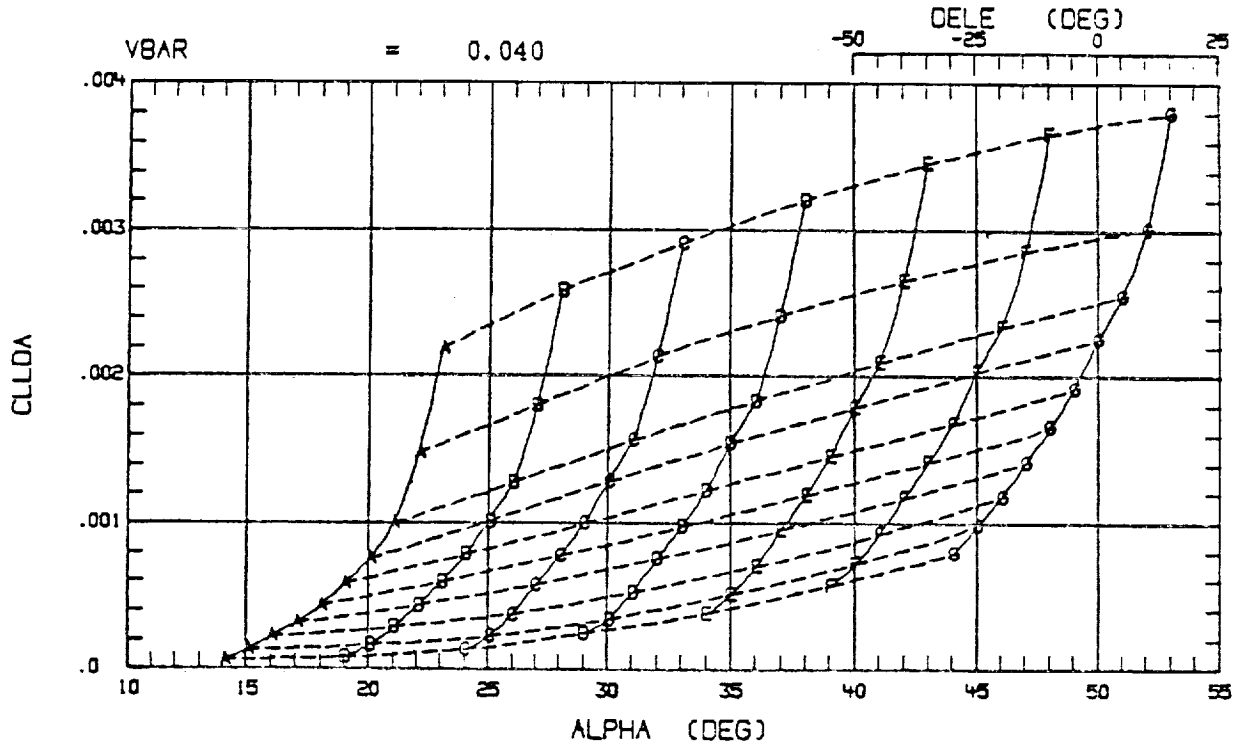
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON ROLLING MOMENT DERIVATIV						
-30.000	0.00006	0.00009	0.00012	0.00020	0.00030	0.00044	0.00060
-25.000	0.00013	0.00016	0.00021	0.00030	0.00043	0.00059	0.00079
-20.000	0.00022	0.00029	0.00036	0.00048	0.00062	0.00079	0.00099
-15.000	0.00031	0.00043	0.00056	0.00071	0.00087	0.00104	0.00122
-10.000	0.00043	0.00059	0.00076	0.00093	0.00111	0.00128	0.00146
-5.000	0.00058	0.00078	0.00098	0.00118	0.00137	0.00155	0.00173
0.0	0.00075	0.00101	0.00127	0.00150	0.00171	0.00190	0.00206
5.000	0.00099	0.00127	0.00155	0.00179	0.00201	0.00220	0.00236
10.000	0.00147	0.00180	0.00212	0.00237	0.00257	0.00272	0.00282
15.000	0.00218	0.00258	0.00299	0.00316	0.00337	0.00352	0.00361

ENGINEER WMT
DATE 10-3-78

FIGURE 4.2.1.3-84
EFFECT OF AILERON



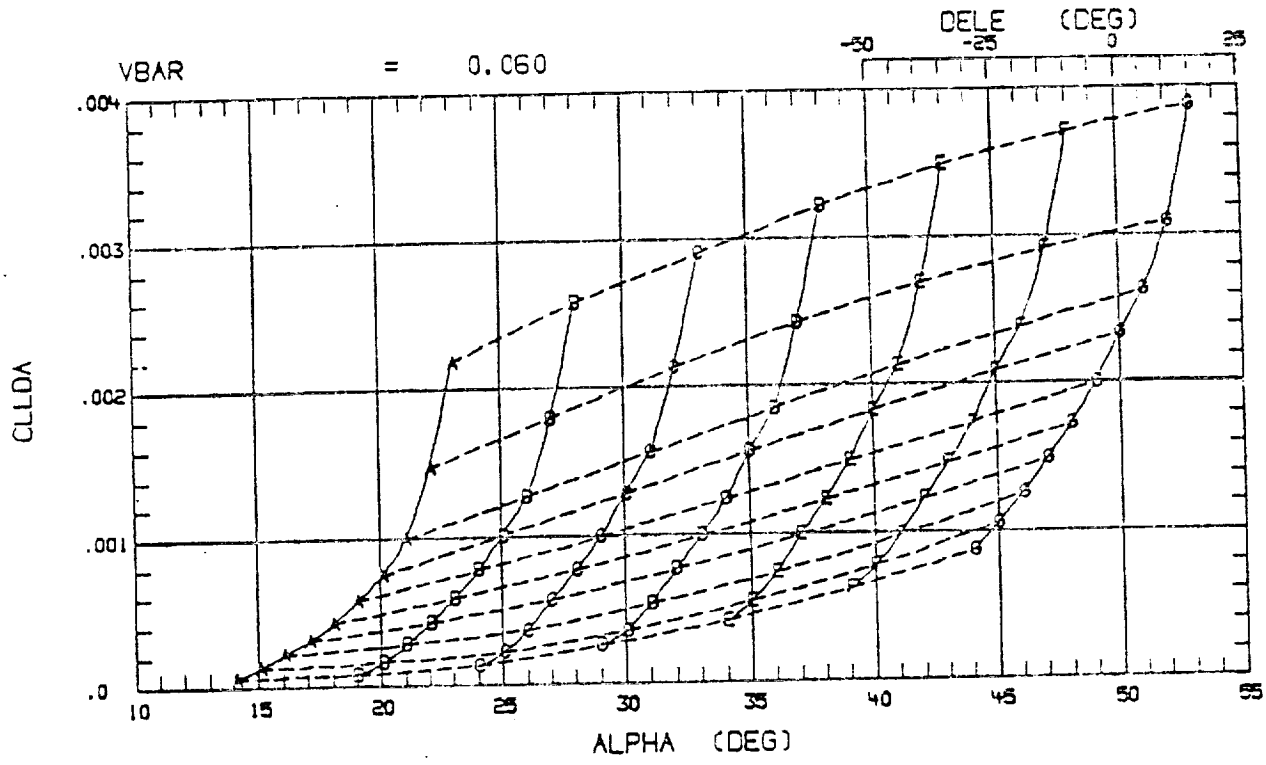
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON ROLLING MOMENT DERIVATIV						
-30.000	0.00006	0.00008	0.00013	0.00024	0.00038	0.00057	0.00079
-25.000	0.00013	0.00016	0.00022	0.00034	0.00051	0.00072	0.00098
-20.000	0.00022	0.00029	0.00037	0.00052	0.00070	0.00092	0.00118
-15.000	0.00031	0.00043	0.00057	0.00075	0.00095	0.00117	0.00141
-10.000	0.00043	0.00059	0.00077	0.00097	0.00119	0.00141	0.00165
-5.000	0.00058	0.00078	0.00099	0.00122	0.00145	0.00168	0.00192
0.0	0.00075	0.00101	0.00128	0.00154	0.00179	0.00203	0.00225
5.000	0.00099	0.00127	0.00156	0.00183	0.00209	0.00233	0.00255
10.000	0.00147	0.00180	0.00213	0.00241	0.00265	0.00295	0.00301
15.000	0.00218	0.00258	0.00290	0.00320	0.00345	0.00365	0.00380

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-85
EFFECT OF AILERON



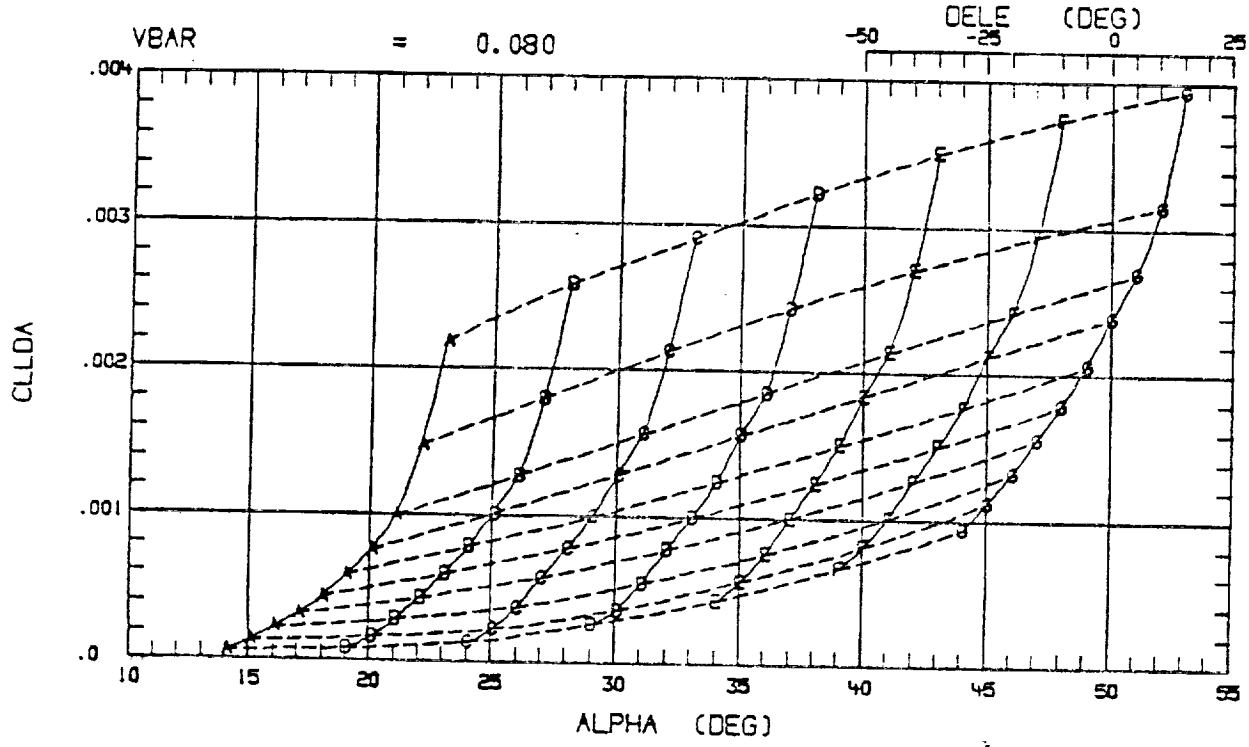
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON ROLLING MOMENT DERIVATIV						
-30.000	0.00006	0.00008	0.00013	0.00026	0.00042	0.00063	0.00087
-25.000	0.00013	0.00016	0.00022	0.00036	0.00055	0.00078	0.00106
-20.000	0.00022	0.00028	0.00037	0.00054	0.00074	0.00098	0.00126
-15.000	0.00031	0.00043	0.00057	0.00077	0.00099	0.00123	0.00149
-10.000	0.00043	0.00059	0.00077	0.00099	0.00123	0.00147	0.00173
-5.000	0.00058	0.00078	0.00099	0.00124	0.00149	0.00174	0.00200
0.0	0.00075	0.00101	0.00129	0.00156	0.00183	0.00209	0.00233
5.000	0.00099	0.00127	0.00156	0.00185	0.00213	0.00239	0.00263
10.000	0.00147	0.00180	0.00213	0.00243	0.00269	0.00291	0.00309
15.000	0.00218	0.00268	0.00290	0.00322	0.00349	0.00371	0.00388

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-86
EFFECT OF AILERON



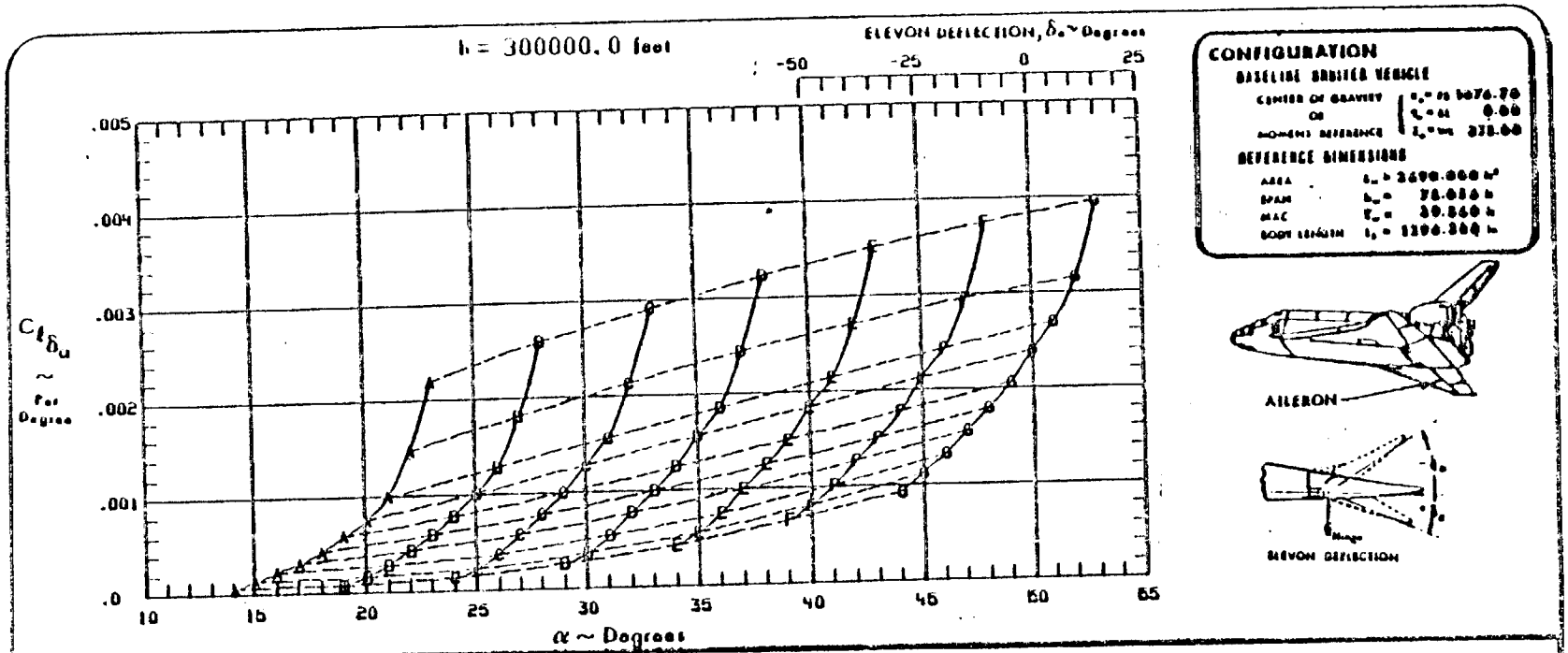
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	AILERON ROLLING MOMENT DERIVATIV						
-30.000	0.00006	0.00008	0.00013	0.00026	0.00043	0.00066	0.00093
-25.000	0.00013	0.00016	0.00022	0.00036	0.00056	0.00081	0.00112
-20.000	0.00022	0.00028	0.00037	0.00054	0.00075	0.00101	0.00132
-15.000	0.00031	0.00043	0.00057	0.00077	0.00100	0.00126	0.00155
-10.000	0.00043	0.00059	0.00077	0.00099	0.00124	0.00150	0.00179
-5.000	0.00058	0.00078	0.00099	0.00124	0.00150	0.00177	0.00206
0.0	0.00075	0.00101	0.00128	0.00156	0.00184	0.00212	0.00239
5.000	0.00099	0.00127	0.00156	0.00185	0.00214	0.00242	0.00269
10.000	0.00147	0.00180	0.00213	0.00243	0.00270	0.00294	0.00315
15.000	0.00218	0.00258	0.00290	0.00322	0.00350	0.00374	0.00394

ENGINEER
DATE

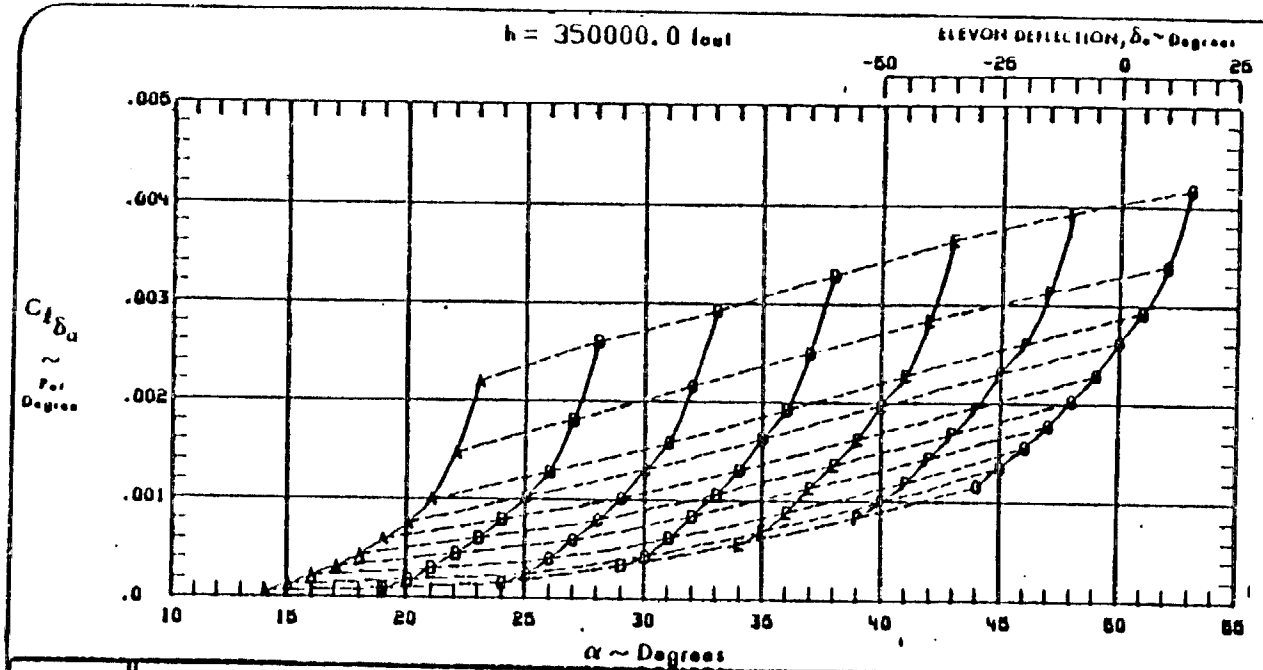
FIGURE 4.2.1.3-87
EFFECT OF AILERON



δ_a ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	F 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{\ell_{\delta_a}}$ ~ per Degree												
-30.000							0.00006	0.00008	0.00013	0.00026	0.00043	0.00066	0.00093
-25.000							0.00013	0.00016	0.00022	0.00036	0.00056	0.00081	0.00112
-20.000							0.00022	0.00028	0.00037	0.00054	0.00075	0.00101	0.00132
-15.000							0.00031	0.00043	0.00057	0.00077	0.00100	0.00126	0.00155
-10.000							0.00043	0.00059	0.00077	0.00099	0.00124	0.00150	0.00179
-5.000							0.00058	0.00078	0.00099	0.00124	0.00150	0.00177	0.00206
0.0							0.00075	0.00101	0.00128	0.00156	0.00184	0.00212	0.00239
5.000							0.00099	0.00127	0.00156	0.00185	0.00214	0.00242	0.00269
10.000							0.00147	0.00180	0.00213	0.00243	0.00270	0.00296	0.00315
15.000							0.00218	0.00258	0.00290	0.00322	0.00350	0.00374	0.00391

ENGINEER
DATE:
REVISED:

Figure 4.2.1.3-88
EFFECT OF AILERON



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY / OF MOMENT REFERENCE

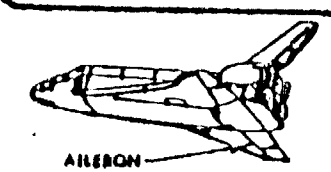
REFERENCE DIMENSIONS

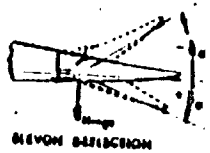
AREA

SPAN

MAC

BODY LENGTH





δ_a ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	F 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{\ell_{\delta_a}}$ ~ per Degree												
-30.000							0.00006	0.00009	0.00015	0.00033	0.00056	0.00084	0.00116
-25.000							0.00013	0.00017	0.00024	0.00043	0.00069	0.00099	0.00135
-20.000							0.00022	0.00029	0.00039	0.00061	0.00088	0.00119	0.00155
-15.000							0.00031	0.00044	0.00059	0.00084	0.00113	0.00144	0.00178
-10.000							0.00043	0.00060	0.00079	0.00106	0.00137	0.00168	0.00202
-5.000							0.00058	0.00079	0.00101	0.00131	0.00163	0.00195	0.00229
0.0							0.00075	0.00102	0.00130	0.00163	0.00197	0.00230	0.00262
5.000							0.00099	0.00128	0.00158	0.00192	0.00227	0.00260	0.00292
10.000							0.00147	0.00181	0.00215	0.00250	0.00283	0.00312	0.00338
15.000							0.00218	0.00259	0.00292	0.00329	0.00363	0.00392	0.00417

ENGINEER: AMT

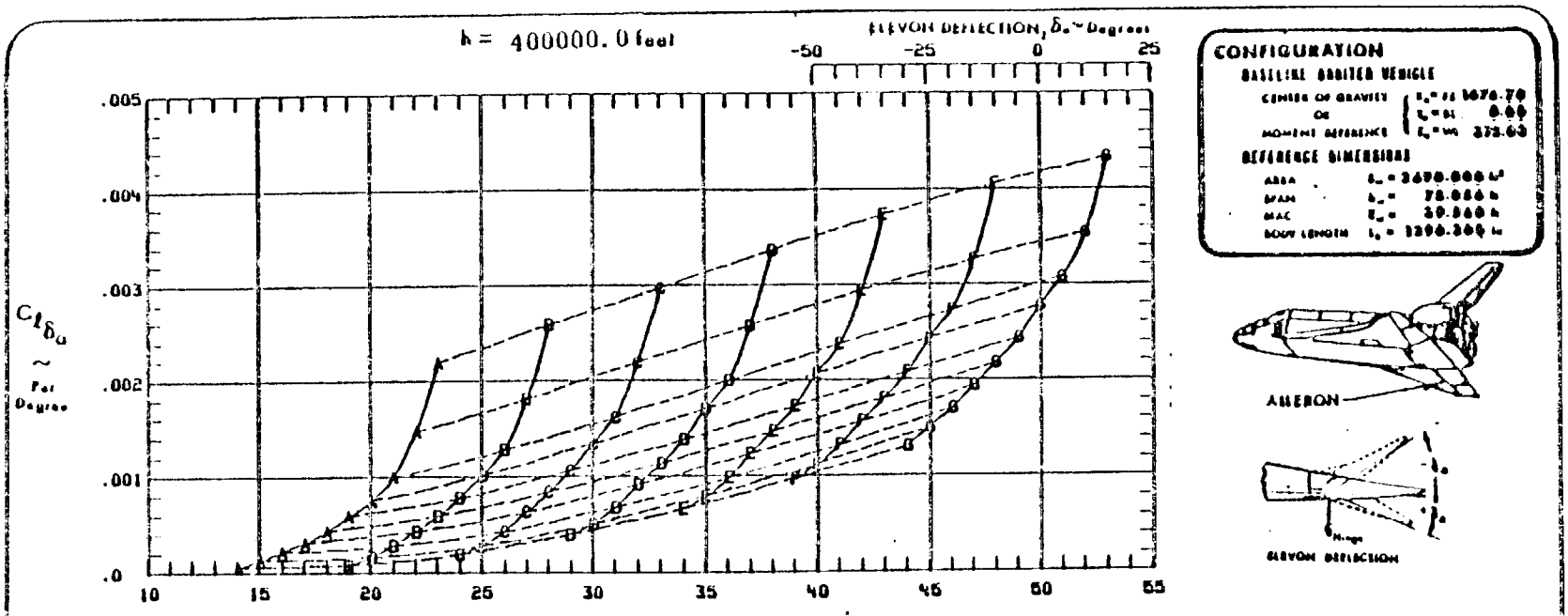
DATE: 10-7-76

REVISED:

Figure 4.2.1.3-89

EFFECT OF AILERON

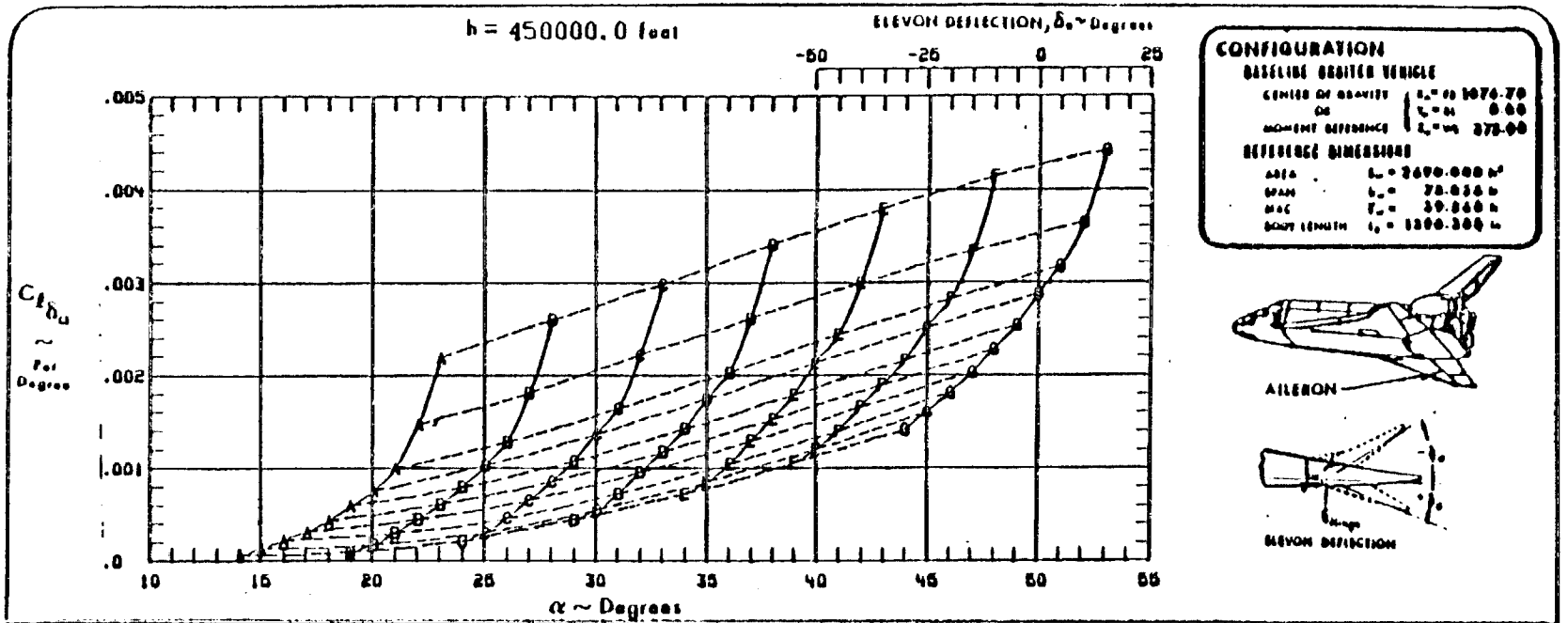
Rockwell International
Space Division



δ_a ~ Degrees	Angle of Attack, α ~ Degrees												
	10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{l_{\delta_a}}$ ~ per Degree												
-30.000							0.00006	0.00008	0.00010	0.00040	0.00066	0.00097	0.00131
-25.000							0.00013	0.00016	0.00020	0.00050	0.00079	0.00112	0.00150
-20.000							0.00022	0.00028	0.00043	0.00068	0.00098	0.00132	0.00170
-15.000							0.00031	0.00043	0.00063	0.00091	0.00123	0.00157	0.00193
-10.000							0.00043	0.00059	0.00083	0.00113	0.00147	0.00181	0.00217
-5.000							0.00058	0.00078	0.00105	0.00138	0.00173	0.00208	0.00244
0.0							0.00075	0.00101	0.00134	0.00170	0.00207	0.00243	0.00277
5.000							0.00099	0.00127	0.00162	0.00199	0.00237	0.00273	0.00307
10.000							0.00147	0.00180	0.00218	0.00257	0.00293	0.00325	0.00353
15.000							0.00218	0.00258	0.00296	0.00336	0.00373	0.00405	0.00432

ENGINEER
DATE: 10-2-78
REVISED:

Figure 4.2.1.3-90
EFFECT OF AILERON



δ_a ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	F 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{\ell_{\delta_a}}$ ~ per Degree												
-30.000							0.00006	0.00009	0.00021	0.00044	0.00072	0.00105	0.00141
-25.000							0.00013	0.00017	0.00030	0.00054	0.00085	0.00120	0.00160
-20.000							0.00022	0.00028	0.00046	0.00072	0.00104	0.00140	0.00180
-15.000							0.00031	0.00044	0.00065	0.00095	0.00129	0.00165	0.00203
-10.000							0.00043	0.00060	0.00085	0.00117	0.00153	0.00189	0.00227
-5.000							0.00058	0.00079	0.00107	0.00142	0.00179	0.00216	0.00254
0.0							0.00075	0.00102	0.00136	0.00174	0.00213	0.00251	0.00287
5.000							0.00099	0.00128	0.00164	0.00203	0.00243	0.00281	0.00317
10.000							0.00147	0.00181	0.00221	0.00261	0.00299	0.00333	0.00363
15.000							0.00218	0.00259	0.00298	0.00340	0.00378	0.00413	0.00442

ENGINEER WMZ
DATE 10-1-78
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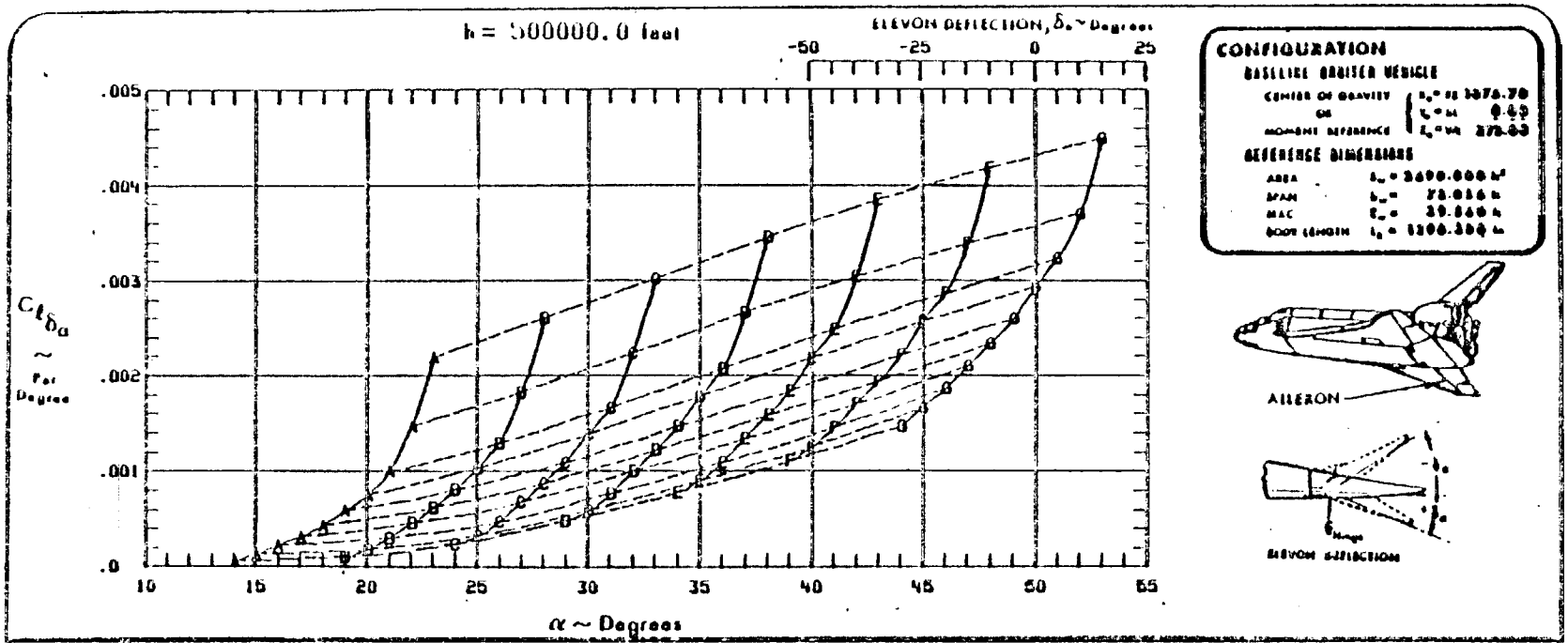
Figure 4.2.1.3-91
EFFECT OF AILERON

4.2.1.3-98

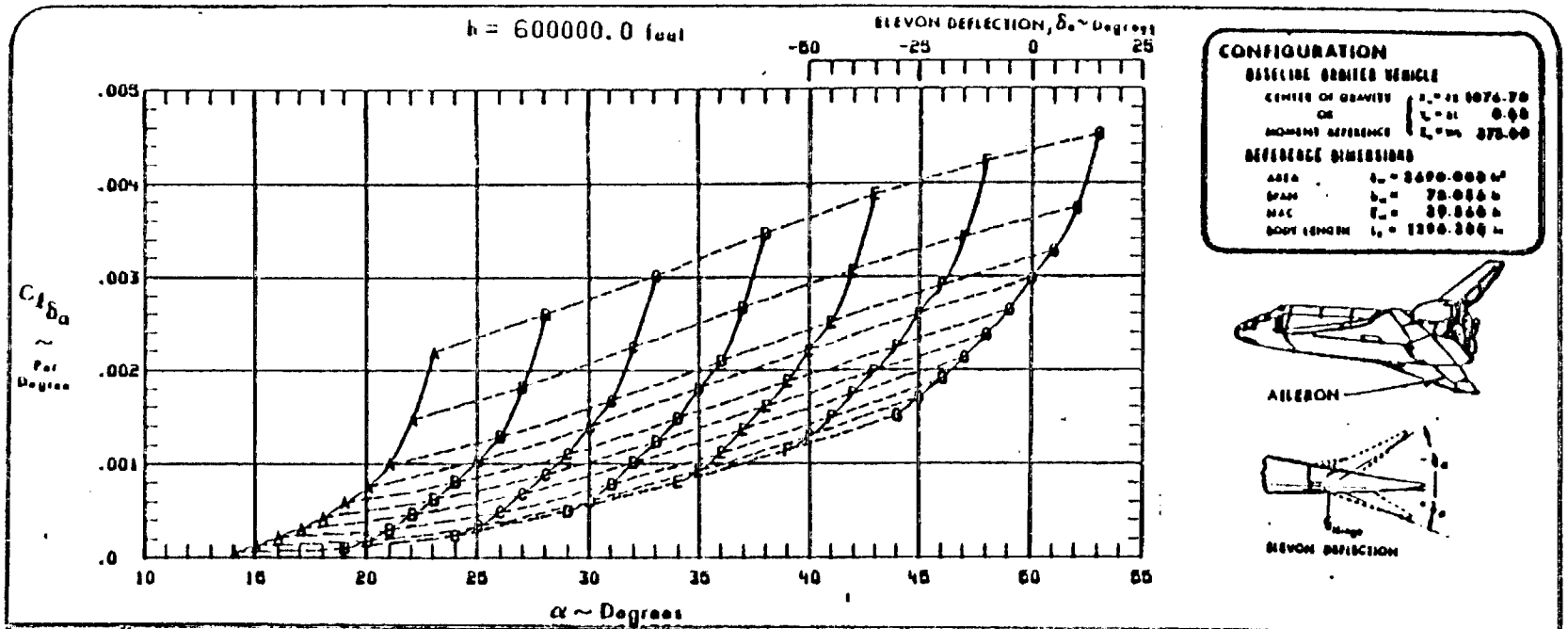
Rockwell International
Space Division



δ_a ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{\ell_{\delta_a}}$ ~ per Degree												
-30.000							0.00006	0.00010	0.00023	0.00048	0.00077	0.00110	0.00147
-25.000							0.00013	0.00018	0.00032	0.00058	0.00090	0.00125	0.00166
-20.000							0.00022	0.00030	0.00047	0.00076	0.00109	0.00145	0.00186
-15.000							0.00031	0.00045	0.00067	0.00089	0.00134	0.00170	0.00209
-10.000							0.00043	0.00061	0.00087	0.00121	0.00158	0.00194	0.00233
-5.000							0.00058	0.00080	0.00109	0.00146	0.00184	0.00221	0.00260
0.0							0.00075	0.00103	0.00138	0.00178	0.00218	0.00256	0.00293
5.000							0.00099	0.00129	0.00166	0.00207	0.00248	0.00286	0.00323
10.000							0.00147	0.00182	0.00223	0.00265	0.00304	0.00339	0.00369
15.000							0.00218	0.00260	0.00300	0.00344	0.00380	0.00410	0.00441

ENGINEER MMS
DATE 10-2-78
REVISED

Figure 4.2.1.3-92
EFFECT OF AILERON

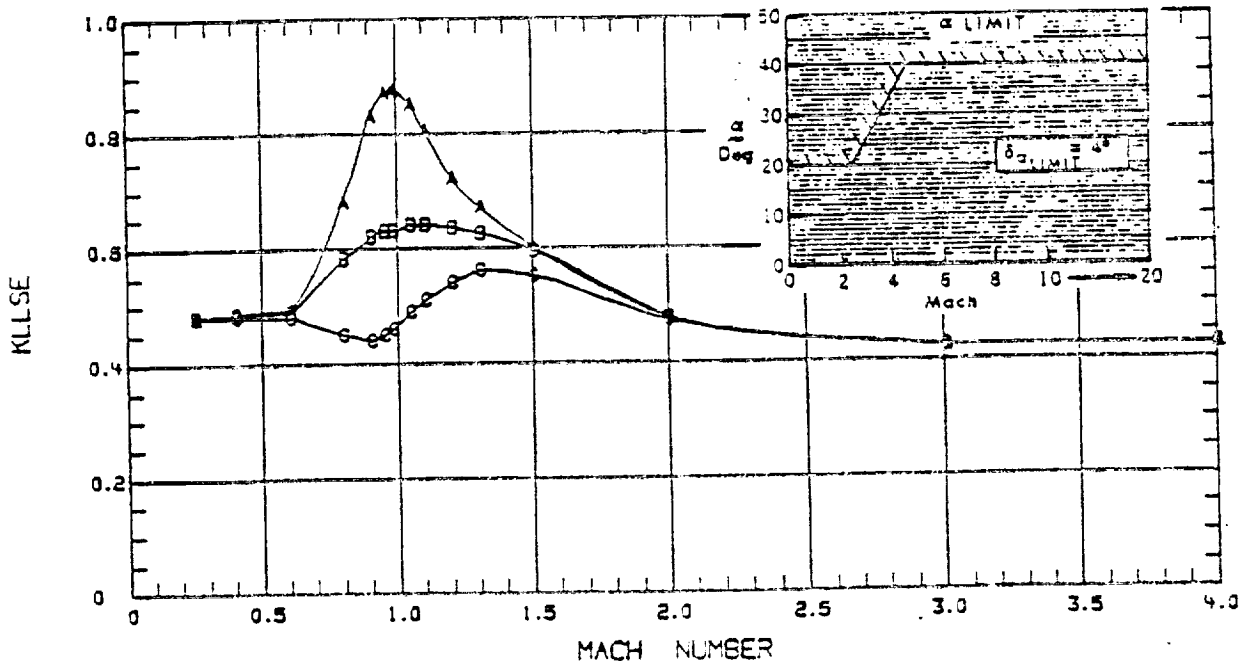


δ_e ~ Degrees	Angle of Attack, α ~ Degrees												
	-10.000	-5.000	0.0	5.000	10.000	15.000	A 20.000	B 25.000	C 30.000	D 35.000	E 40.000	F 45.000	G 50.000
	Aileron Effectiveness, $C_{l_{\delta_a}}$ ~ per Degree												
-30.000							0.00006	0.00010	0.00024	0.00050	0.00080	0.00114	0.00151
-25.000							0.00013	0.00018	0.00033	0.00060	0.00093	0.00129	0.00170
-20.000							0.00022	0.00030	0.00048	0.00078	0.00112	0.00149	0.00190
-15.000							0.00031	0.00045	0.00068	0.00101	0.00137	0.00174	0.00213
-10.000							0.00043	0.00061	0.00088	0.00123	0.00161	0.00198	0.00237
-5.000							0.00058	0.00080	0.00110	0.00148	0.00187	0.00225	0.00264
0.0							0.00075	0.00103	0.00139	0.00180	0.00221	0.00260	0.00297
5.000							0.00099	0.00129	0.00167	0.00209	0.00251	0.00290	0.00327
10.000							0.00147	0.00182	0.00224	0.00267	0.00307	0.00342	0.00373
15.000							0.00218	0.00260	0.00301	0.00346	0.00387	0.00422	0.00452

ENGINEER AMZ
DATE 10-7-76
REVISED

Figure 4.2.1.3-93
EFFECT OF AILERON

Rockwell International
Space Division



CONFIGURATION

BASELINE ORBITER VEHICLE

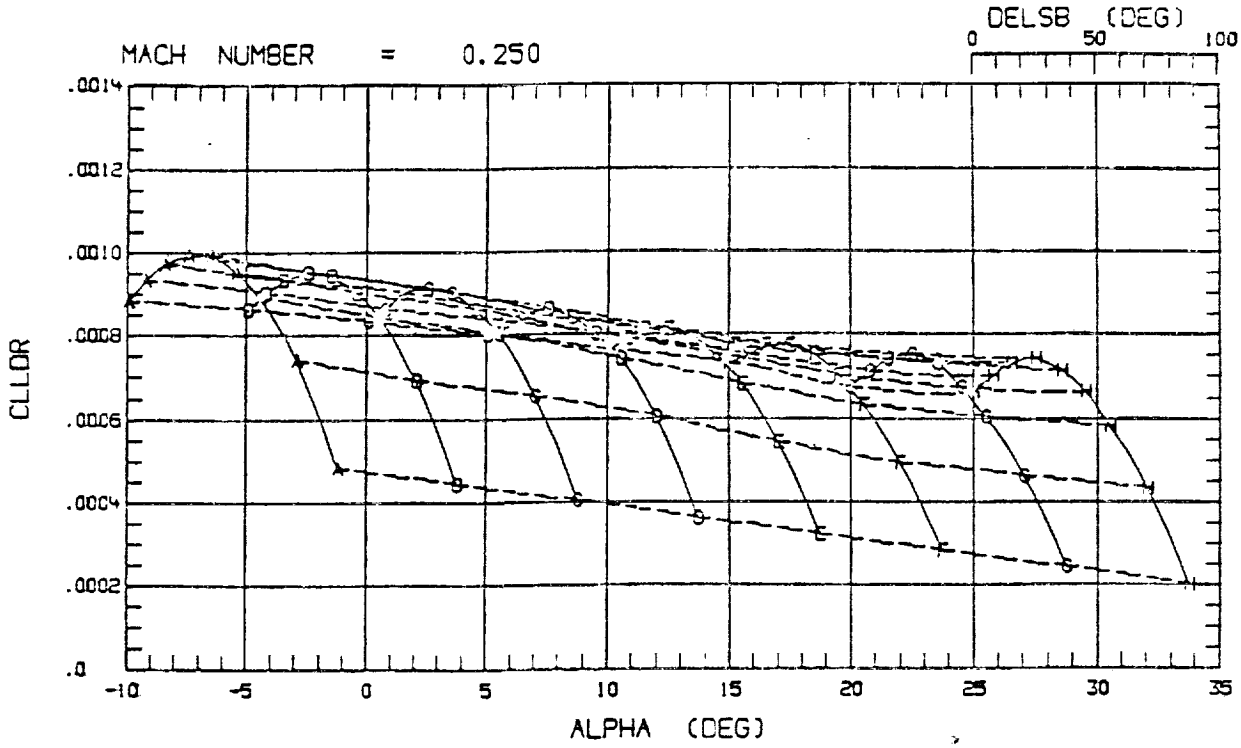
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.360	FT.
		BODY LENGTH	LB = 1290.3	IN.

	DELF (DEG)		
	-5.000	0.0	5.000
	A	B	C
MACH NUMBER	ROLLING MOMENT PARTIAL SPAN FACT		
0.250	0.46000	0.48000	0.48000
0.400	0.46700	0.48500	0.48000
0.600	0.49500	0.49000	0.48000
0.800	0.58000	0.58000	0.45000
0.900	0.83000	0.62000	0.44000
0.950	0.97000	0.63000	0.45000
0.980	0.87500	0.63000	0.46000
1.050	0.85000	0.64000	0.49000
1.100	0.80500	0.64000	0.51000
1.200	0.72000	0.63500	0.54000
1.300	0.67000	0.62500	0.56000
1.500	0.60000	0.59500	0.55000
2.000	0.47700	0.47700	0.47200
3.000	0.42500	0.42500	0.42500
4.000	0.42500	0.42500	0.42500
5.000	0.42500	0.42500	0.42500
8.000	0.42500	0.42500	0.42500
10.000	0.42500	0.42500	0.42500
15.000	0.42500	0.42500	0.42500
20.000	0.42500	0.42500	0.42500

NOTE: In the event partial span factors are required which exceed the given limits, the Aero Data Unit at Rockwell International should be contacted before extrapolation of the given data.

ENGINEER CCO WM 2
DATE 9/13/79 REV 1-24-79

FIGURE 4.2.1.3-94
ELEVON PARTIAL SPAN FACTOR

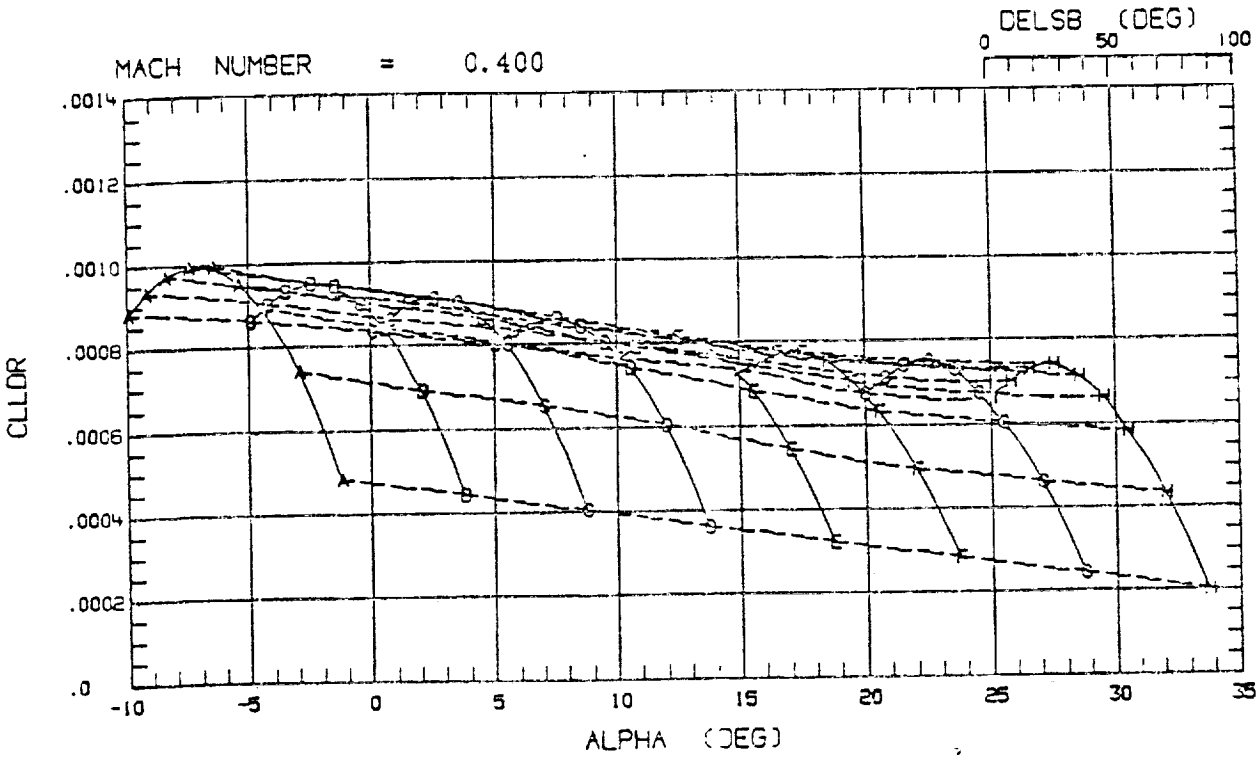


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00088	0.00086	0.00083	0.00080	0.00076	0.00073	0.00067	0.00066
7.500	0.00093	0.00090	0.00086	0.00083	0.00079	0.00075	0.00071	0.00070
15.000	0.00097	0.00093	0.00090	0.00085	0.00081	0.00077	0.00074	0.00073
25.000	0.00099	0.00095	0.00091	0.00086	0.00081	0.00077	0.00075	0.00074
35.000	0.00099	0.00094	0.00090	0.00084	0.00079	0.00075	0.00073	0.00071
45.000	0.00095	0.00090	0.00086	0.00080	0.00075	0.00070	0.00067	0.00066
55.000	0.00089	0.00084	0.00080	0.00074	0.00068	0.00063	0.00060	0.00058
70.000	0.00074	0.00069	0.00065	0.00060	0.00054	0.00049	0.00046	0.00043
87.200	0.00048	0.00044	0.00040	0.00036	0.00032	0.00028	0.00024	0.00020

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-95
EFFECT OF RUDDER



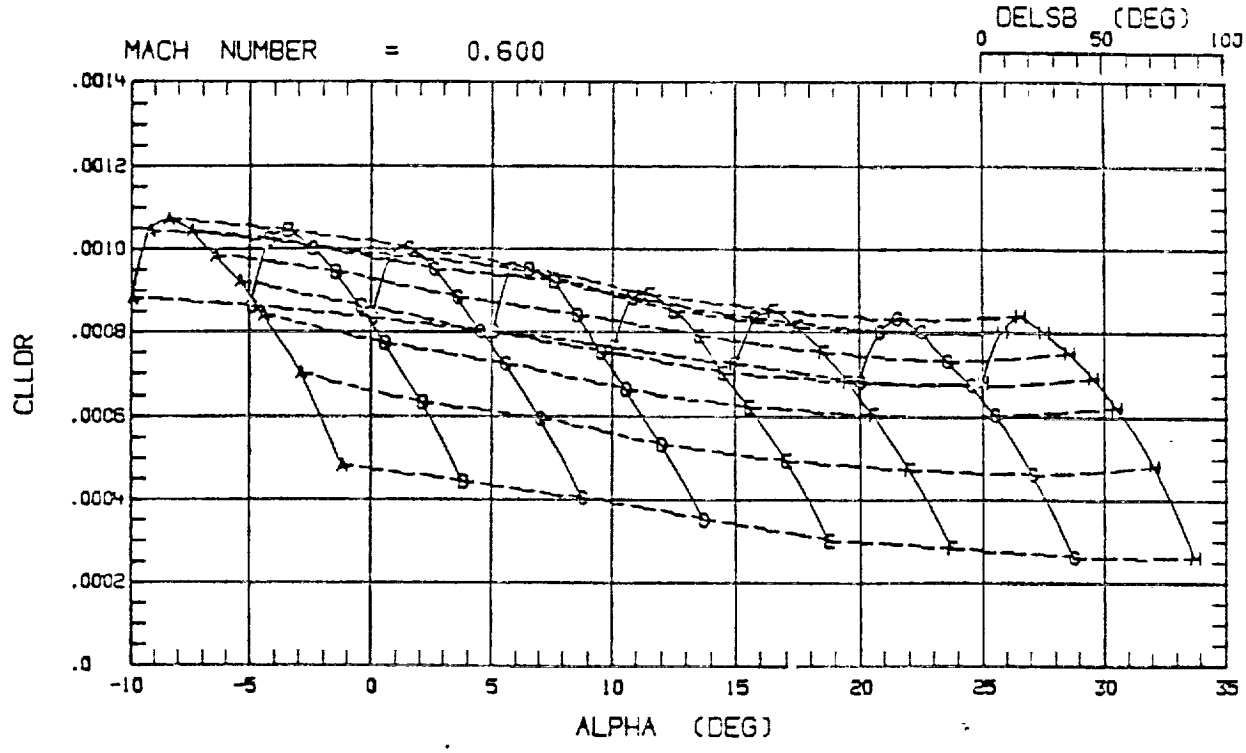
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00088	0.00086	0.00083	0.00080	0.00076	0.00073	0.00067	0.00066
7.500	0.00093	0.00090	0.00086	0.00083	0.00079	0.00075	0.00071	0.00070
15.000	0.00097	0.00093	0.00090	0.00085	0.00081	0.00077	0.00074	0.00073
25.000	0.00099	0.00095	0.00091	0.00086	0.00081	0.00077	0.00075	0.00074
35.000	0.00099	0.00094	0.00090	0.00084	0.00079	0.00075	0.00073	0.00071
45.000	0.00095	0.00090	0.00086	0.00080	0.00075	0.00070	0.00067	0.00066
55.000	0.00089	0.00084	0.00080	0.00074	0.00068	0.00063	0.00060	0.00058
70.000	0.00074	0.00069	0.00065	0.00060	0.00054	0.00049	0.00046	0.00043
87.200	0.00048	0.00044	0.00040	0.00036	0.00032	0.00029	0.00024	0.00020

ENGINEER [illegible]
DATE 12-3-78

FIGURE 4.2.1.3-96
EFFECT OF RUDDER



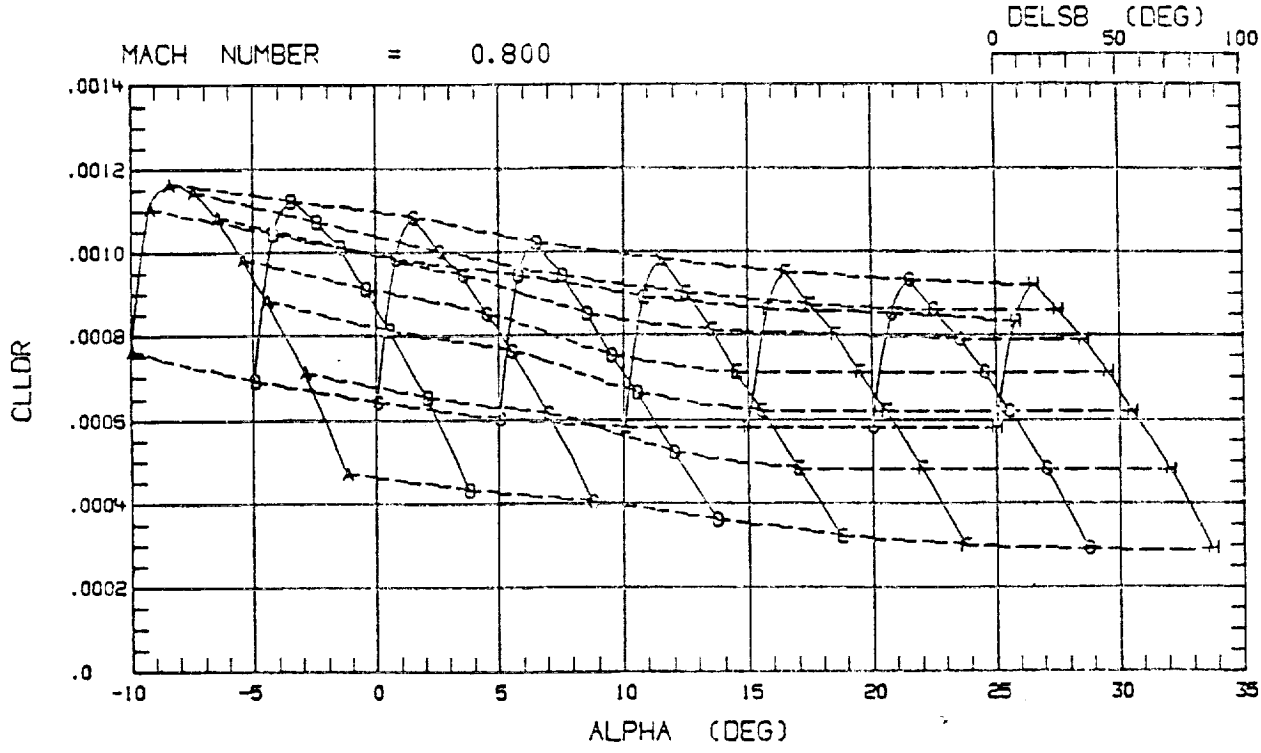
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	SW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00088	0.00086	0.00083	0.00080	0.00076	0.00072	0.00068	0.00068
7.500	0.00104	0.00102	0.00098	0.00095	0.00088	0.00083	0.00080	0.00080
15.000	0.00107	0.00104	0.00100	0.00095	0.00089	0.00085	0.00083	0.00084
25.000	0.00104	0.00100	0.00095	0.00092	0.00085	0.00081	0.00080	0.00080
35.000	0.00098	0.00094	0.00088	0.00084	0.00079	0.00075	0.00073	0.00075
45.000	0.00092	0.00086	0.00080	0.00075	0.00070	0.00068	0.00067	0.00069
55.000	0.00084	0.00077	0.00072	0.00066	0.00062	0.00060	0.00060	0.00062
70.000	0.00070	0.00063	0.00059	0.00053	0.00049	0.00047	0.00046	0.00048
87.200	0.00048	0.00044	0.00040	0.00035	0.00030	0.00029	0.00026	0.00026

ENGINEER _____
DATE 12-7-78

FIGURE 4.2.1.3-97
EFFECT OF RUDDER



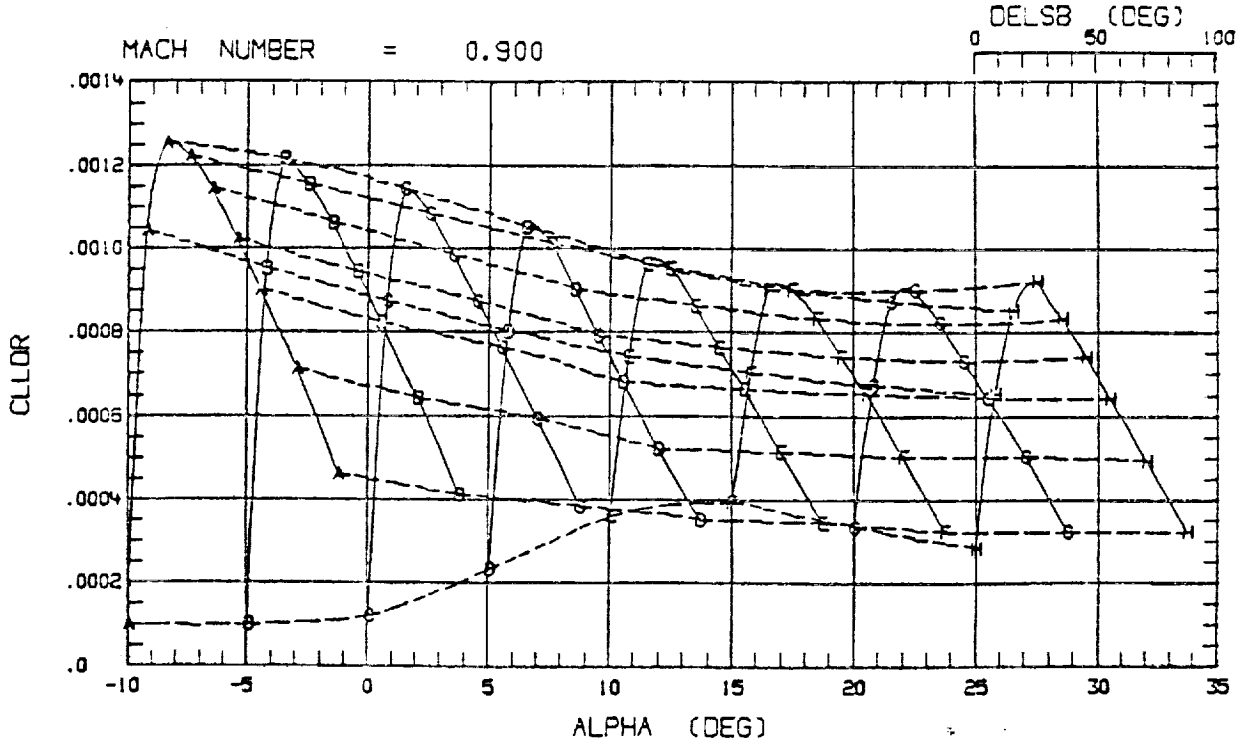
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00076	0.00069	0.00064	0.00060	0.00058	0.00058	0.00058	0.00058
7.500	0.00110	0.00104	0.00098	0.00094	0.00089	0.00086	0.00085	0.00083
15.000	0.00116	0.00112	0.00108	0.00102	0.00098	0.00095	0.00093	0.00092
25.000	0.00114	0.00107	0.00100	0.00094	0.00090	0.00087	0.00086	0.00086
35.000	0.00108	0.00101	0.00094	0.00085	0.00081	0.00080	0.00079	0.00079
45.000	0.00098	0.00091	0.00085	0.00075	0.00071	0.00071	0.00071	0.00071
55.000	0.00088	0.00081	0.00076	0.00066	0.00062	0.00062	0.00062	0.00062
70.000	0.00071	0.00065	0.00061	0.00052	0.00048	0.00048	0.00048	0.00048
87.200	0.00047	0.00043	0.00040	0.00036	0.00032	0.00030	0.00029	0.00029

ENGINEER [illegible]
DATE 10-3-78

FIGURE 4.2.1.3-98
EFFECT OF RUDDER



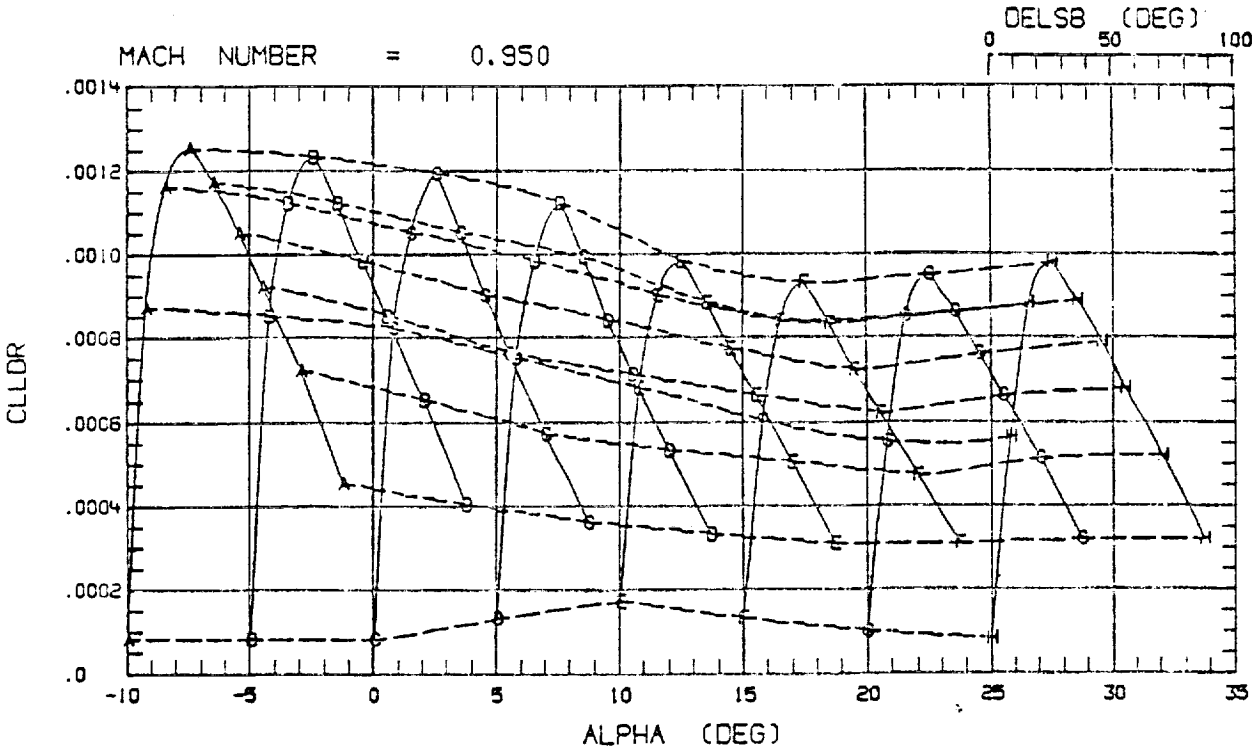
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00010	0.00010	0.00012	0.00023	0.00036	0.00039	0.00033	0.00029
7.500	0.00104	0.00095	0.00087	0.00080	0.00074	0.00070	0.00067	0.00065
15.000	0.00125	0.00121	0.00114	0.00105	0.00096	0.00090	0.00087	0.00085
25.000	0.00122	0.00115	0.00108	0.00101	0.00095	0.00090	0.00090	0.00092
35.000	0.00114	0.00106	0.00098	0.00090	0.00086	0.00083	0.00082	0.00083
45.000	0.00102	0.00094	0.00087	0.00079	0.00076	0.00074	0.00073	0.00074
55.000	0.00090	0.00082	0.00075	0.00068	0.00066	0.00065	0.00064	0.00064
70.000	0.00071	0.00064	0.00059	0.00052	0.00051	0.00050	0.00050	0.00049
87.200	0.00046	0.00041	0.00038	0.00035	0.00034	0.00032	0.00032	0.00032

ENGINEER
DATE

FIGURE 4.2.1.3- 99
EFFECT OF RUDDER



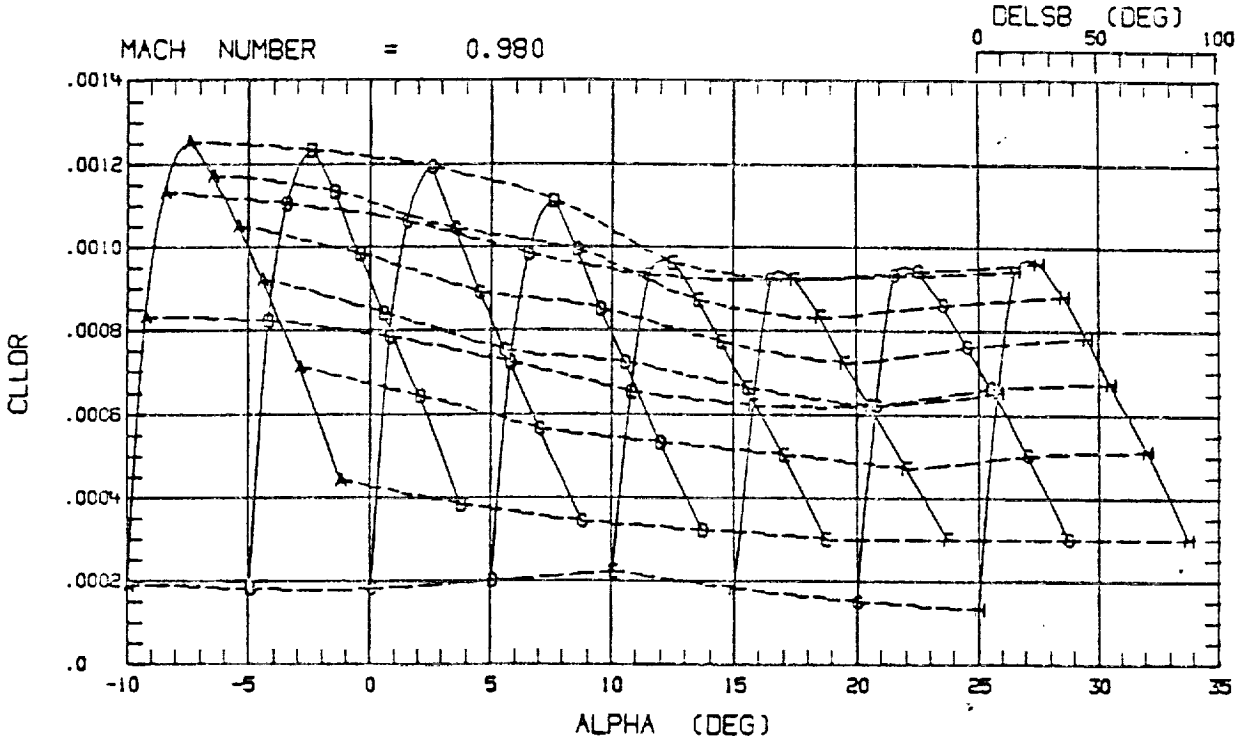
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00008	0.00008	0.00008	0.00013	0.00017	0.00013	0.00010	0.00008
7.500	0.00087	0.00085	0.00082	0.00075	0.00068	0.00060	0.00055	0.00056
15.000	0.00116	0.00112	0.00105	0.00098	0.00090	0.00084	0.00085	0.00088
25.000	0.00125	0.00123	0.00119	0.00112	0.00098	0.00093	0.00095	0.00098
35.000	0.00117	0.00112	0.00105	0.00099	0.00088	0.00083	0.00086	0.00089
45.000	0.00105	0.00098	0.00090	0.00084	0.00077	0.00072	0.00076	0.00079
55.000	0.00092	0.00085	0.00076	0.00071	0.00066	0.00062	0.00066	0.00069
70.000	0.00072	0.00065	0.00057	0.00053	0.00050	0.00047	0.00051	0.00052
87.200	0.00046	0.00040	0.00036	0.00033	0.00031	0.00031	0.00032	0.00032

ENGINEER _____
DATE 8-3-78

FIGURE 4.2.1.3-100
EFFECT OF RUDDER



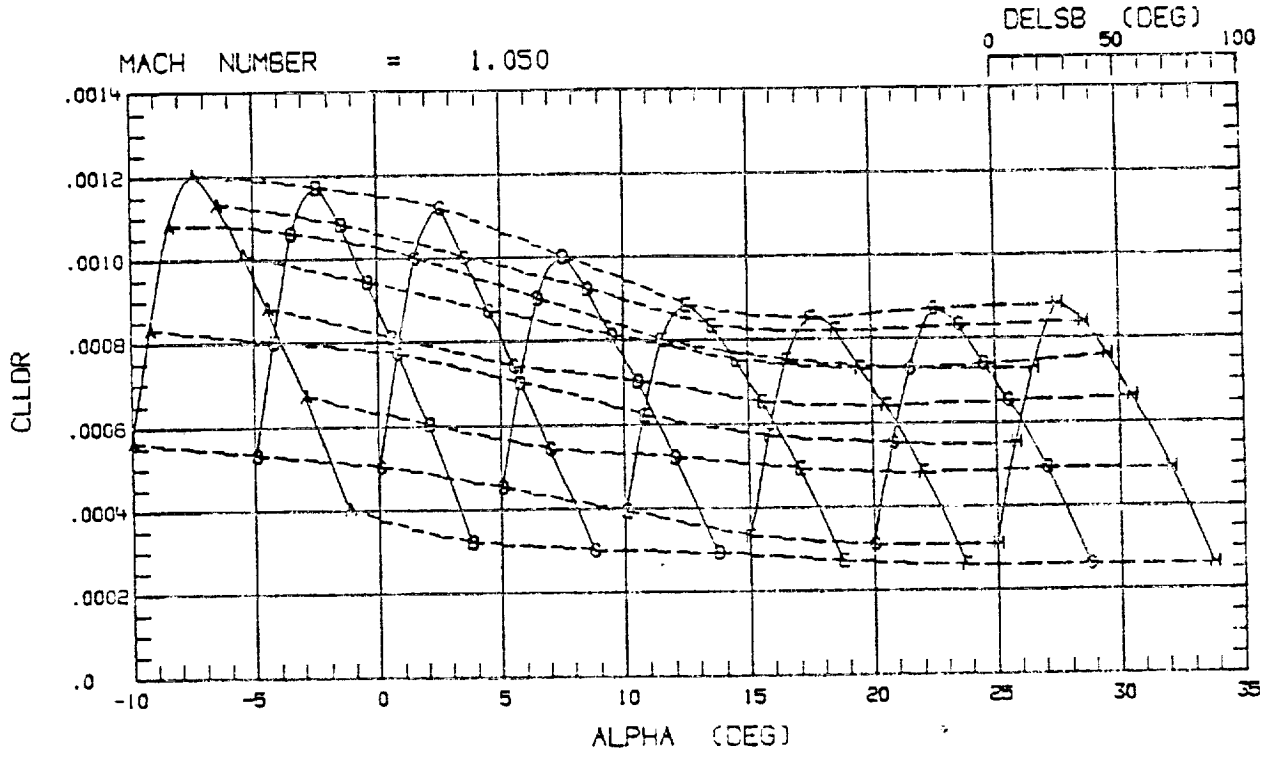
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00019	0.00018	0.00018	0.00020	0.00022	0.00018	0.00015	0.00013
7.500	0.00083	0.00082	0.00078	0.00072	0.00065	0.00062	0.00062	0.00065
15.000	0.00113	0.00110	0.00106	0.00098	0.00093	0.00092	0.00093	0.00094
25.000	0.00125	0.00123	0.00119	0.00111	0.00096	0.00092	0.00094	0.00096
35.000	0.00117	0.00113	0.00104	0.00099	0.00087	0.00083	0.00086	0.00088
45.000	0.00105	0.00098	0.00089	0.00085	0.00077	0.00072	0.00076	0.00078
55.000	0.00092	0.00084	0.00075	0.00072	0.00066	0.00062	0.00066	0.00067
70.000	0.00071	0.00064	0.00056	0.00053	0.00050	0.00047	0.00050	0.00051
87.200	0.00044	0.00038	0.00034	0.00032	0.00030	0.00030	0.00030	0.00030

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-101
EFFECT OF RUDDER



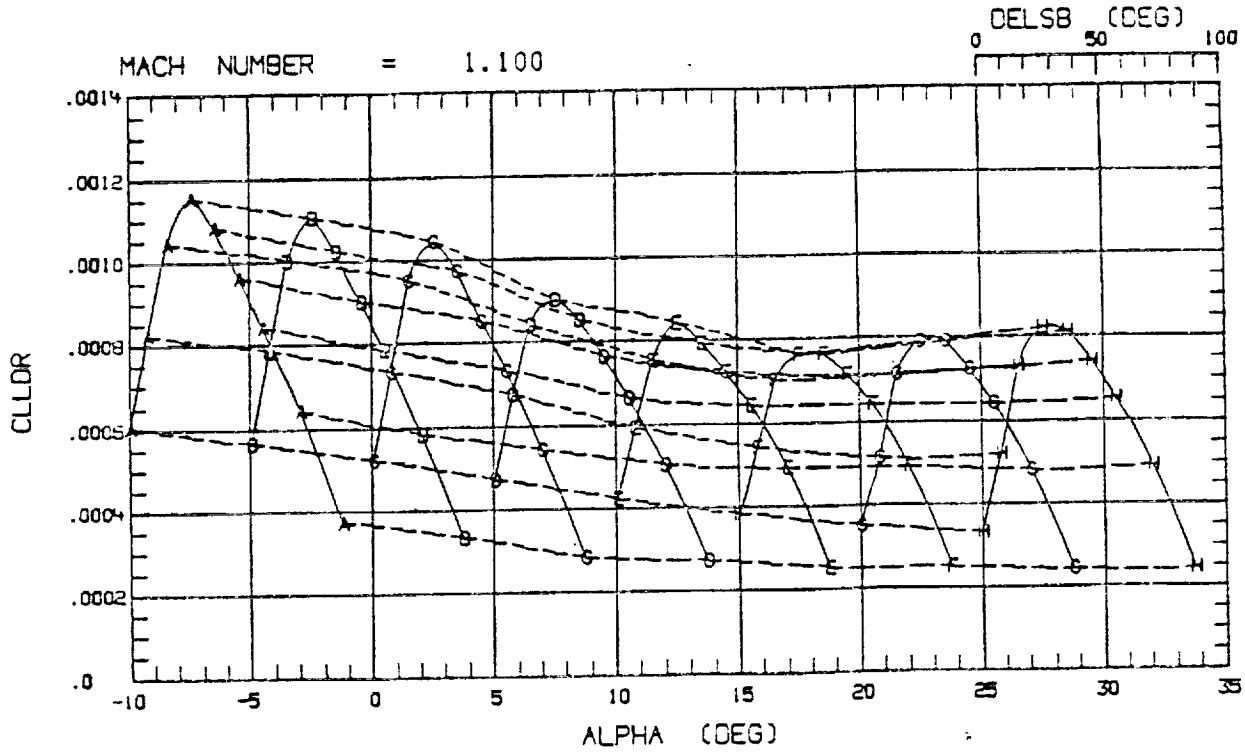
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XC = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00056	0.00053	0.00050	0.00045	0.00039	0.00033	0.00031	0.00031
7.500	0.00083	0.00080	0.00077	0.00070	0.00062	0.00057	0.00055	0.00055
15.000	0.00108	0.00106	0.00100	0.00090	0.00080	0.00075	0.00073	0.00073
25.000	0.00120	0.00117	0.00112	0.00100	0.00088	0.00085	0.00087	0.00088
35.000	0.00113	0.00108	0.00100	0.00092	0.00083	0.00082	0.00093	0.00084
45.000	0.00101	0.00094	0.00087	0.00081	0.00075	0.00073	0.00074	0.00076
55.000	0.00088	0.00081	0.00074	0.00070	0.00065	0.00064	0.00065	0.00066
70.000	0.00067	0.00060	0.00054	0.00052	0.00049	0.00048	0.00049	0.00049
87.200	0.00040	0.00032	0.00030	0.00029	0.00027	0.00026	0.00026	0.00026

ENGINEER
DATE 10-22-79

FIGURE 4.2.1.3-102
EFFECT OF RUDDER



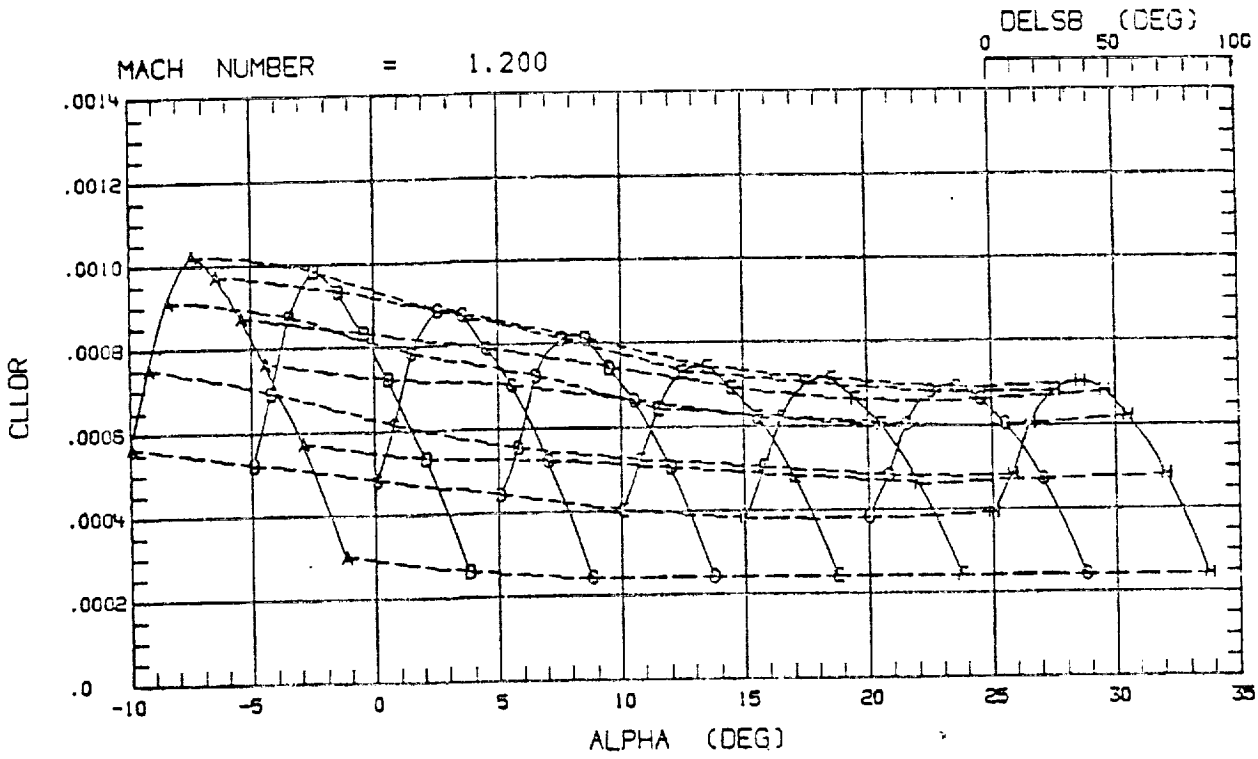
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00060	0.00056	0.00052	0.00047	0.00042	0.00038	0.00035	0.00033
7.500	0.00082	0.00078	0.00073	0.00067	0.00059	0.00054	0.00051	0.00052
15.000	0.00104	0.00100	0.00095	0.00084	0.00075	0.00070	0.00071	0.00073
25.000	0.00115	0.00110	0.00104	0.00090	0.00084	0.00076	0.00079	0.00082
35.000	0.00108	0.00102	0.00097	0.00085	0.00079	0.00076	0.00079	0.00081
45.000	0.00096	0.00090	0.00085	0.00076	0.00072	0.00071	0.00072	0.00074
55.000	0.00084	0.00078	0.00073	0.00066	0.00064	0.00064	0.00064	0.00065
70.000	0.00064	0.00058	0.00054	0.00050	0.00049	0.00049	0.00048	0.00049
87.200	0.00037	0.00033	0.00028	0.00027	0.00025	0.00025	0.00024	0.00024

ENGINEER
DATE

FIGURE 4.2.1.3-103
EFFECT OF RUDDER



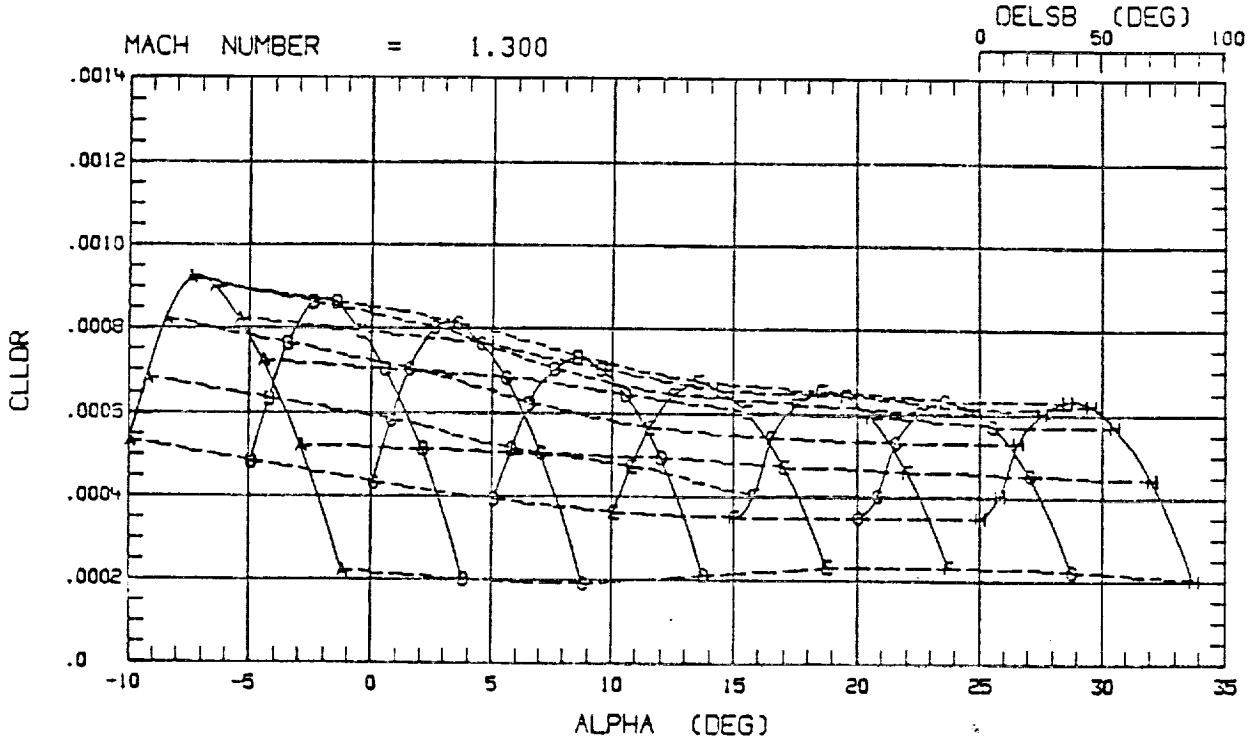
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00056	0.00052	0.00048	0.00044	0.00040	0.00038	0.00038	0.00039
7.500	0.00075	0.00069	0.00061	0.00055	0.00052	0.00050	0.00048	0.00048
15.000	0.00091	0.00087	0.00078	0.00072	0.00064	0.00062	0.00060	0.00060
25.000	0.00102	0.00098	0.00088	0.00081	0.00073	0.00070	0.00068	0.00068
35.000	0.00097	0.00093	0.00087	0.00081	0.00074	0.00071	0.00069	0.00070
45.000	0.00087	0.00083	0.00079	0.00074	0.00069	0.00066	0.00066	0.00068
55.000	0.00076	0.00072	0.00070	0.00066	0.00062	0.00060	0.00060	0.00062
70.000	0.00057	0.00053	0.00052	0.00050	0.00048	0.00046	0.00047	0.00048
87.200	0.00030	0.00026	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-104
EFFECT OF RUDDER



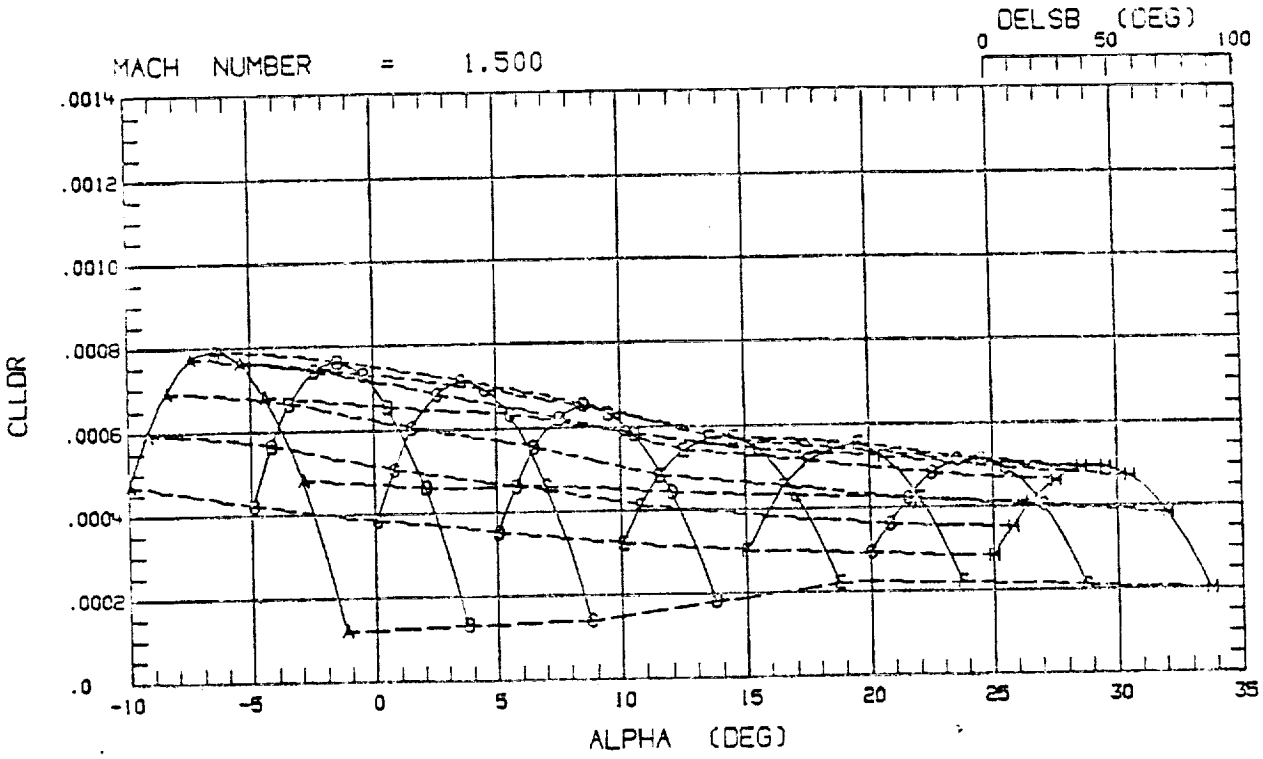
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00053	0.00048	0.00043	0.00039	0.00036	0.00035	0.00035	0.00035
7.500	0.00068	0.00063	0.00058	0.00051	0.00047	0.00040	0.00040	0.00040
15.000	0.00082	0.00076	0.00070	0.00062	0.00056	0.00054	0.00053	0.00053
25.000	0.00092	0.00086	0.00080	0.00070	0.00064	0.00062	0.00060	0.00060
35.000	0.00090	0.00086	0.00081	0.00073	0.00067	0.00065	0.00063	0.00063
45.000	0.00082	0.00079	0.00076	0.00070	0.00065	0.00064	0.00061	0.00062
55.000	0.00072	0.00070	0.00068	0.00064	0.00060	0.00059	0.00057	0.00057
70.000	0.00052	0.00051	0.00050	0.00049	0.00047	0.00046	0.00045	0.00044
87.200	0.00022	0.00020	0.00019	0.00021	0.00023	0.00023	0.00022	0.00020

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-105
EFFECT OF RUDDER



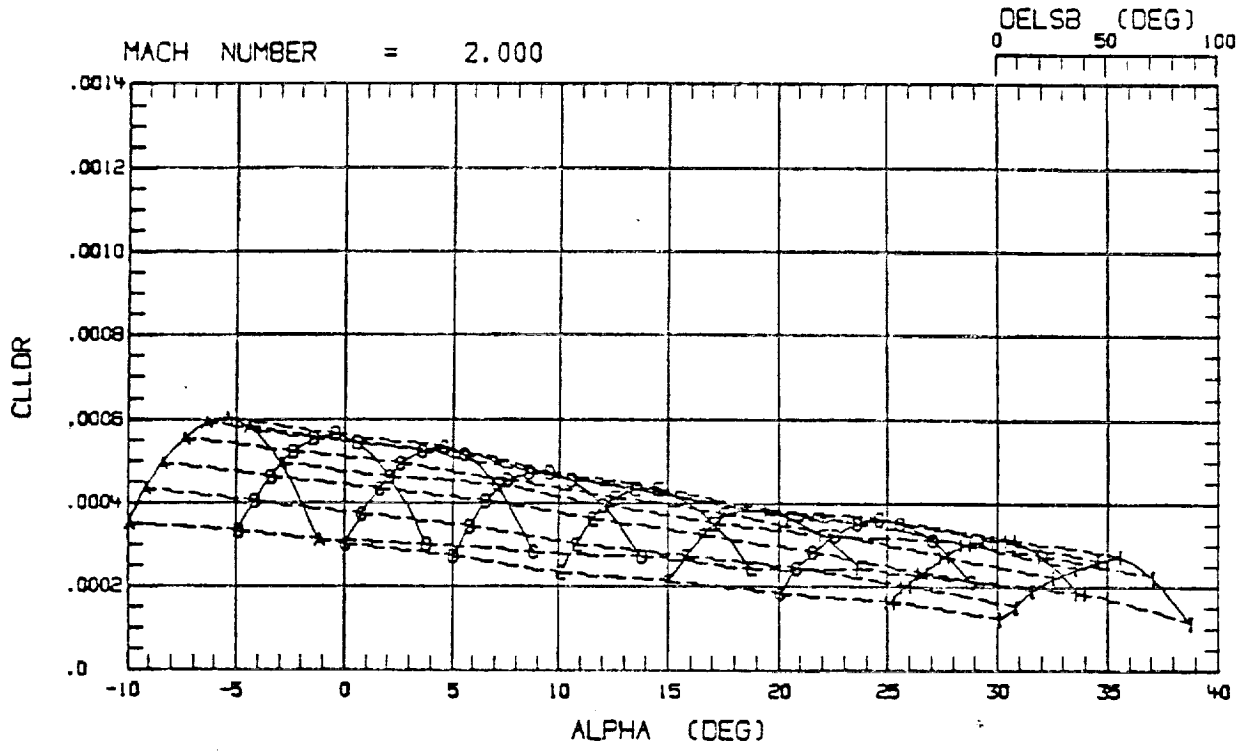
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00047	0.00042	0.00038	0.00035	0.00032	0.00030	0.00029	0.00028
7.500	0.00059	0.00055	0.00050	0.00046	0.00041	0.00038	0.00036	0.00035
15.000	0.00069	0.00066	0.00060	0.00055	0.00048	0.00045	0.00042	0.00041
25.000	0.00077	0.00074	0.00068	0.00062	0.00054	0.00051	0.00048	0.00046
35.000	0.00079	0.00076	0.00071	0.00065	0.00057	0.00054	0.00051	0.00049
45.000	0.00076	0.00073	0.00069	0.00063	0.00057	0.00055	0.00051	0.00049
55.000	0.00068	0.00065	0.00063	0.00058	0.00054	0.00052	0.00049	0.00047
70.000	0.00048	0.00046	0.00046	0.00044	0.00043	0.00042	0.00040	0.00038
97.200	0.00012	0.00013	0.00014	0.00018	0.00022	0.00022	0.00021	0.00020

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-106
EFFECT OF RUDDER



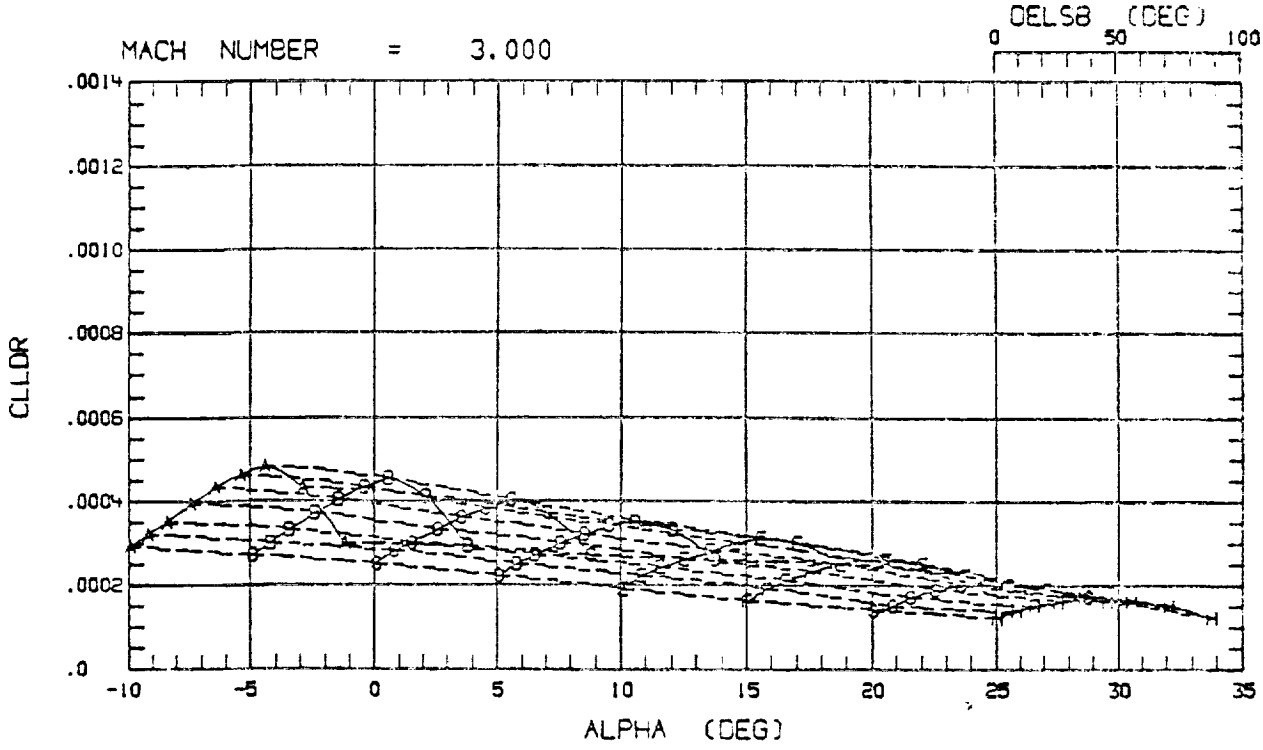
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE								
0.0	0.00035	0.00033	0.00030	0.00027	0.00023	0.00021	0.00018	0.00016	0.00012
7.500	0.00043	0.00040	0.00037	0.00034	0.00030	0.00027	0.00024	0.00020	0.00015
15.000	0.00049	0.00046	0.00043	0.00040	0.00036	0.00032	0.00029	0.00023	0.00019
25.000	0.00055	0.00052	0.00049	0.00045	0.00041	0.00037	0.00032	0.00027	0.00022
35.000	0.00059	0.00055	0.00052	0.00047	0.00043	0.00038	0.00035	0.00030	0.00024
45.000	0.00060	0.00056	0.00053	0.00047	0.00043	0.00038	0.00036	0.00031	0.00026
55.000	0.00058	0.00054	0.00051	0.00045	0.00041	0.00036	0.00035	0.00031	0.00027
70.000	0.00049	0.00046	0.00044	0.00039	0.00035	0.00032	0.00031	0.00027	0.00022
87.200	0.00031	0.00030	0.00029	0.00027	0.00024	0.00024	0.00021	0.00018	0.00011

ENGINEER
DATE 9-7-84

FIGURE 4.2.1.3-107
EFFECT OF RUDDER



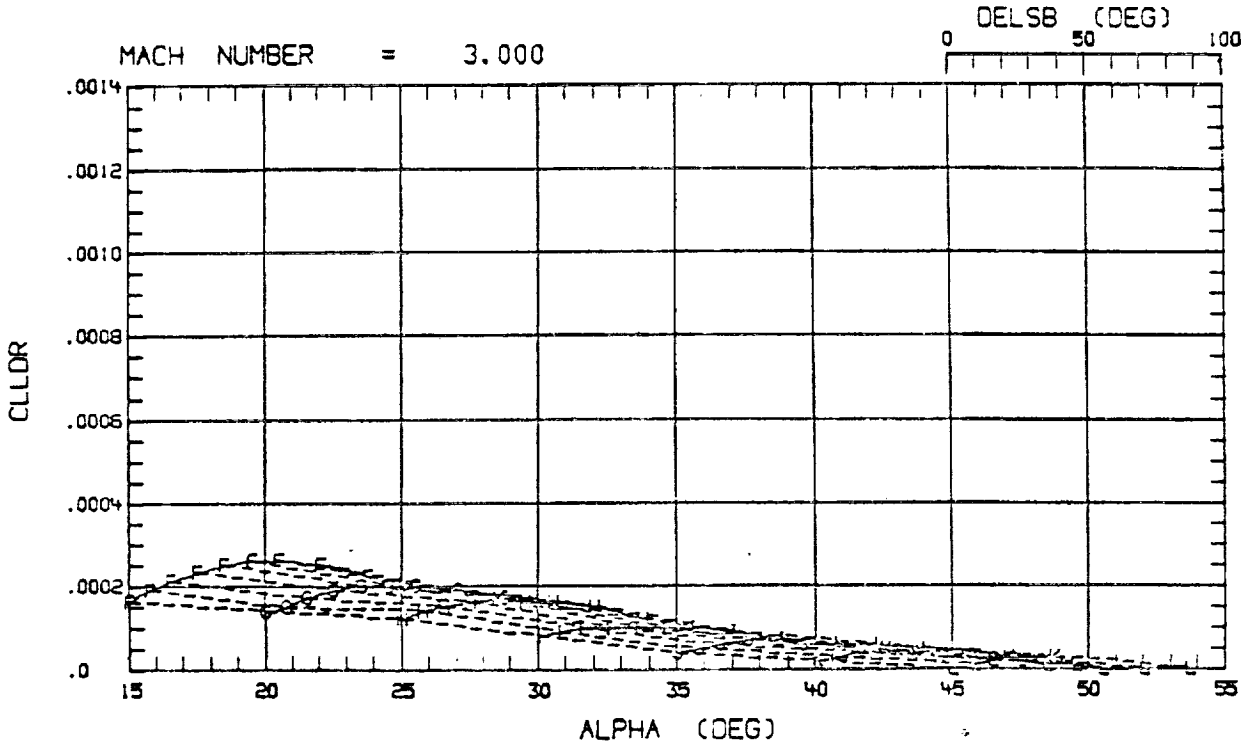
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00029	0.00027	0.00025	0.00022	0.00019	0.00016	0.00014	0.00012
7.500	0.00032	0.00030	0.00028	0.00025	0.00022	0.00019	0.00015	0.00014
15.000	0.00035	0.00033	0.00030	0.00027	0.00024	0.00021	0.00017	0.00015
25.000	0.00039	0.00037	0.00033	0.00030	0.00026	0.00023	0.00019	0.00016
35.000	0.00043	0.00040	0.00036	0.00032	0.00029	0.00025	0.00020	0.00017
45.000	0.00046	0.00043	0.00038	0.00034	0.00030	0.00026	0.00020	0.00016
55.000	0.00048	0.00045	0.00040	0.00035	0.00031	0.00026	0.00020	0.00016
70.000	0.00043	0.00041	0.00037	0.00033	0.00030	0.00025	0.00019	0.00015
87.200	0.00030	0.00029	0.00027	0.00026	0.00025	0.00022	0.00017	0.00012

ENGINEER
DATE 10-12

FIGURE 4.2.1.3-108
EFFECT OF RUDDER



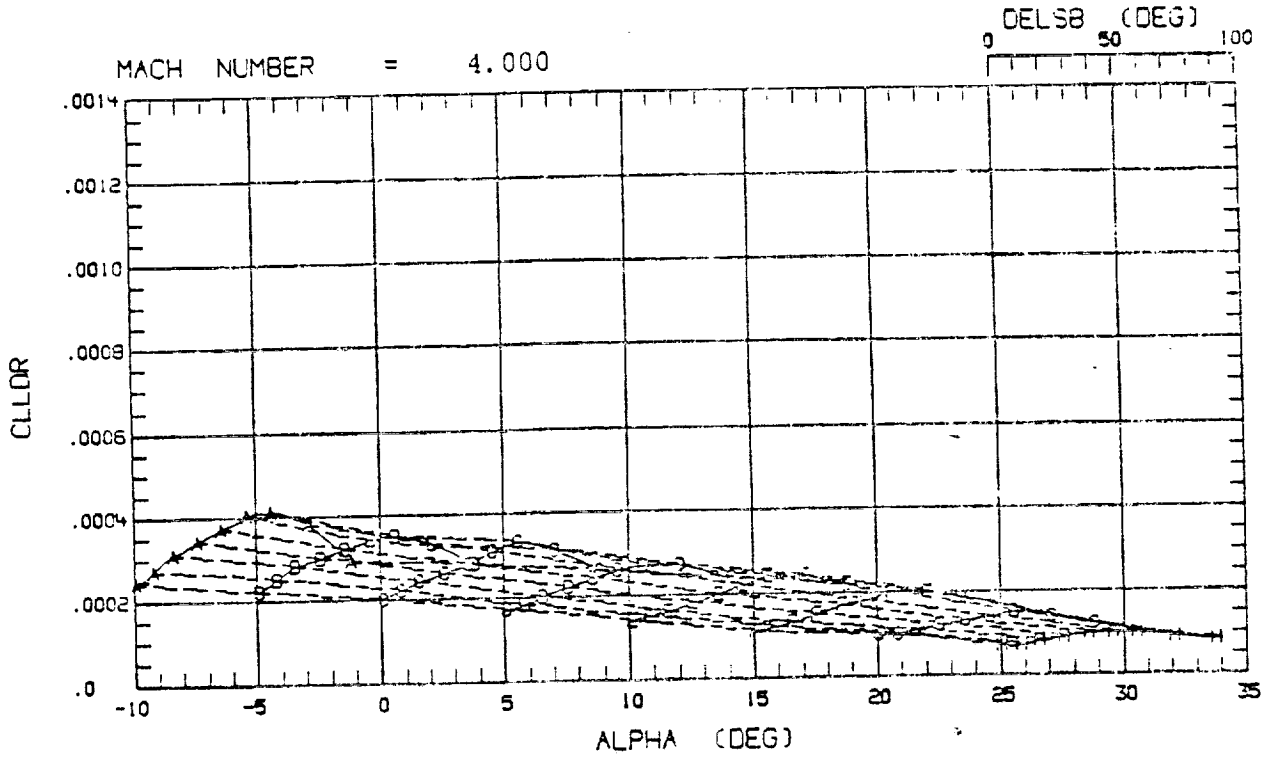
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE						
0.0	0.00016	0.00014	0.00012	0.00008	0.00004	0.00002	0.0
7.500	0.00019	0.00015	0.00014	0.00009	0.00005	0.00003	0.00001
15.000	0.00021	0.00017	0.00015	0.00010	0.00006	0.00004	0.00002
25.000	0.00023	0.00019	0.00016	0.00010	0.00007	0.00005	0.00002
35.000	0.00025	0.00020	0.00017	0.00010	0.00007	0.00004	0.00001
45.000	0.00025	0.00020	0.00016	0.00010	0.00006	0.00003	0.00001
55.000	0.00025	0.00020	0.00016	0.00010	0.00006	0.00003	0.0
70.000	0.00025	0.00019	0.00015	0.00009	0.00006	0.00003	0.0
87.200	0.00022	0.00017	0.00012	0.00007	0.00005	0.00003	0.0

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-109
EFFECT OF RUDDER



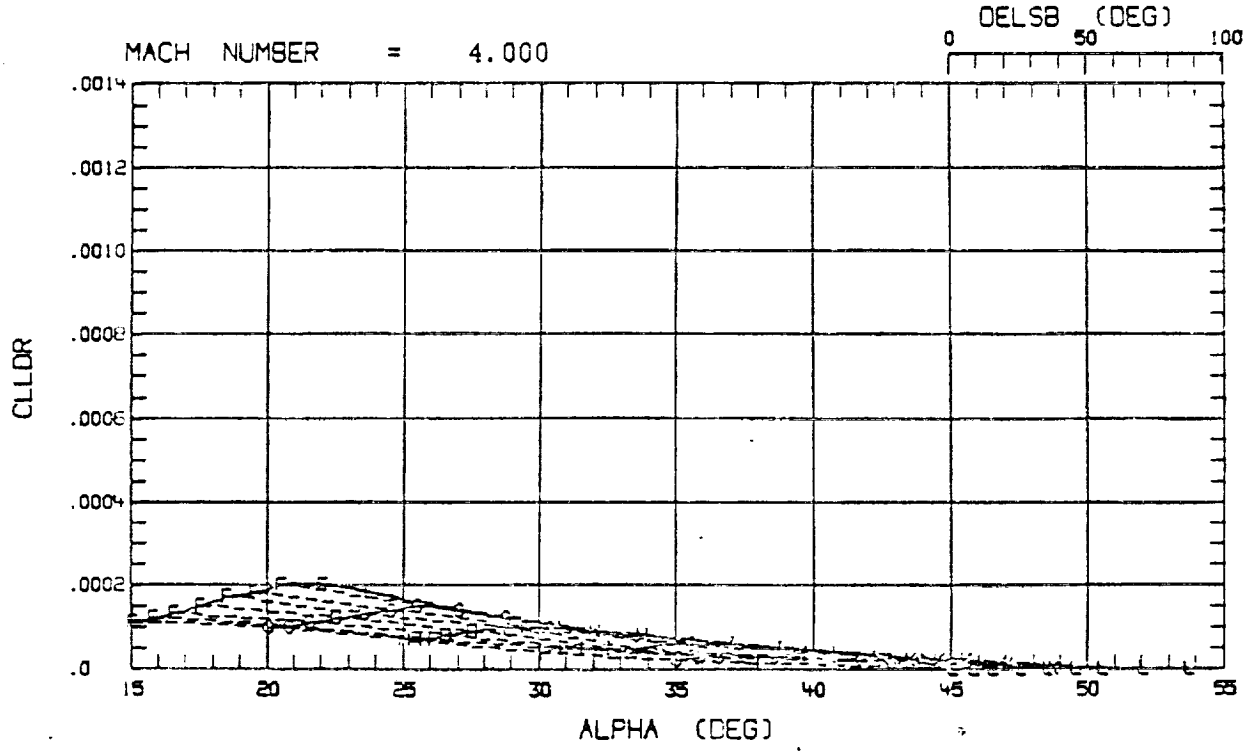
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00024	0.00022	0.00020	0.00017	0.00014	0.00011	0.00010	0.00007
7.500	0.00027	0.00025	0.00022	0.00018	0.00015	0.00012	0.00010	0.00007
15.000	0.00031	0.00029	0.00024	0.00020	0.00016	0.00013	0.00011	0.00008
25.000	0.00034	0.00030	0.00026	0.00022	0.00018	0.00015	0.00012	0.00009
35.000	0.00037	0.00032	0.00028	0.00024	0.00020	0.00017	0.00013	0.00010
45.000	0.00040	0.00034	0.00031	0.00026	0.00022	0.00018	0.00014	0.00010
55.000	0.00041	0.00035	0.00033	0.00027	0.00024	0.00020	0.00015	0.00010
70.000	0.00038	0.00033	0.00031	0.00027	0.00024	0.00020	0.00014	0.00009
87.200	0.00029	0.00028	0.00026	0.00024	0.00022	0.00018	0.00013	0.00008

ENGINEER
DATE 4-3-79

FIGURE 4.2.1.3-110
EFFECT OF RUDDER



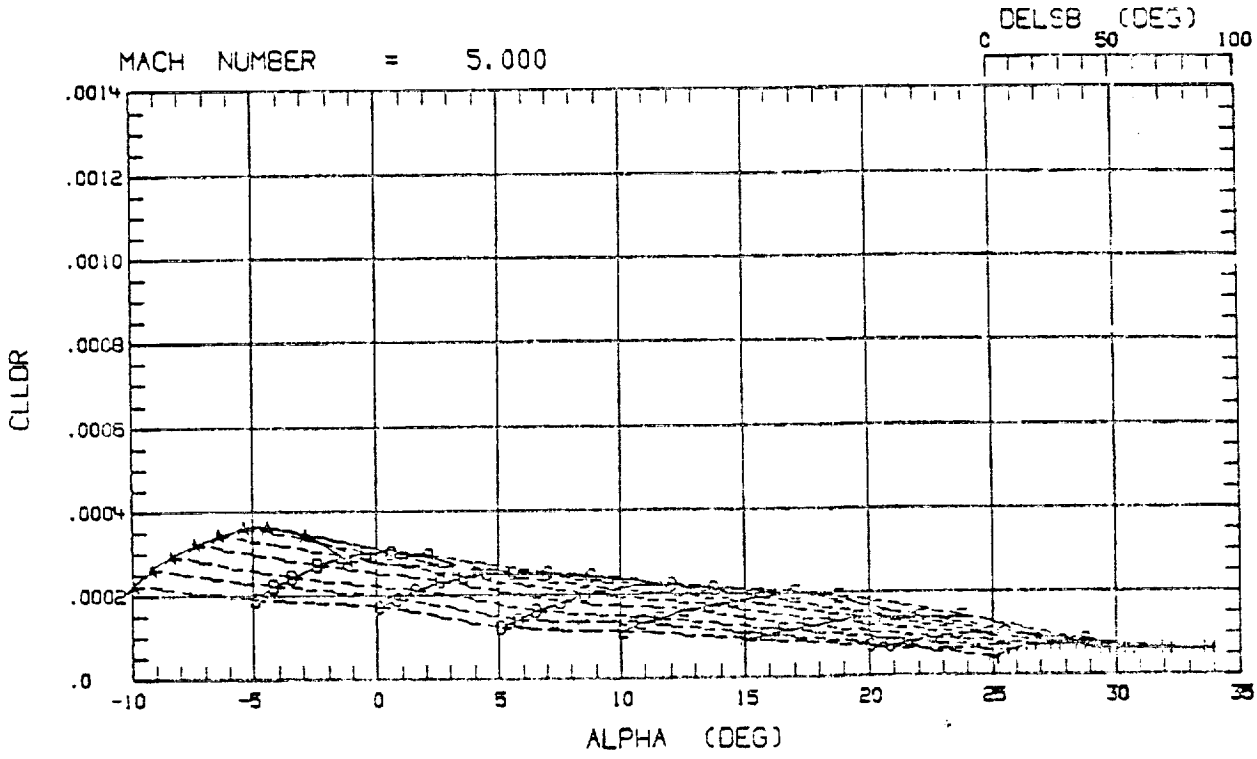
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0	IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0	IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE						
0.0	0.00011	0.00010	0.00007	0.00004	0.00002	0.00001	0.0
7.500	0.00012	0.00010	0.00007	0.00005	0.00003	0.00002	0.0
15.000	0.00013	0.00011	0.00008	0.00005	0.00003	0.00002	0.0
25.000	0.00015	0.00012	0.00009	0.00005	0.00003	0.00002	0.0
35.000	0.00017	0.00013	0.00010	0.00005	0.00003	0.00002	0.0
45.000	0.00018	0.00014	0.00010	0.00006	0.00004	0.00002	0.0
55.000	0.00020	0.00015	0.00010	0.00006	0.00004	0.00002	0.0
70.000	0.00020	0.00014	0.00009	0.00006	0.00003	0.00001	0.0
87.200	0.00018	0.00012	0.00008	0.00005	0.00002	0.0	0.0

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-111
EFFECT OF RUDDER



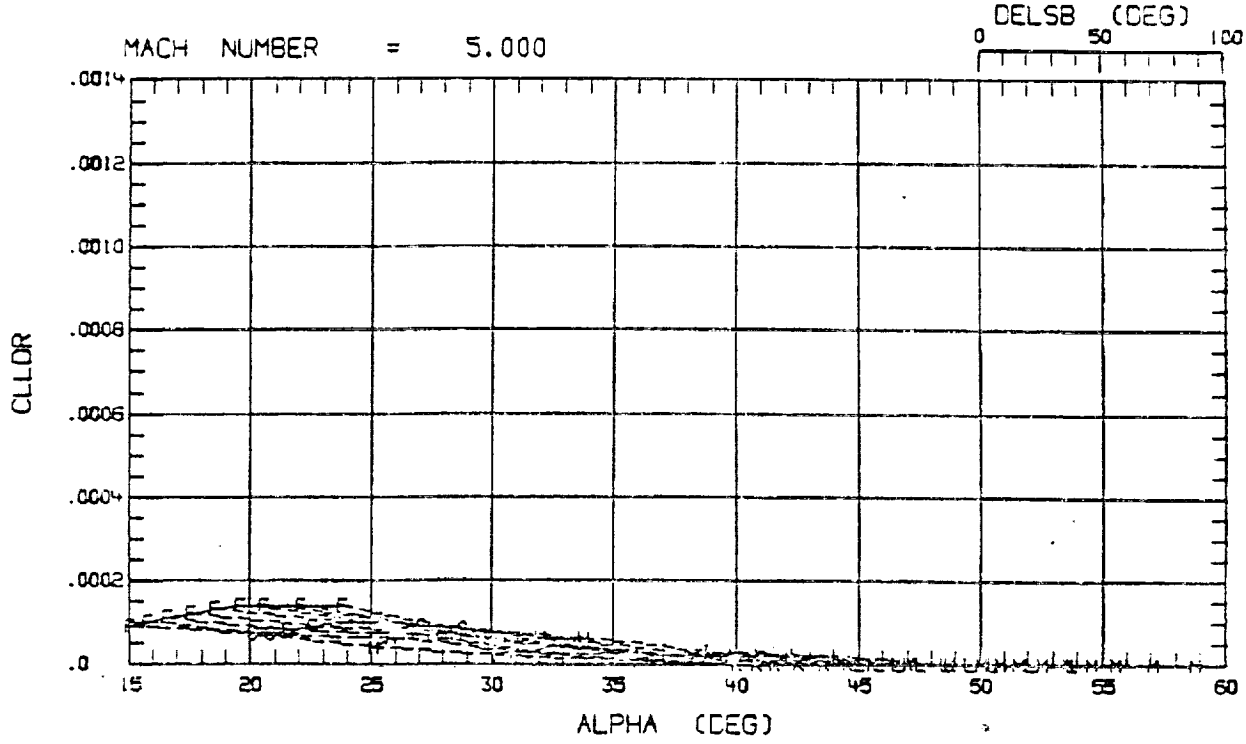
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00022	0.00019	0.00017	0.00012	0.00011	0.00009	0.00007	0.00004
7.500	0.00026	0.00022	0.00019	0.00014	0.00013	0.00010	0.00007	0.00006
15.000	0.00029	0.00024	0.00021	0.00016	0.00014	0.00011	0.00008	0.00007
25.000	0.00032	0.00027	0.00023	0.00018	0.00016	0.00012	0.00009	0.00007
35.000	0.00034	0.00029	0.00024	0.00020	0.00017	0.00013	0.00010	0.00007
45.000	0.00036	0.00030	0.00025	0.00021	0.00018	0.00014	0.00010	0.00006
55.000	0.00036	0.00030	0.00025	0.00022	0.00019	0.00014	0.00010	0.00006
70.000	0.00034	0.00029	0.00025	0.00022	0.00020	0.00014	0.00009	0.00006
87.200	0.00028	0.00025	0.00024	0.00021	0.00019	0.00014	0.00008	0.00005

ENGINEER _____
DATE 10-23-78

FIGURE 4.2.1.3-112
EFFECT OF RUDDER



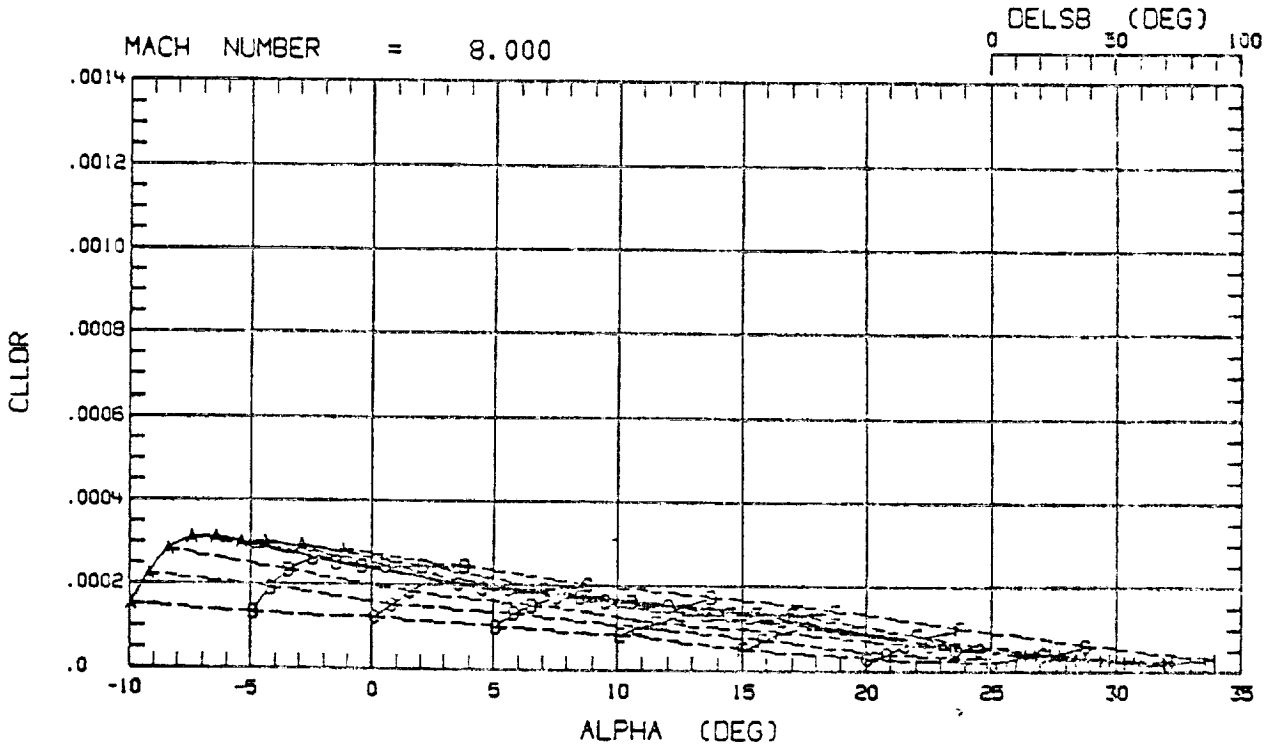
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00009	0.00007	0.00004	0.00002	0.00001	0.0	0.0	0.0
7.500	0.00010	0.00007	0.00006	0.00003	0.00001	0.0	0.0	0.0
15.000	0.00011	0.00008	0.00007	0.00003	0.00002	0.0	0.0	0.0
25.000	0.00012	0.00009	0.00007	0.00004	0.00002	0.0	0.0	0.0
35.000	0.00013	0.00010	0.00007	0.00004	0.00002	0.0	0.0	0.0
45.000	0.00014	0.00010	0.00006	0.00003	0.00002	0.0	0.0	0.0
55.000	0.00014	0.00010	0.00006	0.00003	0.00002	0.0	0.0	0.0
70.000	0.00014	0.00009	0.00005	0.00003	0.00002	0.0	0.0	0.0
87.200	0.00014	0.00008	0.00006	0.00003	0.00002	0.0	0.0	0.0

ENGINEER _____
DATE 10-3-78

FIGURE 4.2.1.3-113
EFFECT OF RUDDER



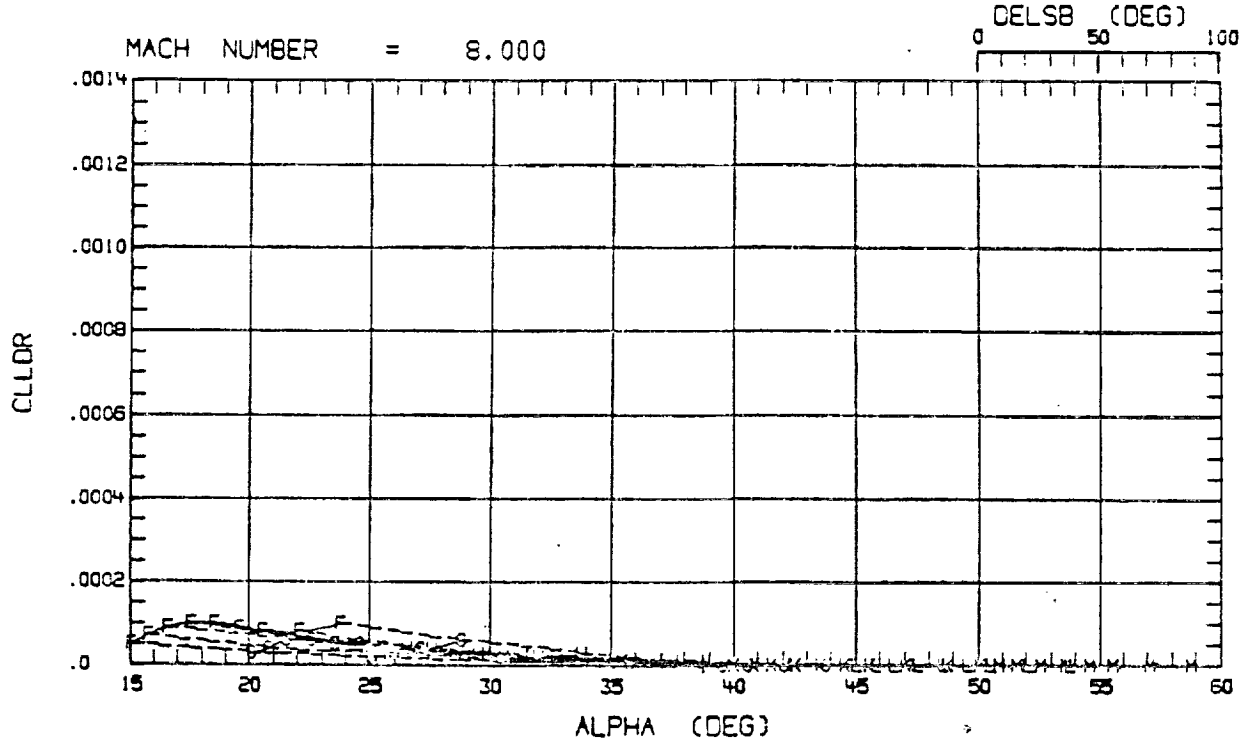
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00015	0.00013	0.00012	0.00010	0.00008	0.00005	0.00003	0.00002
7.500	0.00022	0.00019	0.00015	0.00013	0.00010	0.00007	0.00004	0.00003
15.000	0.00028	0.00023	0.00018	0.00015	0.00011	0.00009	0.00006	0.00004
25.000	0.00031	0.00026	0.00021	0.00017	0.00013	0.00010	0.00006	0.00004
35.000	0.00031	0.00025	0.00020	0.00017	0.00013	0.00010	0.00005	0.00003
45.000	0.00030	0.00024	0.00019	0.00016	0.00013	0.00009	0.00005	0.00003
55.000	0.00030	0.00024	0.00019	0.00016	0.00013	0.00008	0.00004	0.00002
70.000	0.00029	0.00024	0.00019	0.00015	0.00013	0.00008	0.00004	0.00002
87.200	0.00029	0.00024	0.00020	0.00017	0.00014	0.00010	0.00006	0.00003

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-114
EFFECT OF RUDDER



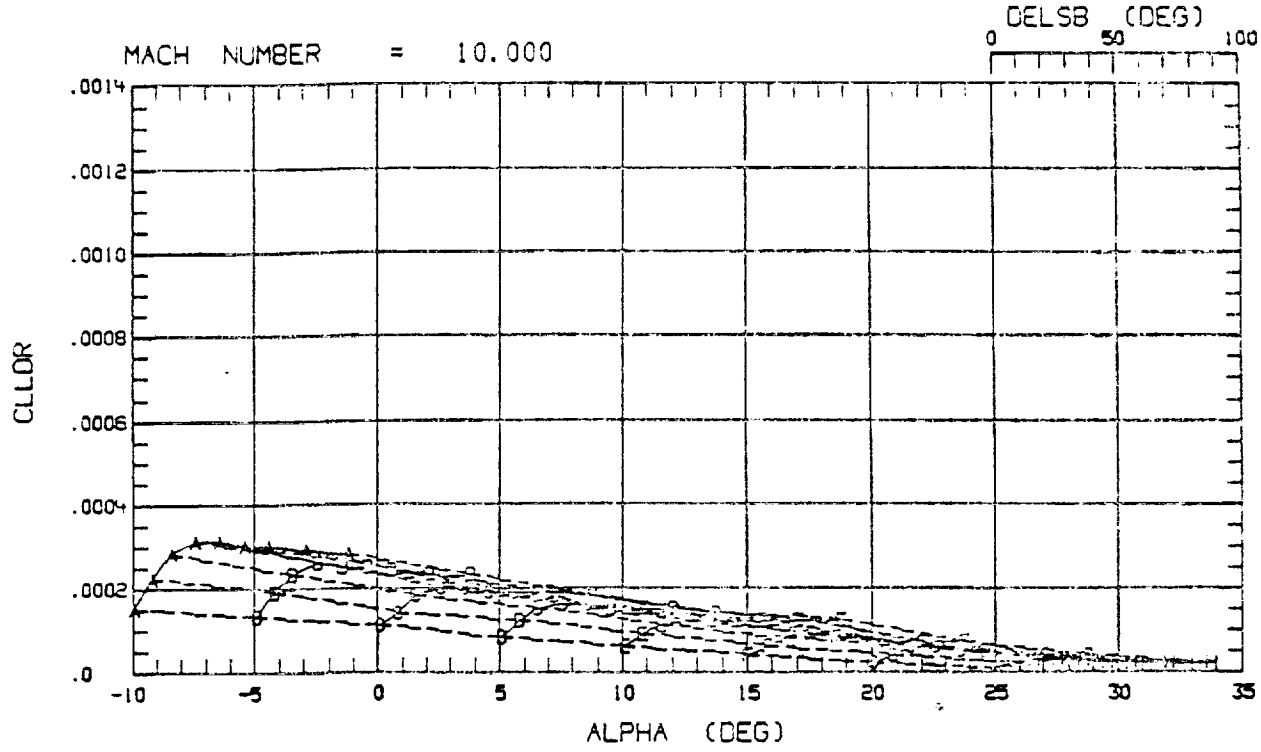
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00005	0.00003	0.00002	0.00001	0.00001	0.0	0.0	0.0
7.500	0.00007	0.00004	0.00003	0.00001	0.00001	0.0	0.0	0.0
15.000	0.00009	0.00006	0.00004	0.00002	0.00001	0.0	0.0	0.0
25.000	0.00010	0.00006	0.00004	0.00002	0.00001	0.0	0.0	0.0
35.000	0.00010	0.00005	0.00003	0.00002	0.00001	0.0	0.0	0.0
45.000	0.00009	0.00005	0.00003	0.00001	0.0	0.0	0.0	0.0
55.000	0.00008	0.00004	0.00002	0.00001	0.0	0.0	0.0	0.0
70.000	0.00008	0.00004	0.00002	0.00001	0.0	0.0	0.0	0.0
87.200	0.00010	0.00006	0.00003	0.0	0.0	0.0	0.0	0.0

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-115
EFFECT OF RUDDER



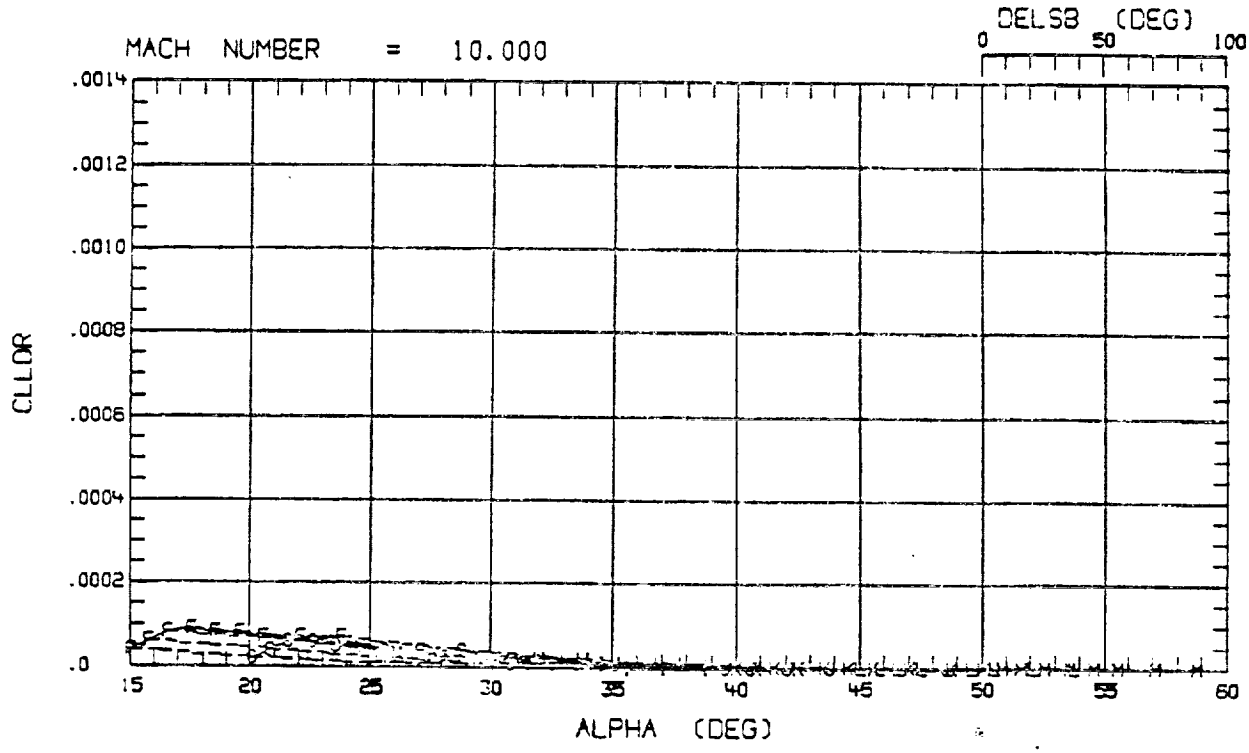
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00015	0.00013	0.00011	0.00009	0.00006	0.00004	0.00002	0.00001
7.500	0.00022	0.00019	0.00014	0.00012	0.00009	0.00006	0.00004	0.00002
15.000	0.00028	0.00023	0.00018	0.00015	0.00011	0.00008	0.00006	0.00003
25.000	0.00031	0.00025	0.00020	0.00016	0.00012	0.00009	0.00006	0.00003
35.000	0.00031	0.00025	0.00020	0.00016	0.00012	0.00008	0.00005	0.00003
45.000	0.00030	0.00025	0.00019	0.00015	0.00012	0.00008	0.00005	0.00002
55.000	0.00030	0.00024	0.00019	0.00015	0.00012	0.00007	0.00004	0.00002
70.000	0.00029	0.00023	0.00019	0.00015	0.00012	0.00007	0.00004	0.00002
87.200	0.00029	0.00023	0.00018	0.00014	0.00012	0.00007	0.00004	0.00002

ENGINEER
DATE

FIGURE 4.2.1.3-116
EFFECT OF RUDDER



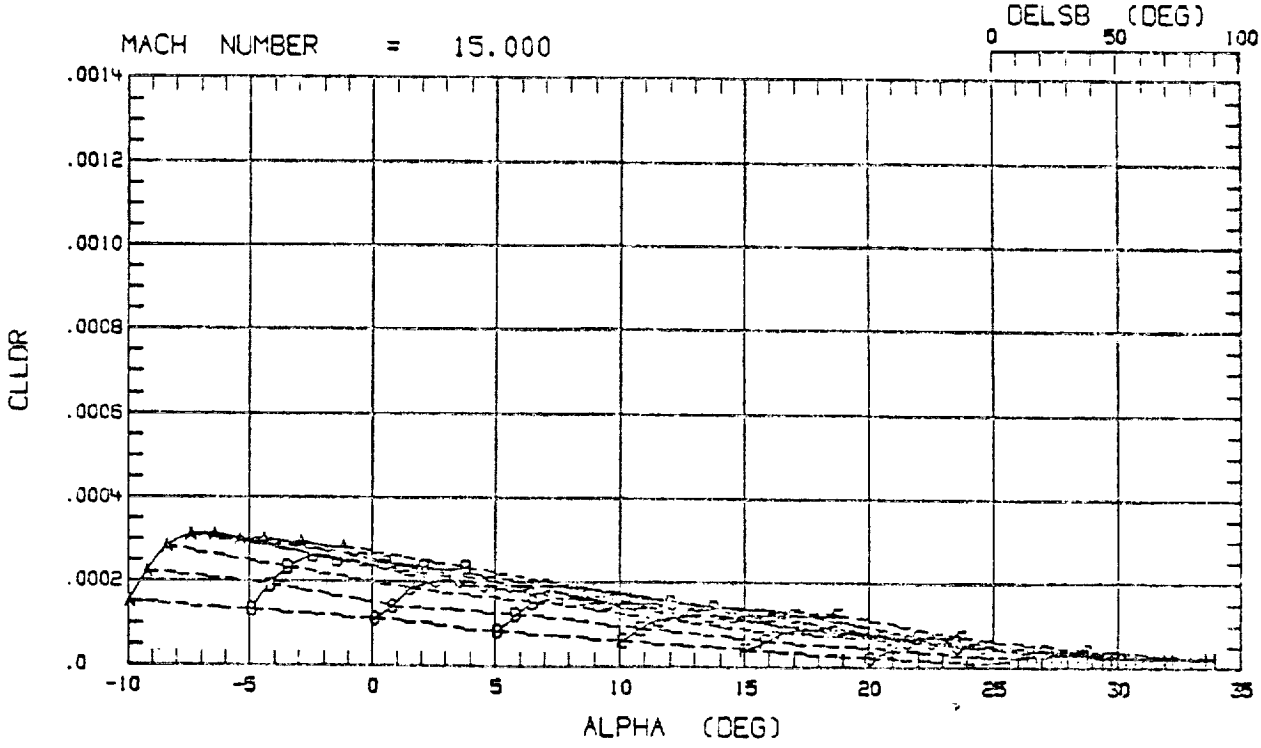
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1075.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00004	0.00002	0.00001	0.00001	0.00001	0.0	0.0	0.0
7.500	0.00006	0.00004	0.00002	0.00001	0.00001	0.0	0.0	0.0
15.000	0.00008	0.00006	0.00003	0.00001	0.00001	0.0	0.0	0.0
25.000	0.00009	0.00006	0.00003	0.00001	0.00001	0.0	0.0	0.0
35.000	0.00008	0.00005	0.00003	0.00001	0.00001	0.0	0.0	0.0
45.000	0.00008	0.00005	0.00002	0.00001	0.0	0.0	0.0	0.0
55.000	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0
70.000	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0
87.200	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-117
EFFECT OF RUDDER



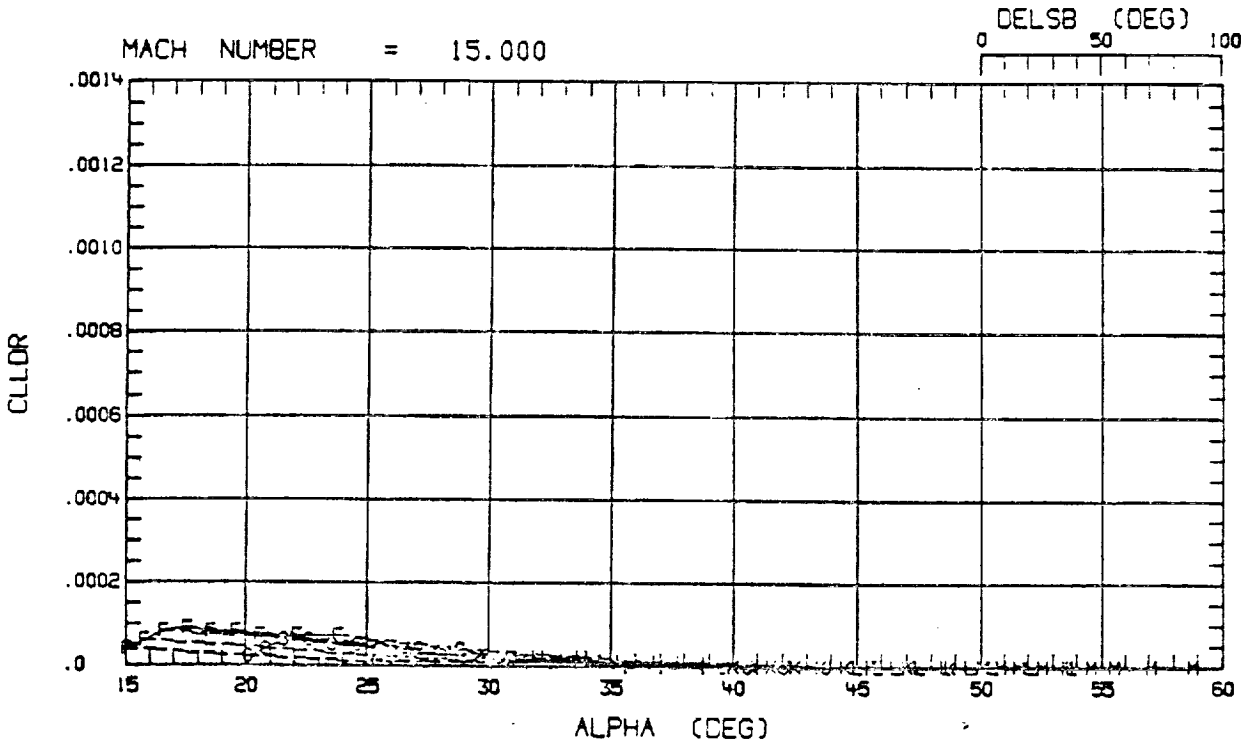
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB	= 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00015	0.00013	0.00011	0.00008	0.00006	0.00004	0.00002	0.00001
7.500	0.00022	0.00019	0.00014	0.00012	0.00009	0.00006	0.00004	0.00002
15.000	0.00028	0.00023	0.00018	0.00015	0.00011	0.00008	0.00006	0.00003
25.000	0.00031	0.00026	0.00020	0.00016	0.00012	0.00009	0.00006	0.00003
35.000	0.00031	0.00025	0.00020	0.00016	0.00012	0.00008	0.00005	0.00003
45.000	0.00030	0.00025	0.00019	0.00015	0.00012	0.00008	0.00005	0.00002
55.000	0.00030	0.00024	0.00019	0.00015	0.00012	0.00007	0.00004	0.00002
70.000	0.00029	0.00023	0.00019	0.00015	0.00012	0.00007	0.00004	0.00002
87.200	0.00028	0.00023	0.00018	0.00014	0.00012	0.00007	0.00004	0.00002

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-118
EFFECT OF RUDDER



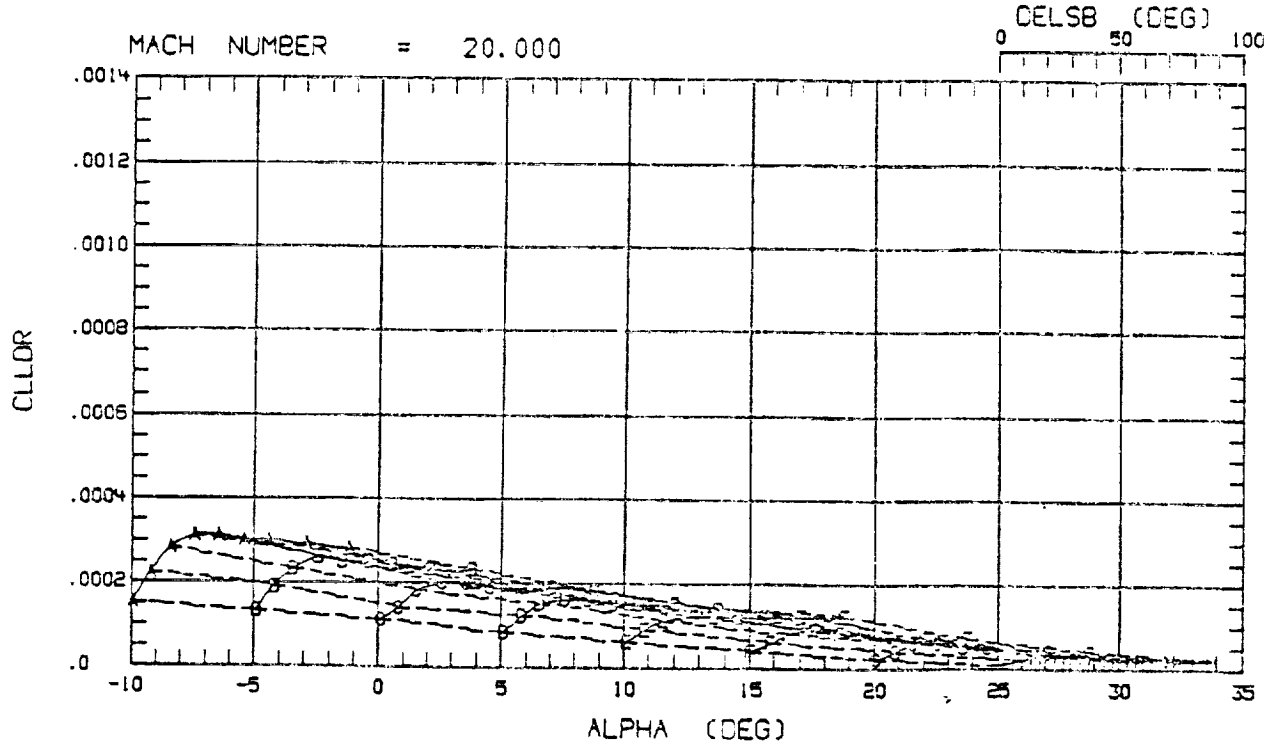
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00004	0.00002	0.00001	0.00001	0.00001	0.0	0.0	0.0
7.500	0.00006	0.00004	0.00002	0.00001	0.00001	0.0	0.0	0.0
15.000	0.00008	0.00006	0.00003	0.00001	0.00001	0.0	0.0	0.0
25.000	0.00009	0.00006	0.00003	0.00001	0.00001	0.0	0.0	0.0
35.000	0.00008	0.00005	0.00003	0.00001	0.00001	0.0	0.0	0.0
45.000	0.00003	0.00005	0.00002	0.00001	0.0	0.0	0.0	0.0
55.000	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0
70.000	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0
87.200	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-119
EFFECT OF RUDDER



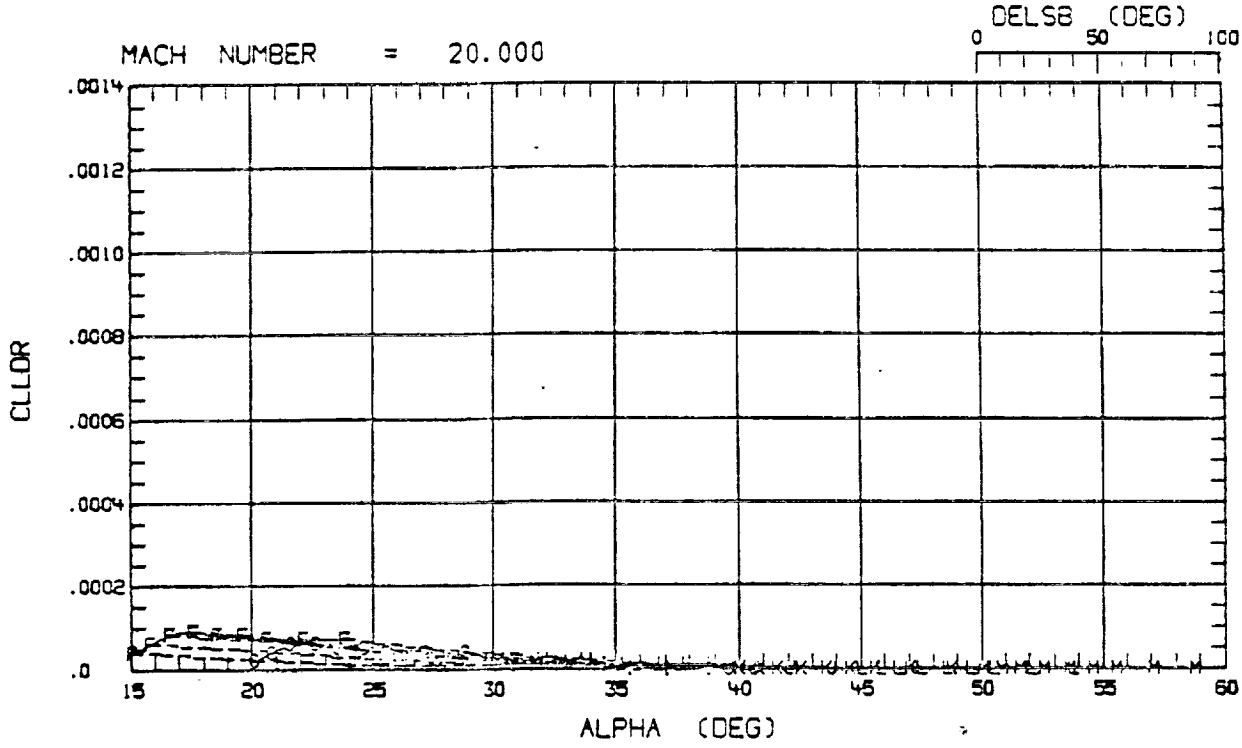
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00015	0.00013	0.00011	0.00009	0.00006	0.00004	0.00002	0.00001
7.500	0.00022	0.00019	0.00014	0.00012	0.00009	0.00006	0.00004	0.00002
15.000	0.00029	0.00023	0.00018	0.00015	0.00011	0.00008	0.00006	0.00003
25.000	0.00031	0.00026	0.00020	0.00016	0.00012	0.00009	0.00006	0.00003
35.000	0.00031	0.00025	0.00020	0.00016	0.00012	0.00008	0.00005	0.00003
46.000	0.00030	0.00025	0.00019	0.00015	0.00012	0.00008	0.00005	0.00002
55.000	0.00030	0.00024	0.00019	0.00015	0.00012	0.00007	0.00004	0.00002
70.000	0.00029	0.00023	0.00019	0.00015	0.00012	0.00007	0.00004	0.00002
87.200	0.00029	0.00023	0.00018	0.00014	0.00012	0.00007	0.00004	0.00002

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-120
EFFECT OF RUDDER



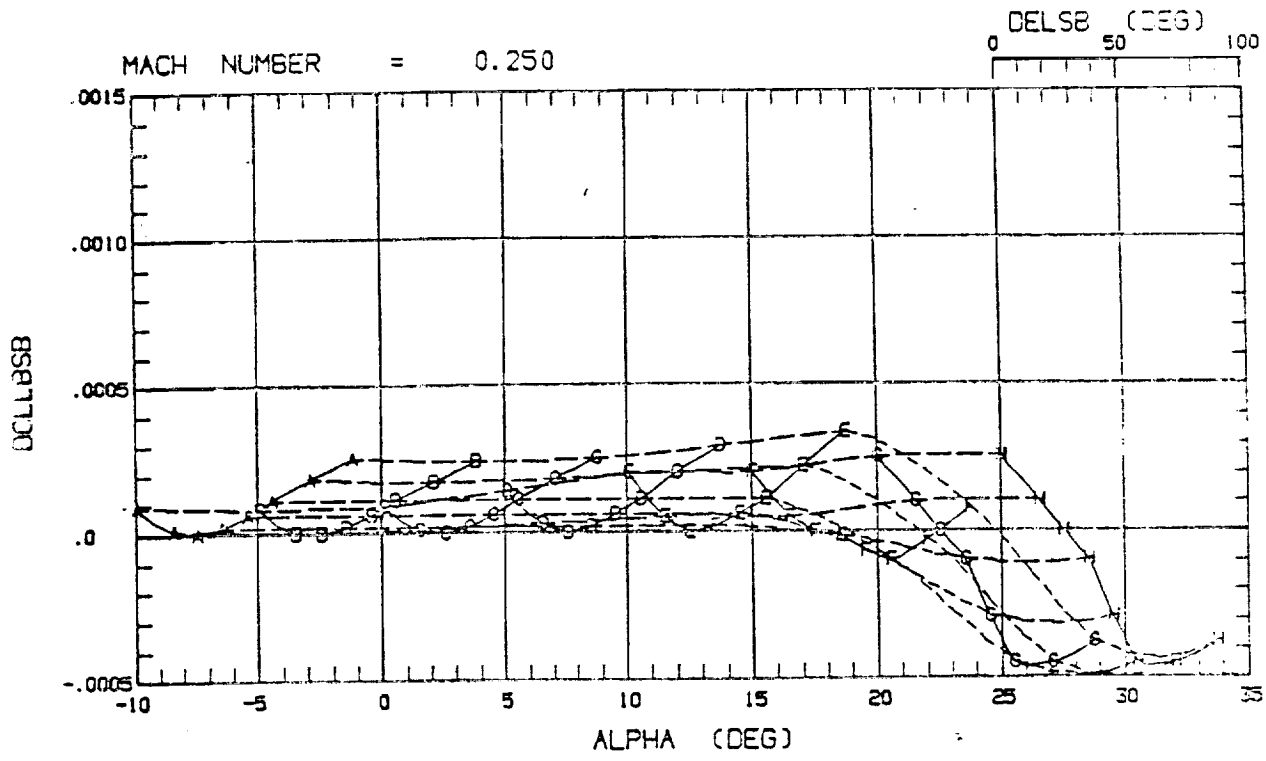
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER ROLLING MOMENT DERIVATIVE							
0.0	0.00004	0.00002	0.00001	0.00001	0.00001	0.0	0.0	0.0
7.500	0.00006	0.00004	0.00002	0.00001	0.00001	0.0	0.0	0.0
15.000	0.00008	0.00006	0.00003	0.00001	0.00001	0.0	0.0	0.0
25.000	0.00009	0.00006	0.00003	0.00001	0.00001	0.0	0.0	0.0
35.000	0.00008	0.00005	0.00003	0.00001	0.00001	0.0	0.0	0.0
45.000	0.00008	0.00005	0.00002	0.00001	0.0	0.0	0.0	0.0
55.000	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0
70.000	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0
87.200	0.00007	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0

ENGINEER _____
DATE _____

FIGURE 4.2.1.3-121
EFFECT OF RUDDER



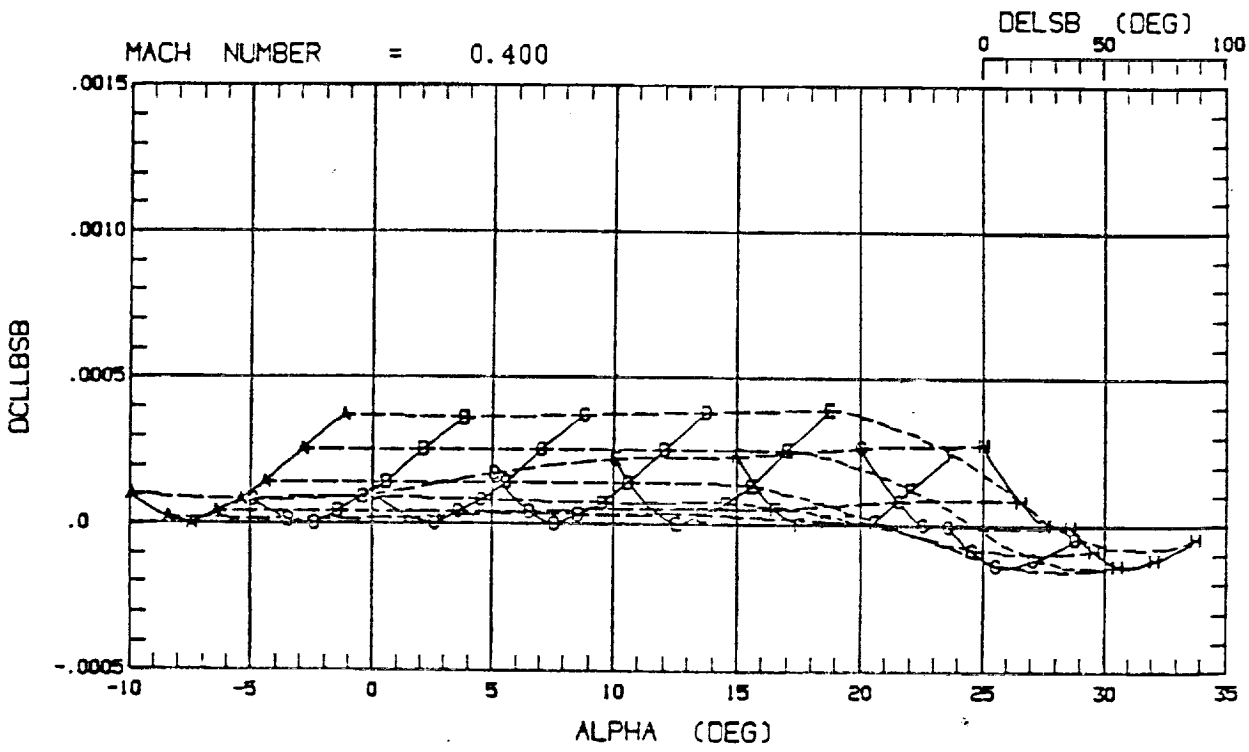
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00009	0.00008	0.00009	0.00014	0.00020	0.00020	0.00025	0.00025
15.000	0.00001	0.0	0.00001	0.00003	0.00005	0.00005	0.00010	0.00010
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00002	0.00002	0.00002	0.00002	0.00002	-0.00002	-0.00010	-0.00010
45.000	0.00006	0.00006	0.00006	0.00006	0.00006	-0.00007	-0.00029	-0.00029
55.000	0.00011	0.00011	0.00011	0.00011	0.00011	-0.00010	-0.00045	-0.00045
70.000	0.00018	0.00017	0.00018	0.00020	0.00022	-0.00003	-0.00045	-0.00045
87.200	0.00025	0.00024	0.00025	0.00029	0.00034	0.00008	-0.00038	-0.00038

ENGINEER LLL
DATE 9-14-78

FIGURE 4.2.1.3-122
EFFECT OF SPEEDBRAKE

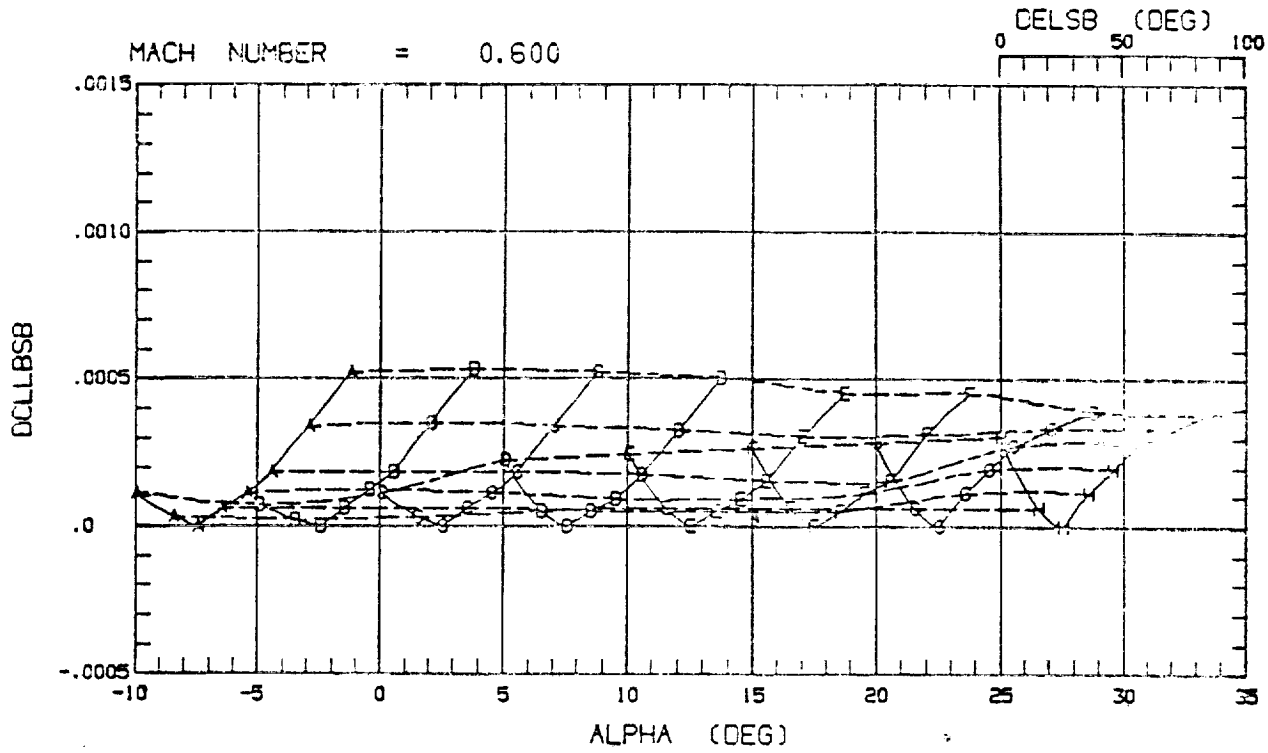


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00010	0.00008	0.00010	0.00017	0.00022	0.00023	0.00026	0.00027
15.000	0.00002	0.00001	0.00002	0.00004	0.00005	0.00005	0.00008	0.00008
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00004	0.00004	0.00004	0.00003	0.00003	0.00001	-0.00001	-0.00001
45.000	0.00008	0.00009	0.00008	0.00007	0.00007	0.00001	-0.00009	-0.00009
55.000	0.00014	0.00014	0.00014	0.00014	0.00013	0.00001	-0.00014	-0.00014
70.000	0.00025	0.00025	0.00025	0.00025	0.00025	0.00012	-0.00012	-0.00012
87.200	0.00037	0.00036	0.00037	0.00038	0.00039	0.00024	-0.00005	-0.00005

ENGINEER LL
DATE 2-24-83

FIGURE 4.2.1.3-123
EFFECT OF SPEEDBRAKE



CONFIGURATION

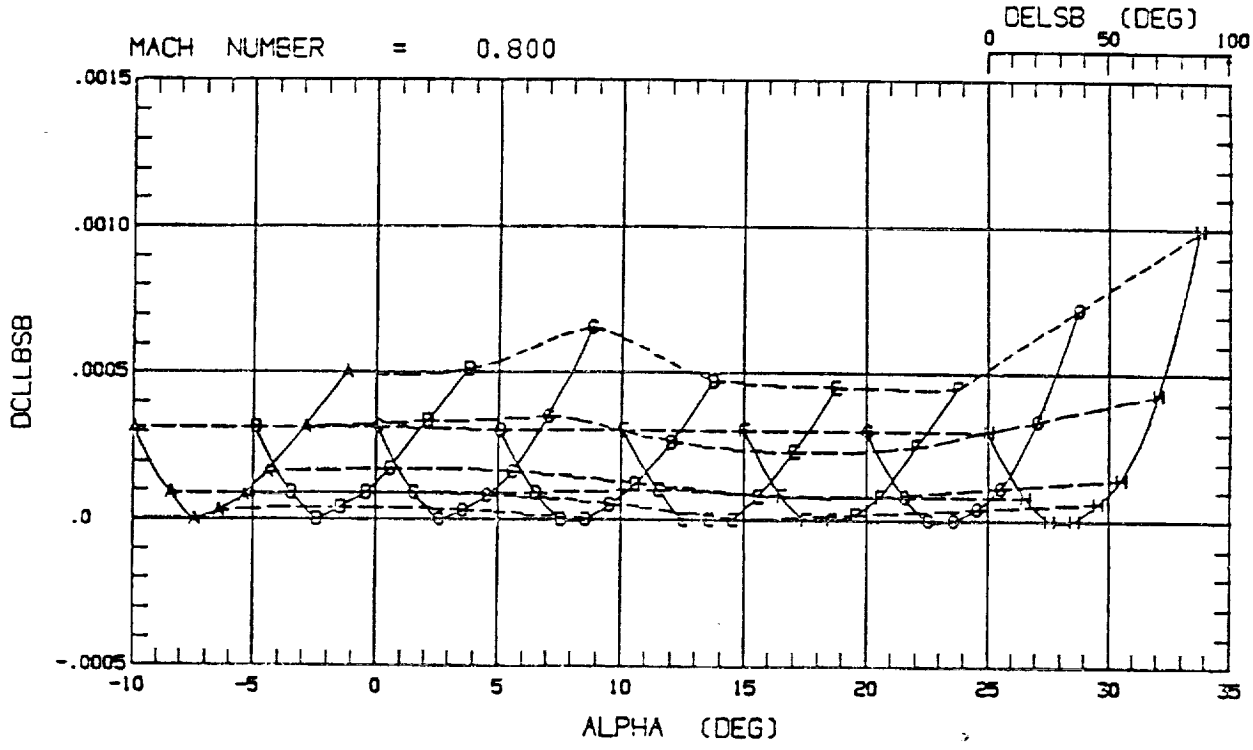
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560	FT.
		BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00011	0.00007	0.00011	0.00022	0.00024	0.00026	0.00028	0.00030
15.000	0.00003	0.00002	0.00003	0.00005	0.00006	0.00006	0.00006	0.00006
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00006	0.00006	0.00006	0.00005	0.00005	0.00005	0.00011	0.00011
45.000	0.00011	0.00012	0.00011	0.00009	0.00009	0.00011	0.00019	0.00019
55.000	0.00018	0.00018	0.00018	0.00017	0.00015	0.00015	0.00027	0.00027
70.000	0.00034	0.00035	0.00034	0.00032	0.00030	0.00031	0.00033	0.00033
87.200	0.00052	0.00053	0.00052	0.00050	0.00045	0.00045	0.00039	0.00039

ENGINEER [illegible]
DATE 9-14-78

FIGURE 4.2.1.3-124
EFFECT OF SPEEDBRAKE



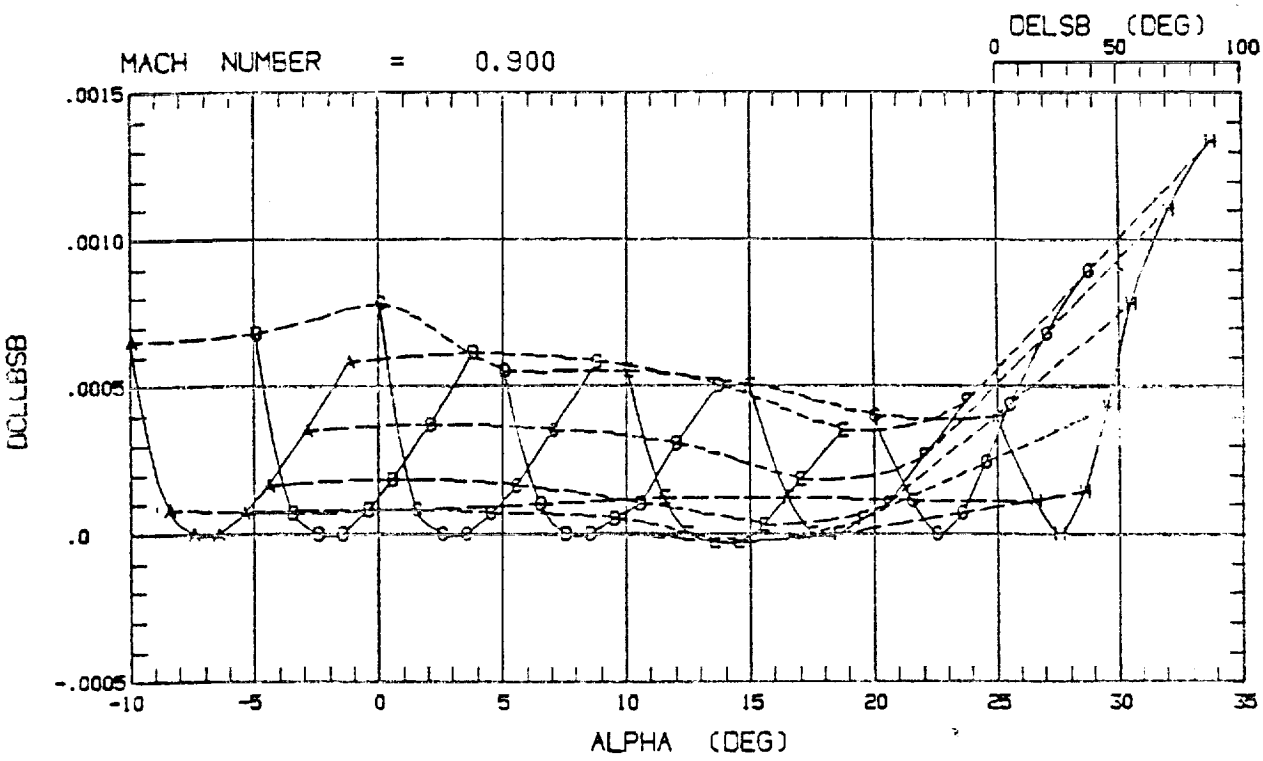
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00031	0.00031	0.00031	0.00030	0.00030	0.00030	0.00030	0.00030
15.000	0.00009	0.00009	0.00009	0.00009	0.00010	0.00008	0.00008	0.00008
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00003	0.00004	0.00003	0.0	0.0	0.0	0.0	0.0
45.000	0.00008	0.00009	0.00008	0.00005	0.0	0.00002	0.00004	0.00006
55.000	0.00016	0.00017	0.00016	0.00012	0.00008	0.00008	0.00011	0.00014
70.000	0.00031	0.00033	0.00035	0.00026	0.00023	0.00025	0.00034	0.00043
87.200	0.00050	0.00051	0.00065	0.00047	0.00045	0.00045	0.00072	0.00098

ENGINEER
DATE 9-14-78

FIGURE 4.2.1.3-125
EFFECT OF SPEEDBRAKE



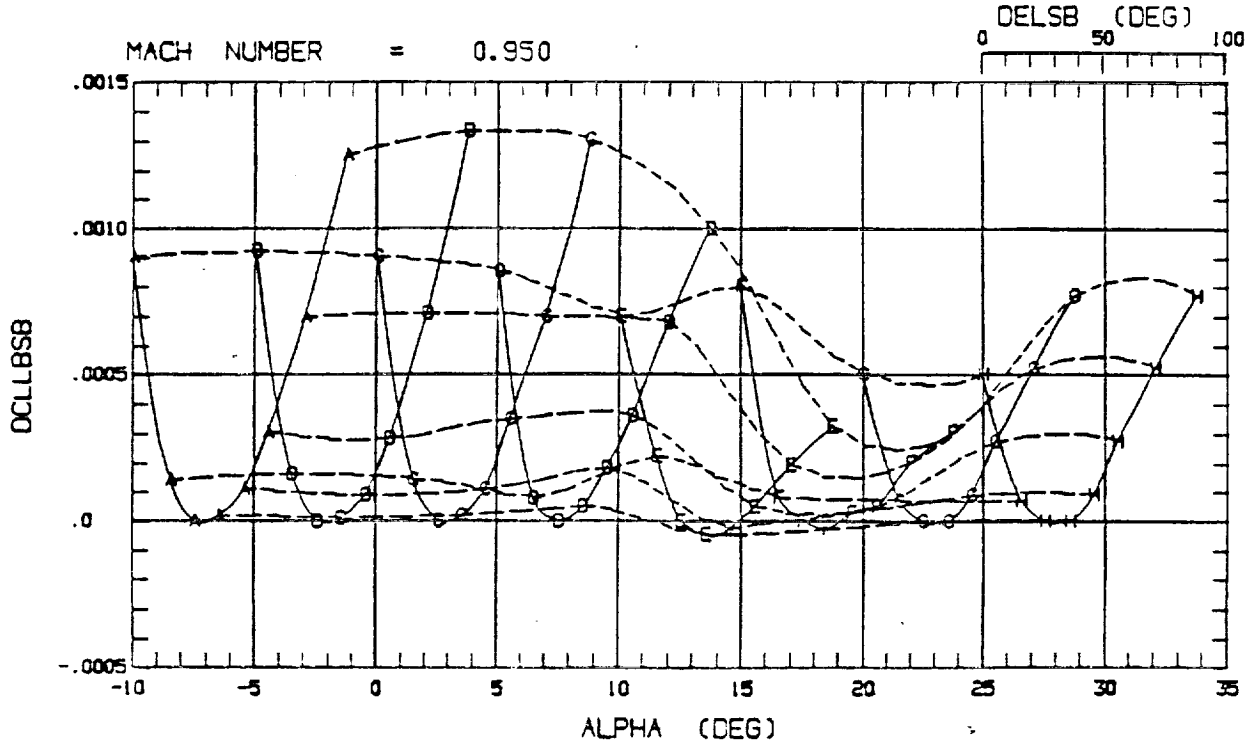
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00065	0.00068	0.00078	0.00055	0.00055	0.00050	0.00040	0.00040
15.000	0.00008	0.00007	0.00008	0.00010	0.00012	0.00012	0.00011	0.00011
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	-0.00003	0.0	0.00007	0.00014
45.000	0.00007	0.00008	0.00007	0.00005	-0.00003	0.00005	0.00024	0.00043
55.000	0.00016	0.00018	0.00016	0.00010	0.00003	0.00010	0.00044	0.00072
70.000	0.00035	0.00037	0.00035	0.00030	0.00018	0.00025	0.00068	0.00110
87.200	0.00058	0.00061	0.00058	0.00050	0.00035	0.00045	0.00089	0.00133

ENGINEER LLL
DATE 9-14-78

FIGURE 4.2.1.3-126
EFFECT OF SPEEDBRAKE



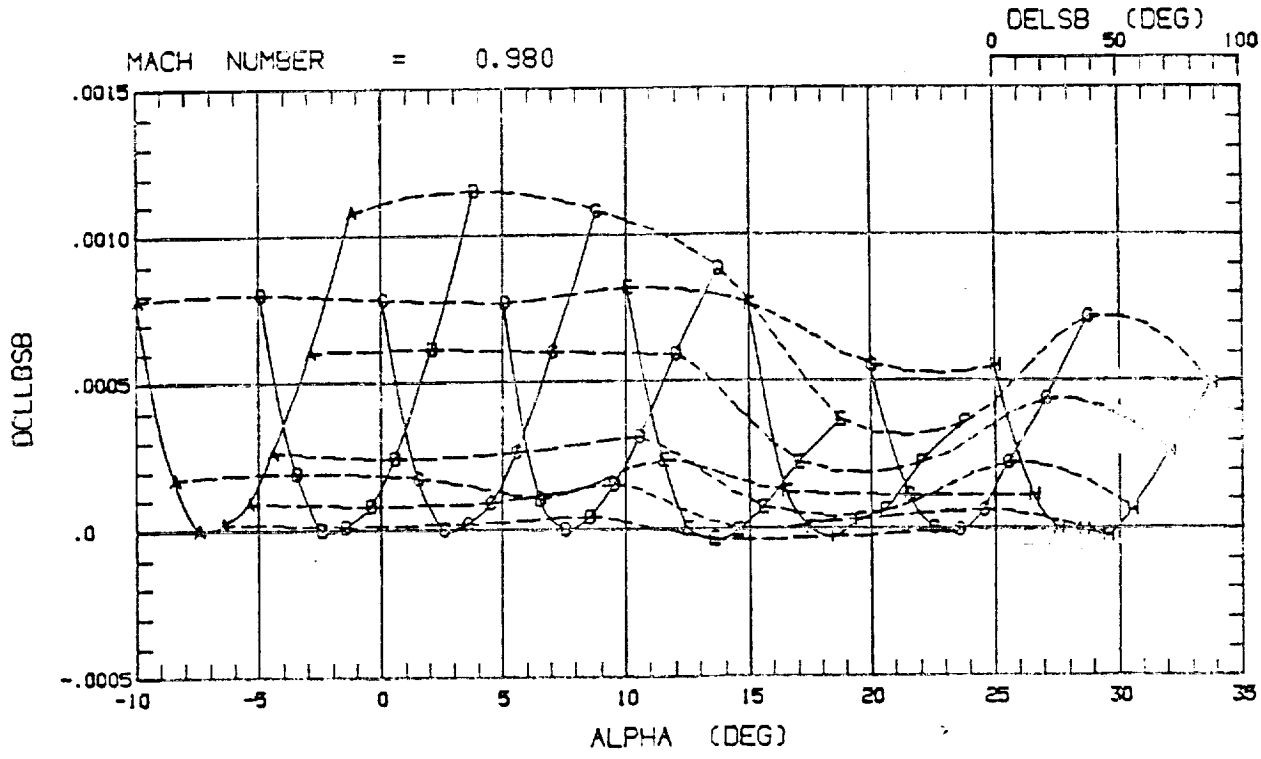
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00090	0.00092	0.00090	0.00085	0.00070	0.00080	0.00050	0.00050
15.000	0.00014	0.00016	0.00014	0.00008	0.00022	0.00008	0.00007	0.00007
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00002	0.00001	0.00002	0.00005	-0.00005	-0.00003	0.0	0.0
45.000	0.00011	0.00009	0.00011	0.00018	-0.00003	0.00003	0.00009	0.00009
55.000	0.00030	0.00028	0.00035	0.00036	0.00005	0.00005	0.00027	0.00027
70.000	0.00070	0.00071	0.00070	0.00068	0.00019	0.00020	0.00052	0.00052
87.200	0.00125	0.00133	0.00130	0.00100	0.00032	0.00030	0.00077	0.00077

ENGINEER
DATE 9-14-78

FIGURE 4.2.1.3-127
EFFECT OF SPEEDBRAKE

SD72-SH-0060 IM



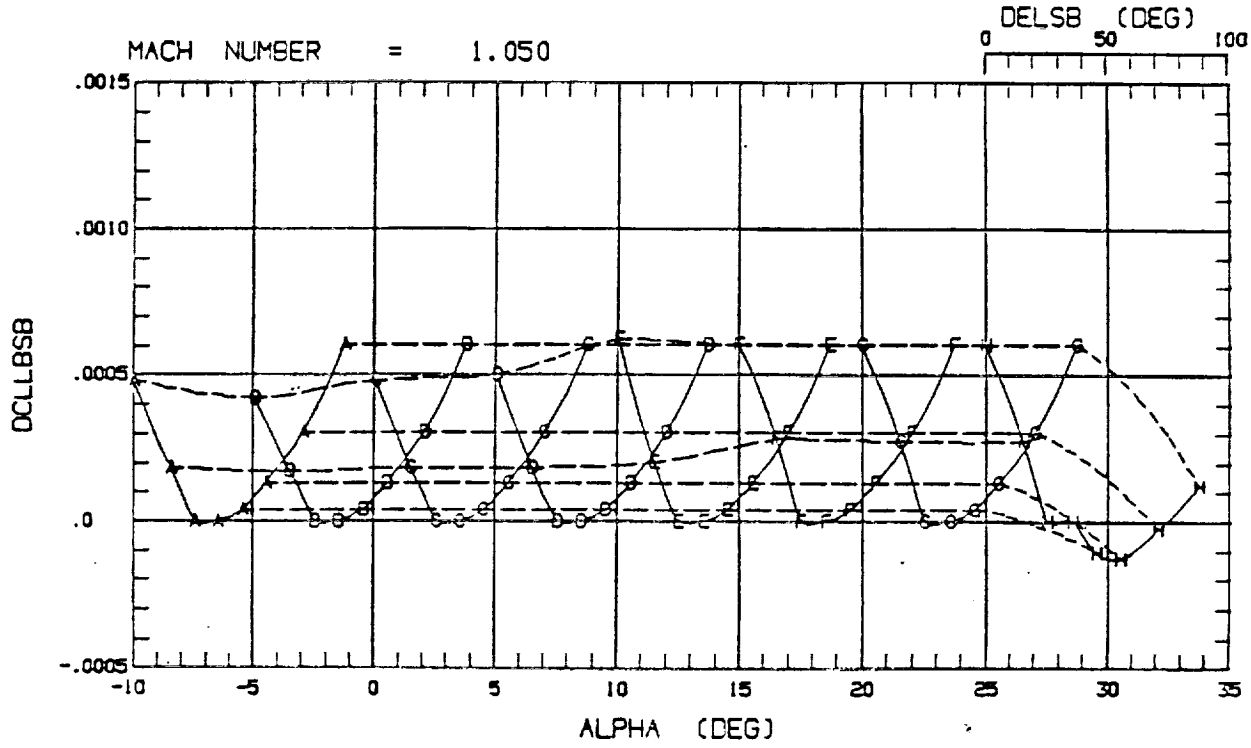
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00078	0.00080	0.00078	0.00077	0.00082	0.00076	0.00055	0.00055
15.000	0.00017	0.00019	0.00017	0.00010	0.00023	0.00012	0.00011	0.00011
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00002	0.00001	0.00002	0.00004	-0.00004	-0.00003	-0.00001	-0.00001
45.000	0.00009	0.00008	0.00009	0.00015	-0.00001	0.00003	0.00006	-0.00003
55.000	0.00026	0.00024	0.00026	0.00031	0.00007	0.00006	0.00022	0.00006
70.000	0.00060	0.00061	0.00060	0.00059	0.00022	0.00022	0.00044	0.00026
87.200	0.00108	0.00115	0.00108	0.00099	0.00037	0.00036	0.00072	0.00049

ENGINEER LLL
DATE 9-14-78

FIGURE 4.2.1.3-128
EFFECT OF SPEEDBRAKE



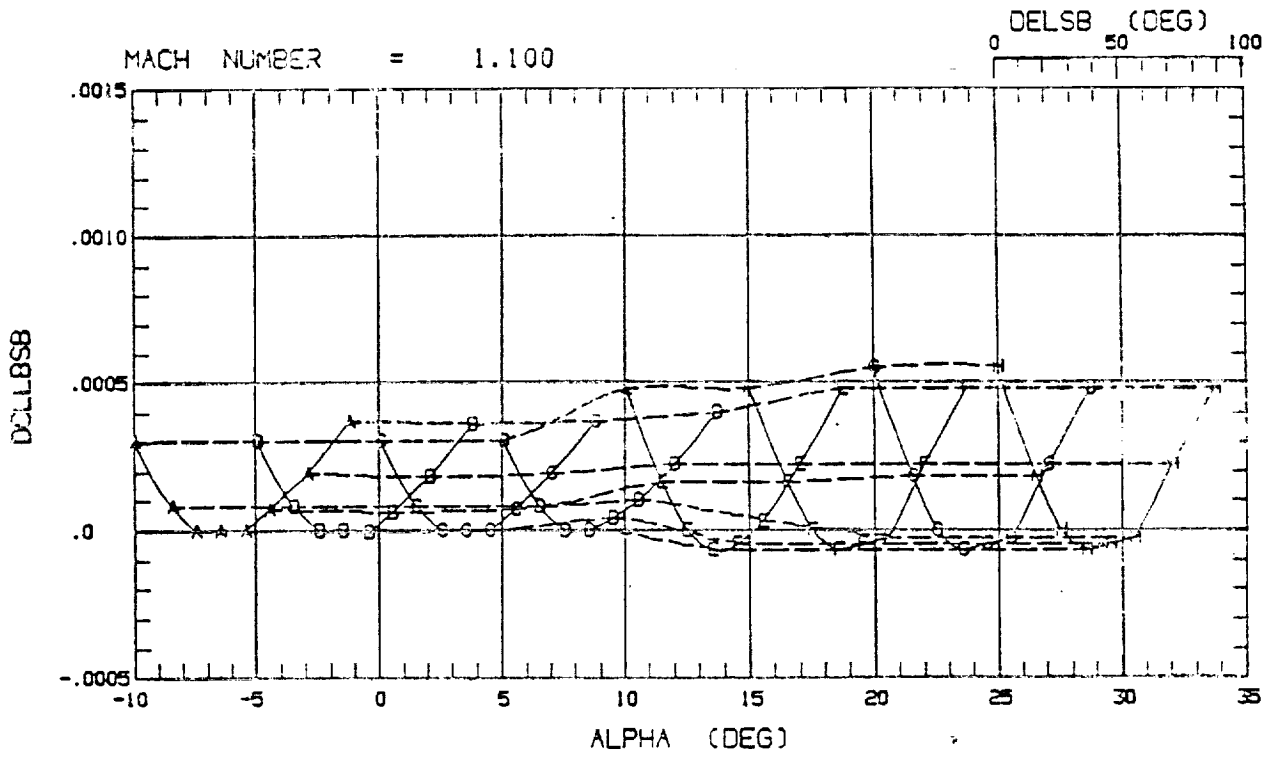
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00048	0.00042	0.00048	0.00050	0.00062	0.00060	0.00060	0.00060
15.000	0.00018	0.00017	0.00018	0.00018	0.00020	0.00029	0.00027	0.00027
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	-0.00011
55.000	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	-0.00013
70.000	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	0.00030	-0.00003
97.200	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00012

ENGINEER
DATE 7-14-78

FIGURE 4.2.1.3-129
EFFECT OF SPEEDBRAKE



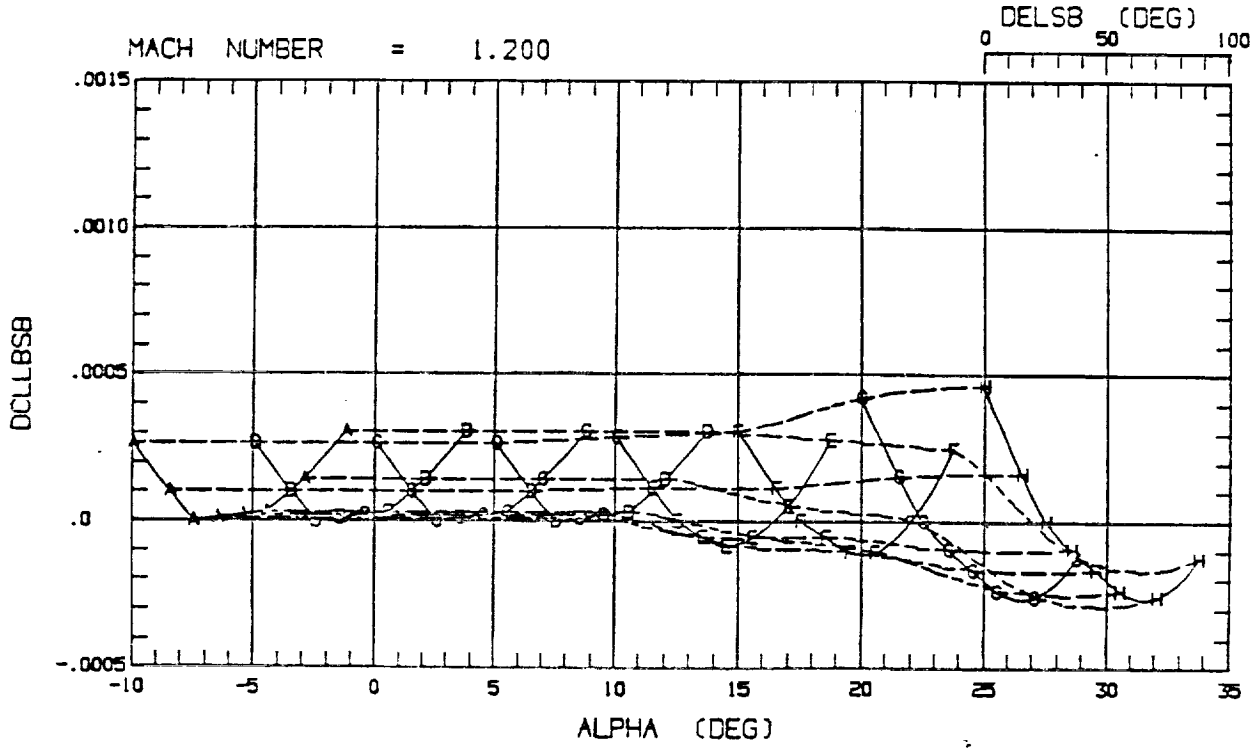
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00030	0.00030	0.00030	0.00030	0.00048	0.00048	0.00055	0.00055
15.000	0.00008	0.00008	0.00008	0.00008	0.00016	0.00016	0.00018	0.00018
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	-0.00007	-0.00007	-0.00007	-0.00007
45.000	0.0	-0.00001	0.0	0.00004	-0.00005	-0.00005	-0.00005	-0.00005
55.000	0.00007	0.00006	0.00007	0.00010	0.00003	-0.00003	-0.00003	-0.00003
70.000	0.00019	0.00018	0.00019	0.00022	0.00022	0.00022	0.00022	0.00022
87.200	0.00037	0.00036	0.00037	0.00040	0.00048	0.00048	0.00048	0.00048

ENGINEER [illegible]
DATE 3-14-72

FIGURE 4.2.1.3-130
EFFECT OF SPEEDBRAKE



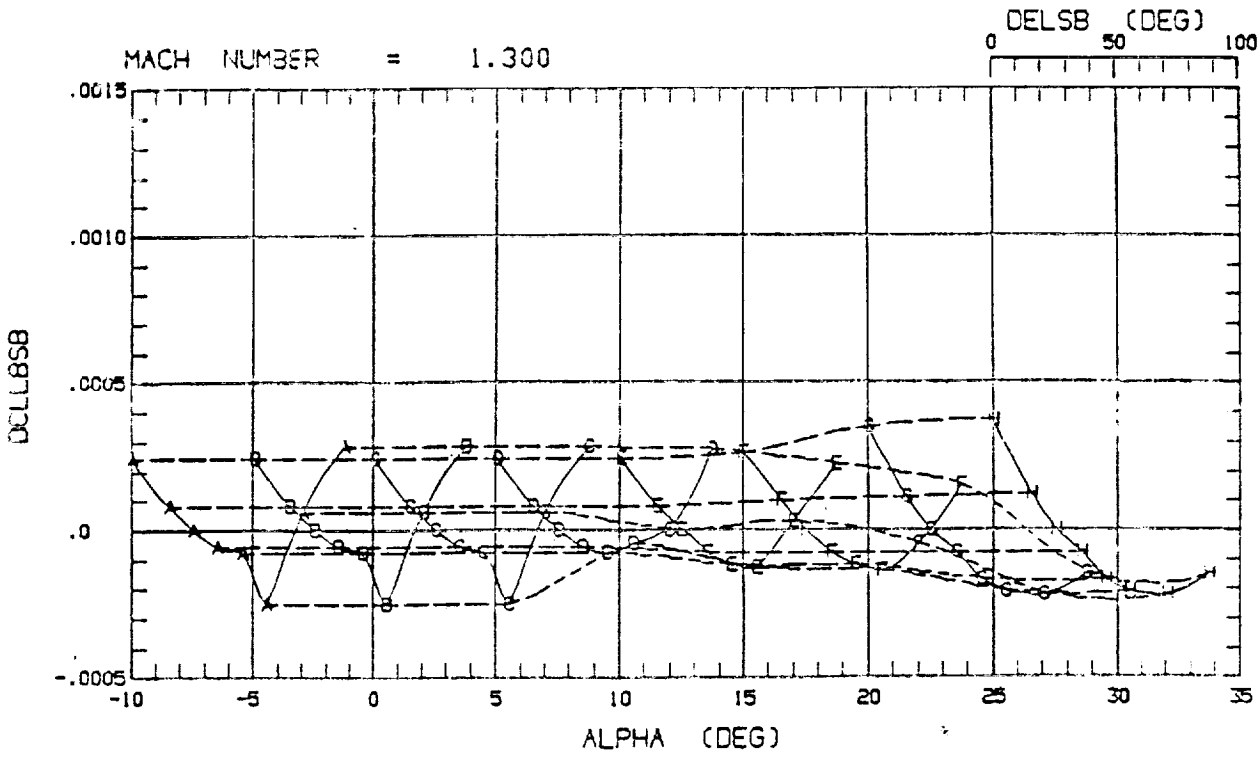
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00026	0.00026	0.00026	0.00026	0.00028	0.00030	0.00042	0.00046
15.000	0.00010	0.00010	0.00010	0.00010	0.00011	0.00011	0.00015	0.00016
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00001	0.00001	0.00001	0.00001	-0.00006	-0.00006	-0.00010	-0.00010
45.000	0.00002	0.00002	0.00002	0.00002	-0.00009	-0.00011	-0.00017	-0.00017
55.000	0.00003	0.00003	0.00003	0.00003	-0.00006	-0.00011	-0.00024	-0.00024
70.000	0.00014	0.00014	0.00014	0.00014	0.00005	0.0	-0.00026	-0.00026
87.200	0.00030	0.00030	0.00030	0.00030	0.00027	0.00024	-0.00013	-0.00013

ENGINEER LLL
DATE 7-14-78

FIGURE 4.2.1.3-131
EFFECT OF SPEEDBRAKE



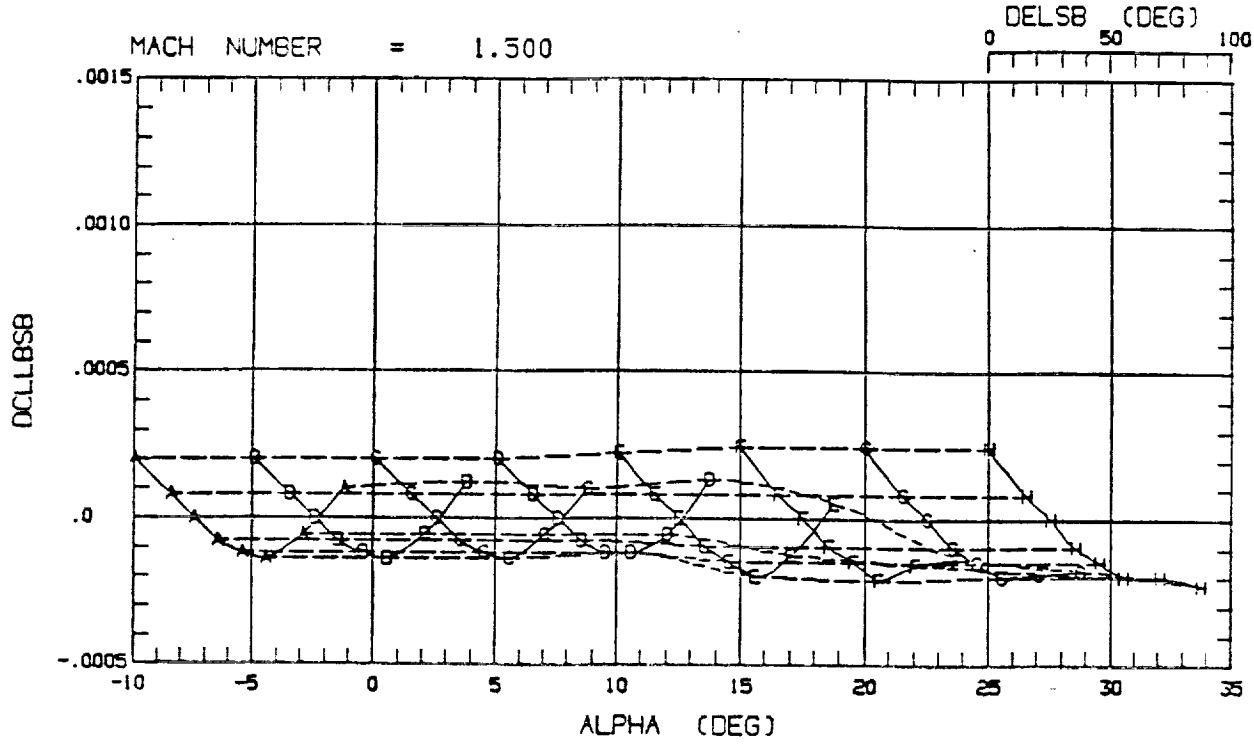
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00024	0.00024	0.00024	0.00024	0.00024	0.00026	0.00035	0.00037
15.000	0.00008	0.00008	0.00008	0.00008	0.00008	0.00010	0.00011	0.00012
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00006	-0.00006	-0.00006	-0.00006	-0.00008	-0.00008	-0.00008	-0.00008
45.000	-0.00008	-0.00008	-0.00008	-0.00008	-0.00012	-0.00012	-0.00017	-0.00017
55.000	-0.00025	-0.00025	-0.00025	-0.00005	-0.00013	-0.00014	-0.00021	-0.00021
70.000	0.00006	0.00006	0.00006	0.0	0.00003	-0.00005	-0.00022	-0.00022
97.200	0.00028	0.00028	0.00028	0.00027	0.00022	0.00015	-0.00015	-0.00015

ENGINEER
DATE 9-[illegible]

FIGURE 4.2.1.3-132
EFFECT OF SPEEDBRAKE

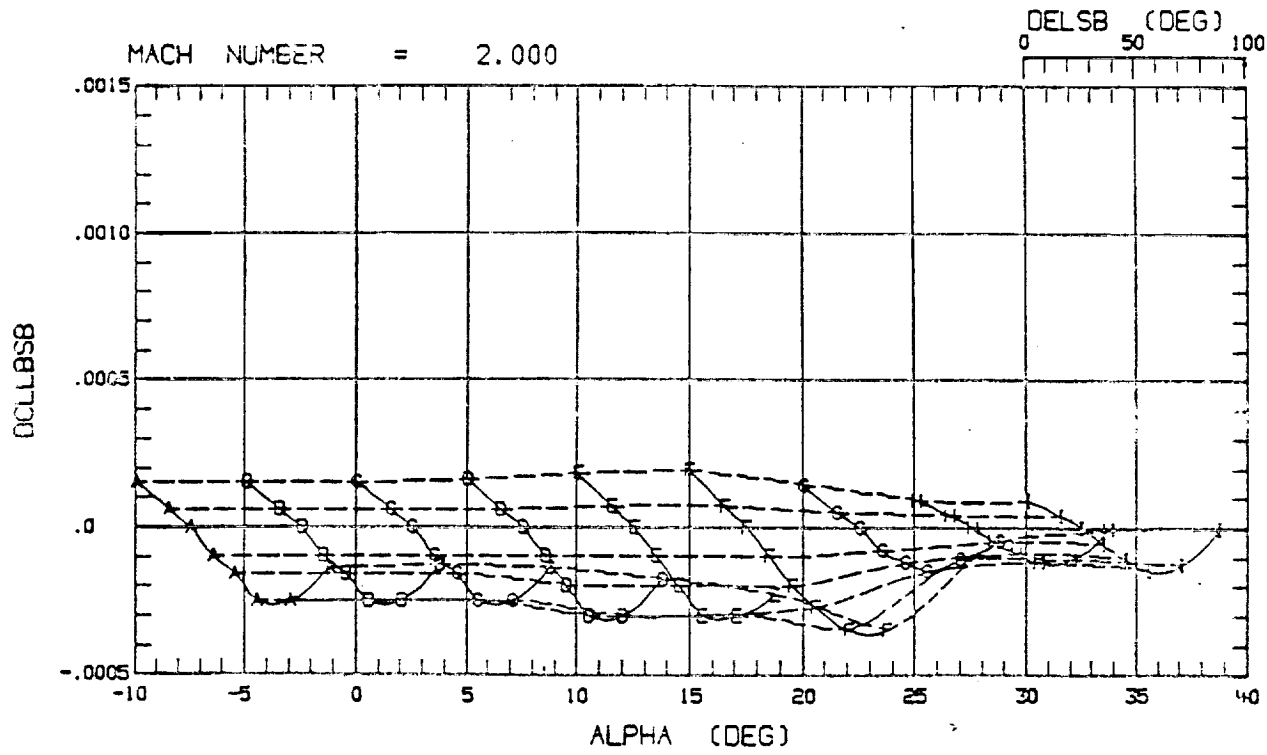


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00020	0.00020	0.00020	0.00020	0.00022	0.00024	0.00024	0.00024
15.000	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00008	-0.00008	-0.00008	-0.00008	-0.00010	-0.00010	-0.00010	-0.00010
45.000	-0.00012	-0.00012	-0.00012	-0.00012	-0.00015	-0.00015	-0.00015	-0.00015
55.000	-0.00014	-0.00014	-0.00014	-0.00012	-0.00020	-0.00021	-0.00020	-0.00020
70.000	-0.00006	-0.00006	-0.00006	-0.00006	-0.00013	-0.00016	-0.00019	-0.00020
87.200	0.00010	0.00012	0.00010	0.00013	0.00005	-0.00014	-0.00018	-0.00023

ENGINEER CH
DATE 9-19-78

FIGURE 4.2.1.3-133
EFFECT OF SPEEDBRAKE



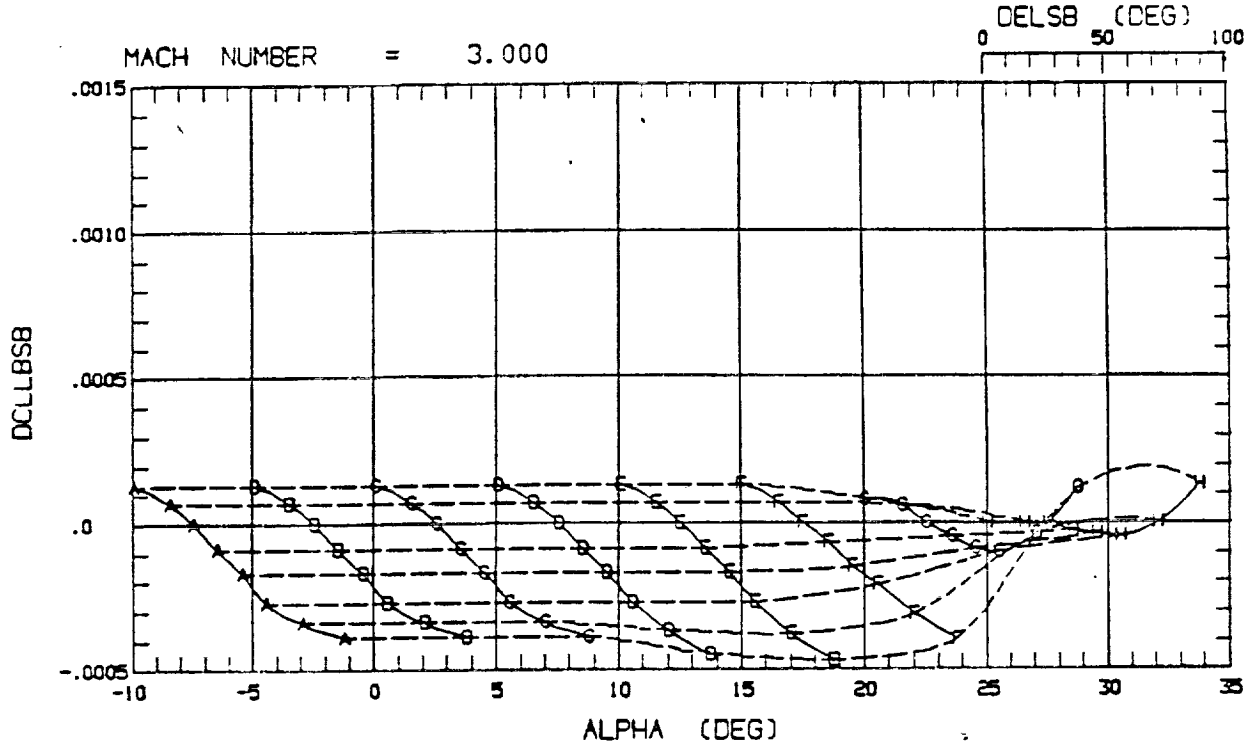
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.								
0.0	0.00015	0.00015	0.00015	0.00016	0.00018	0.00019	0.00014	0.00009	0.00009
15.000	0.00006	0.00006	0.00006	0.00006	0.00007	0.00007	0.00005	0.00004	0.00004
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00008	-0.00005	-0.00006
45.000	-0.00016	-0.00016	-0.00016	-0.00020	-0.00020	-0.00020	-0.00012	-0.00009	-0.00011
55.000	-0.00025	-0.00025	-0.00025	-0.00030	-0.00030	-0.00027	-0.00015	-0.00012	-0.00015
70.000	-0.00025	-0.00025	-0.00025	-0.00030	-0.00030	-0.00035	-0.00011	-0.00011	-0.00013
87.200	-0.00014	-0.00013	-0.00014	-0.00018	-0.00023	-0.00035	-0.00005	-0.00001	-0.00001

ENGINEER LJL
DATE 9-14-78

FIGURE 4.2.1.3-134
EFFECT OF SPEEDBRAKE



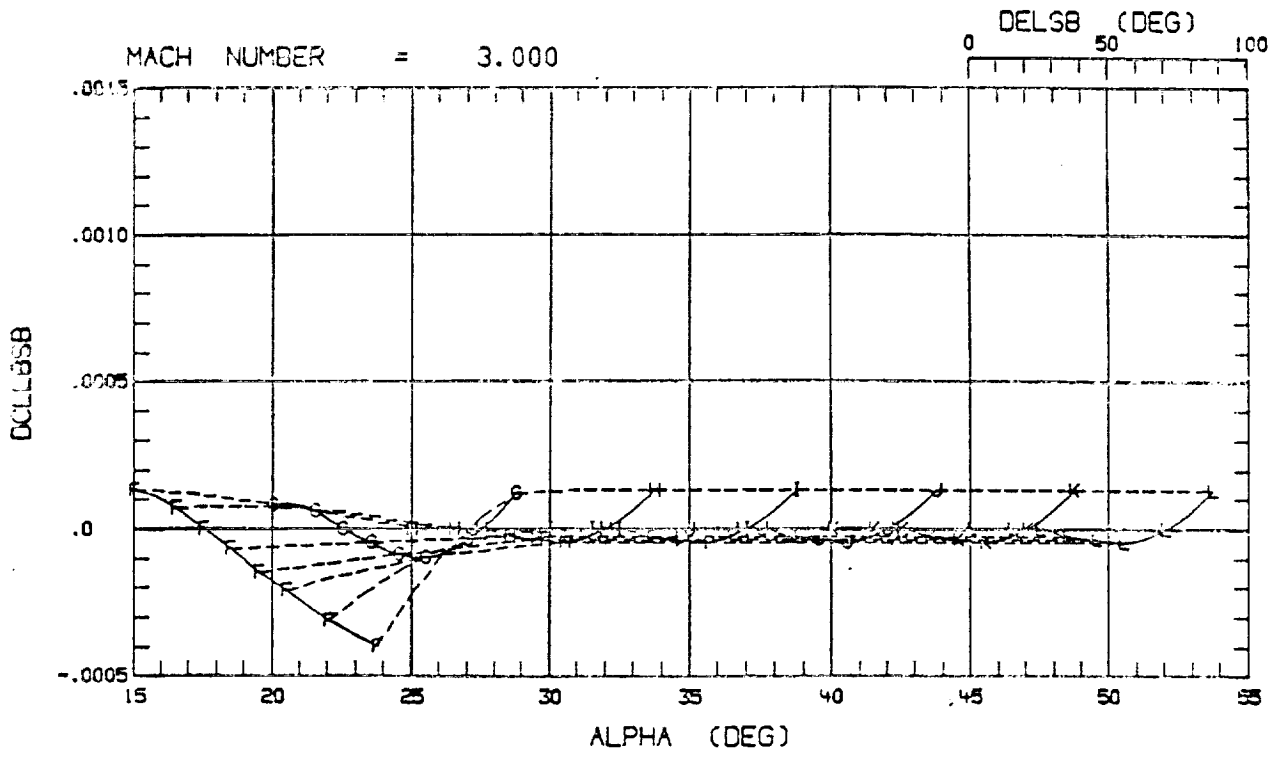
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00008	0.0
15.000	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00006	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00009	-0.00009	-0.00009	-0.00009	-0.00009	-0.00007	-0.00005	-0.00003
45.000	-0.00017	-0.00017	-0.00017	-0.00017	-0.00017	-0.00015	-0.00009	-0.00004
55.000	-0.00027	-0.00027	-0.00027	-0.00027	-0.00027	-0.00021	-0.00010	-0.00005
70.000	-0.00034	-0.00034	-0.00034	-0.00037	-0.00038	-0.00031	-0.00004	0.0
87.200	-0.00039	-0.00039	-0.00039	-0.00045	-0.00047	-0.00040	0.00012	0.00013

ENGINEER LLL
DATE 9-14-95

FIGURE 4.2.1.3-135
EFFECT OF SPEEDBRAKE

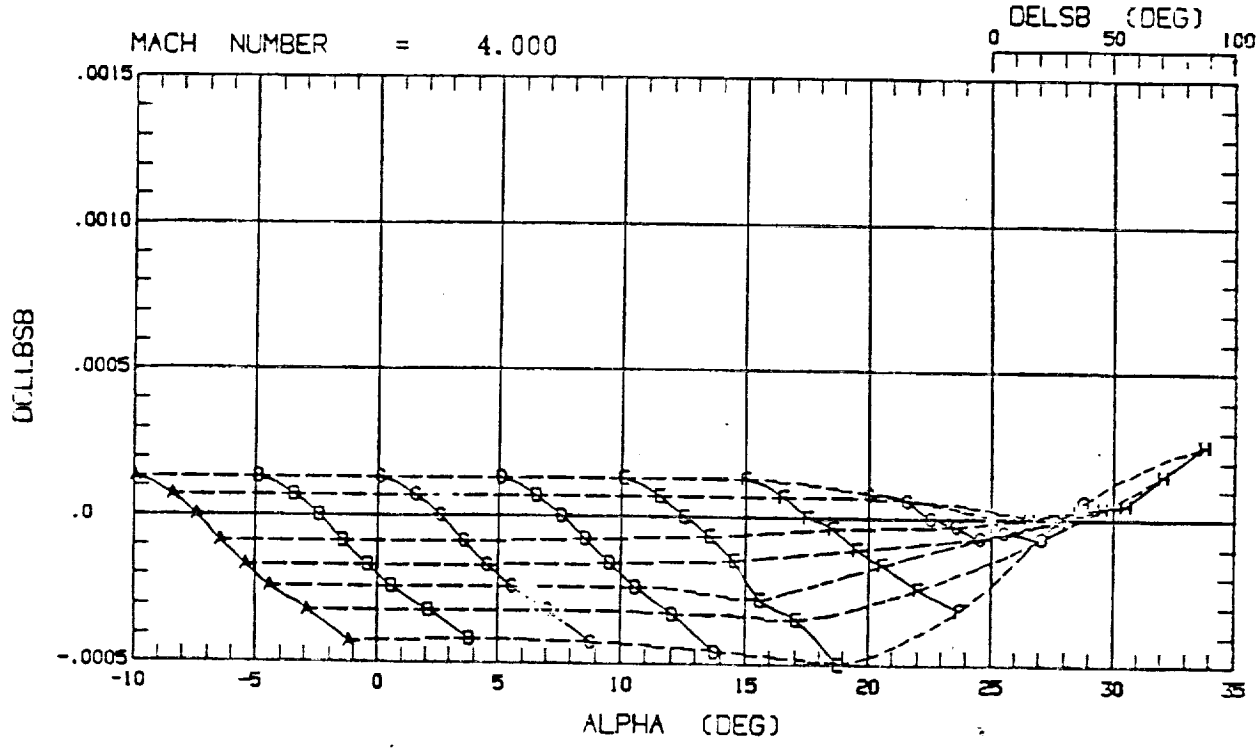


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000	20.000	25.000	30.000	35.000	40.000	45.000
	F	G	H	I	J	K	L
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.						
0.0	0.00013	0.00008	0.0	0.0	0.0	0.0	0.0
15.000	0.00007	0.00006	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00007	-0.00005	-0.00003	-0.00003	-0.00003	-0.00003	-0.00003
45.000	-0.00015	-0.00009	-0.00004	-0.00004	-0.00004	-0.00004	-0.00004
55.000	-0.00021	-0.00010	-0.00005	-0.00005	-0.00005	-0.00005	-0.00005
70.000	-0.00031	-0.00004	0.0	0.0	0.0	0.0	0.0
87.200	-0.00040	0.00012	0.00013	0.00013	0.00013	0.00013	0.00013

ENGINEER LLL
DATE 9-12-73

FIGURE 4.2.1.3-136
EFFECT OF SPEEDBRAKE



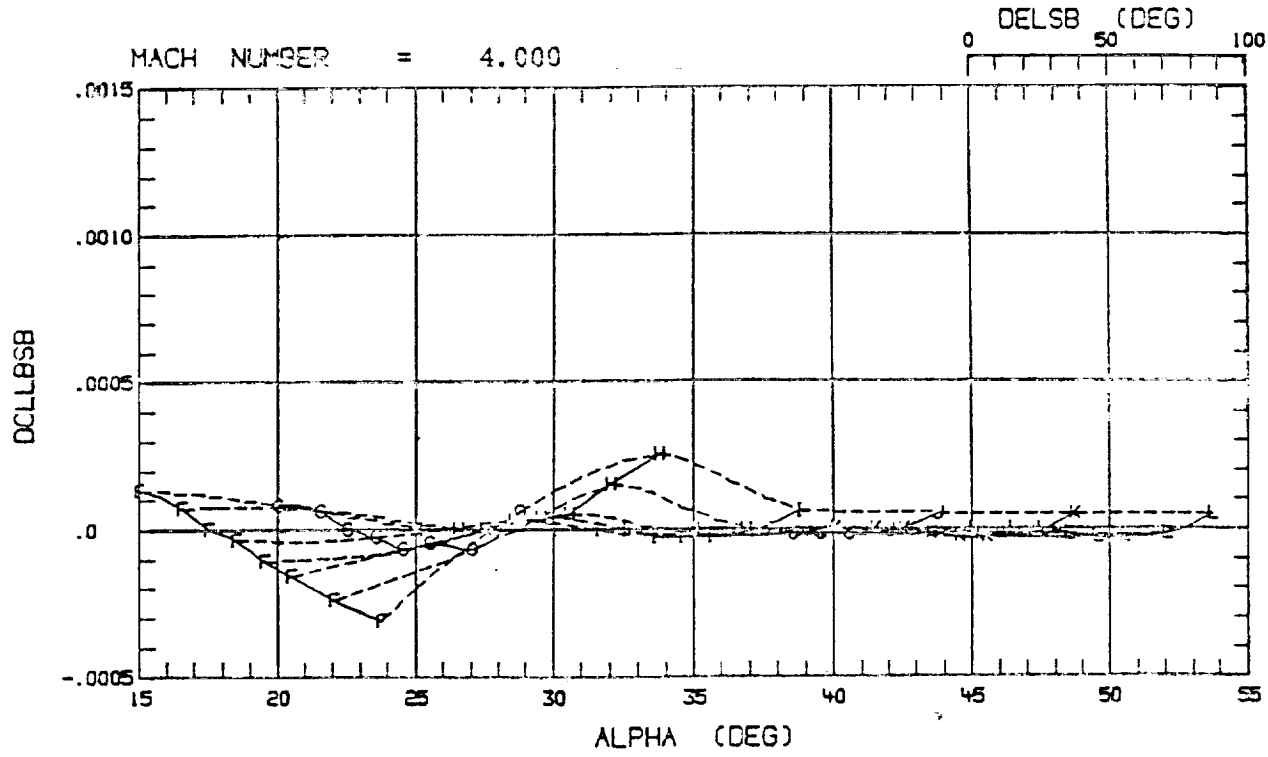
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1250.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00009	0.0
15.000	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00006	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00009	-0.00009	-0.00009	-0.00008	-0.00007	-0.00004	-0.00003	0.00003
45.000	-0.00017	-0.00017	-0.00017	-0.00016	-0.00015	-0.00011	-0.00007	0.00004
55.000	-0.00024	-0.00024	-0.00024	-0.00024	-0.00028	-0.00016	-0.00005	0.00005
70.000	-0.00032	-0.00032	-0.00032	-0.00033	-0.00035	-0.00024	-0.00007	0.00015
87.200	-0.00043	-0.00042	-0.00043	-0.00046	-0.00050	-0.00031	0.00006	0.00025

ENGINEER LLL
DATE 9-14-78

FIGURE 4.2.1.3-137
EFFECT OF SPEEDBRAKE

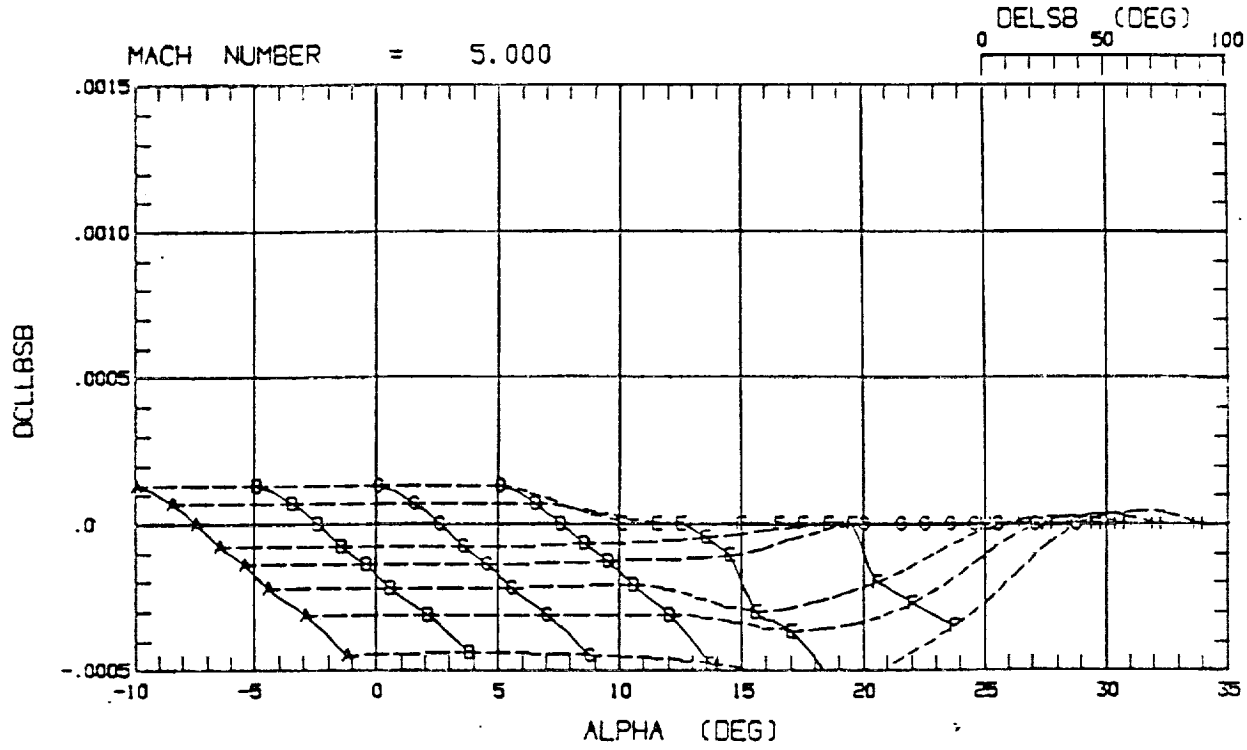


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.						
0.0	0.00013	0.00008	0.0	0.0	0.0	0.0	0.0
15.000	0.00007	0.00006	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00004	-0.00003	0.00003	-0.00003	-0.00002	-0.00002	-0.00002
45.000	-0.00011	-0.00007	0.00004	-0.00003	-0.00002	-0.00003	-0.00003
55.000	-0.00016	-0.00005	0.00005	-0.00003	-0.00002	-0.00003	-0.00003
70.000	-0.00024	-0.00007	0.00015	-0.00001	-0.00001	-0.00002	-0.00002
87.200	-0.00031	0.00006	0.00025	0.00006	0.00005	0.00005	0.00005

ENGINEER (illegible)
DATE 9-14-83

FIGURE 4.2.1.3-138
EFFECT OF SPEEDBRAKE



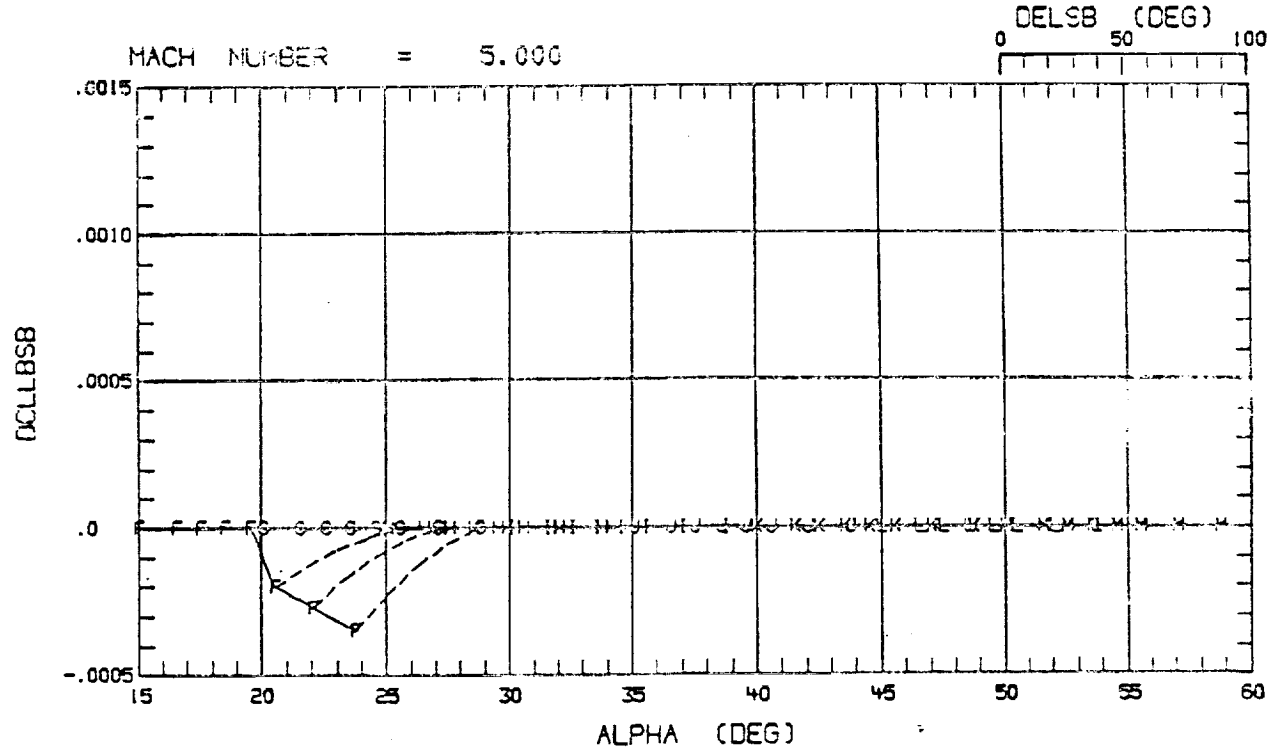
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00013	0.00013	0.00013	0.00013	0.0	0.0	0.0	0.0
15.000	0.00007	0.00007	0.00007	0.00007	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00008	-0.00008	-0.00008	-0.00007	-0.00005	0.0	0.0	0.0
45.000	-0.00014	-0.00014	-0.00014	-0.00013	-0.00011	0.0	0.0	0.0
55.000	-0.00022	-0.00022	-0.00022	-0.00021	-0.00030	-0.00020	0.0	0.0
70.000	-0.00031	-0.00031	-0.00031	-0.00031	-0.00037	-0.00027	0.0	0.0
87.200	-0.00045	-0.00044	-0.00045	-0.00048	-0.00055	-0.00035	0.0	0.0

ENGINEER [illegible]
DATE 9-14-78

FIGURE 4.2.1.3-139
EFFECT OF SPEEDBRAKE

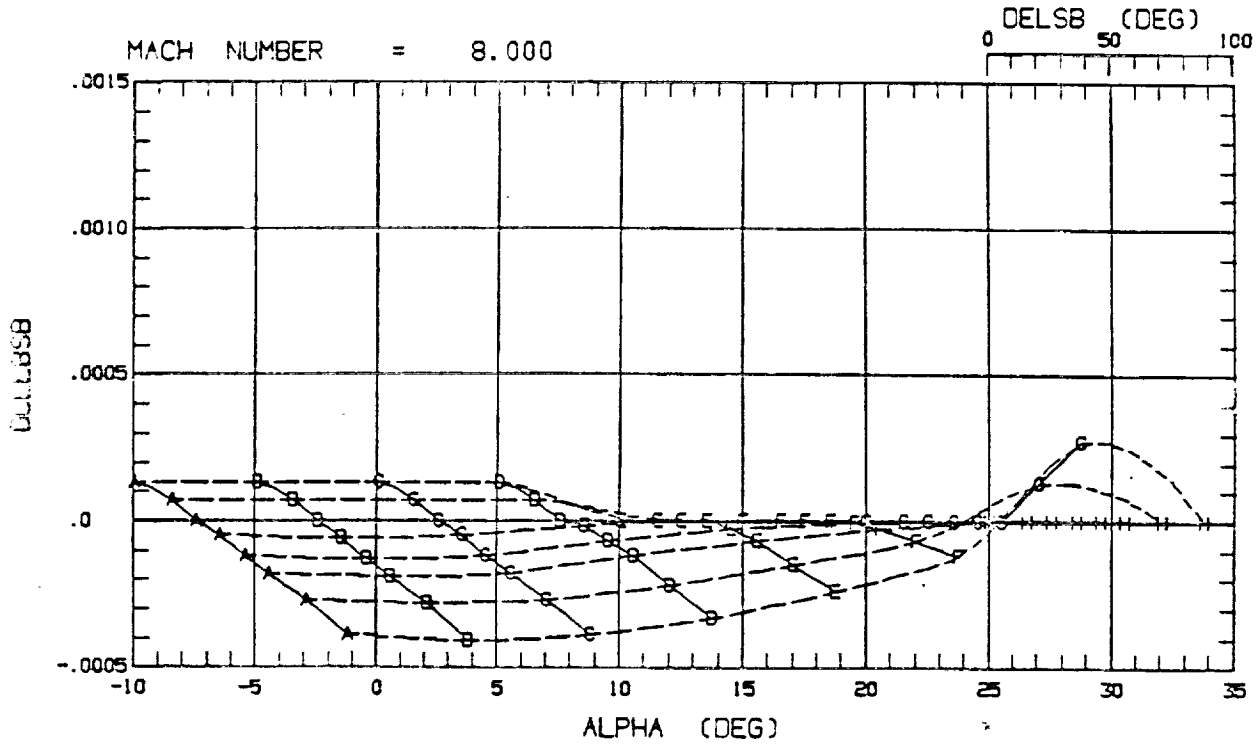


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00020	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00027	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	-0.00035	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE 9-14-79

FIGURE 4.2.1.3-140
EFFECT OF SPEEDBRAKE



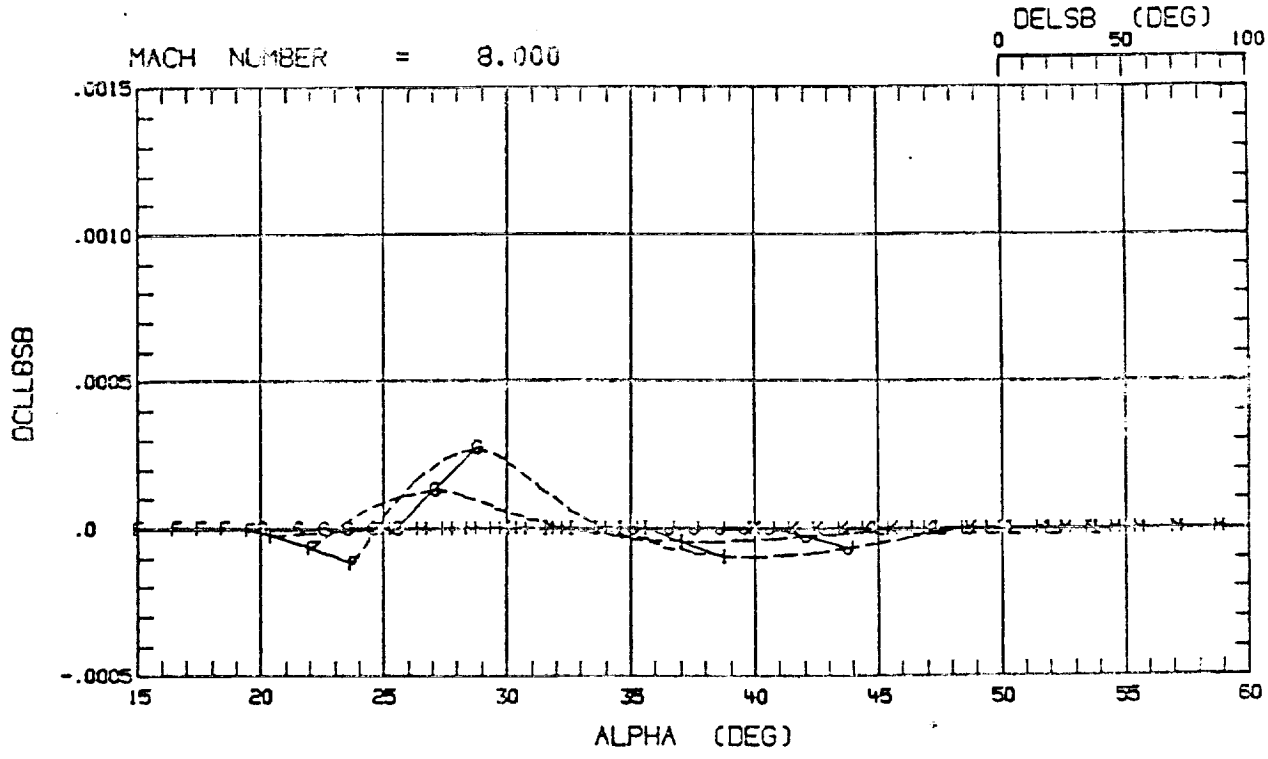
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00013	0.00013	0.00013	0.00013	0.0	0.0	0.0	0.0
15.000	0.00007	0.00007	0.00007	0.00007	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00005	-0.00006	-0.00005	-0.00002	0.0	0.0	0.0	0.0
45.000	-0.00012	-0.00013	-0.00012	-0.00007	-0.00003	-0.00001	0.0	0.0
55.000	-0.00018	-0.00019	-0.00018	-0.00012	-0.00007	-0.00003	0.0	0.0
70.000	-0.00027	-0.00028	-0.00027	-0.00022	-0.00015	-0.00007	0.00013	0.0
97.200	-0.00039	-0.00041	-0.00039	-0.00033	-0.00024	-0.00012	0.00027	0.0

ENGINEER LLL
DATE 9-24-78

FIGURE 4.2.1.3-141
EFFECT OF SPEEDBRAKE



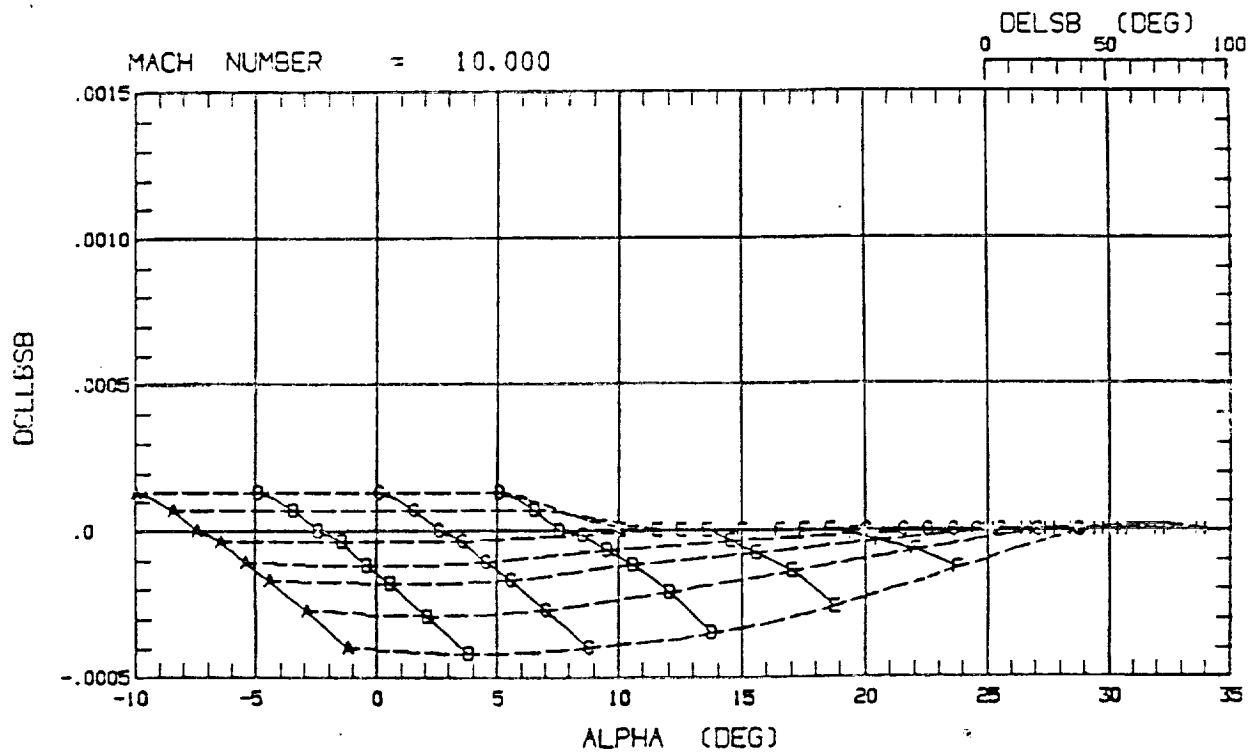
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00001	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00007	0.00013	0.0	-0.00005	-0.00003	0.0	0.0	0.0
87.200	-0.00012	0.00027	0.0	-0.00010	-0.00007	0.0	0.0	0.0

ENGINEER
DATE 7-14-78

FIGURE 4.2.1.3-142
EFFECT OF SPEEDBRAKE

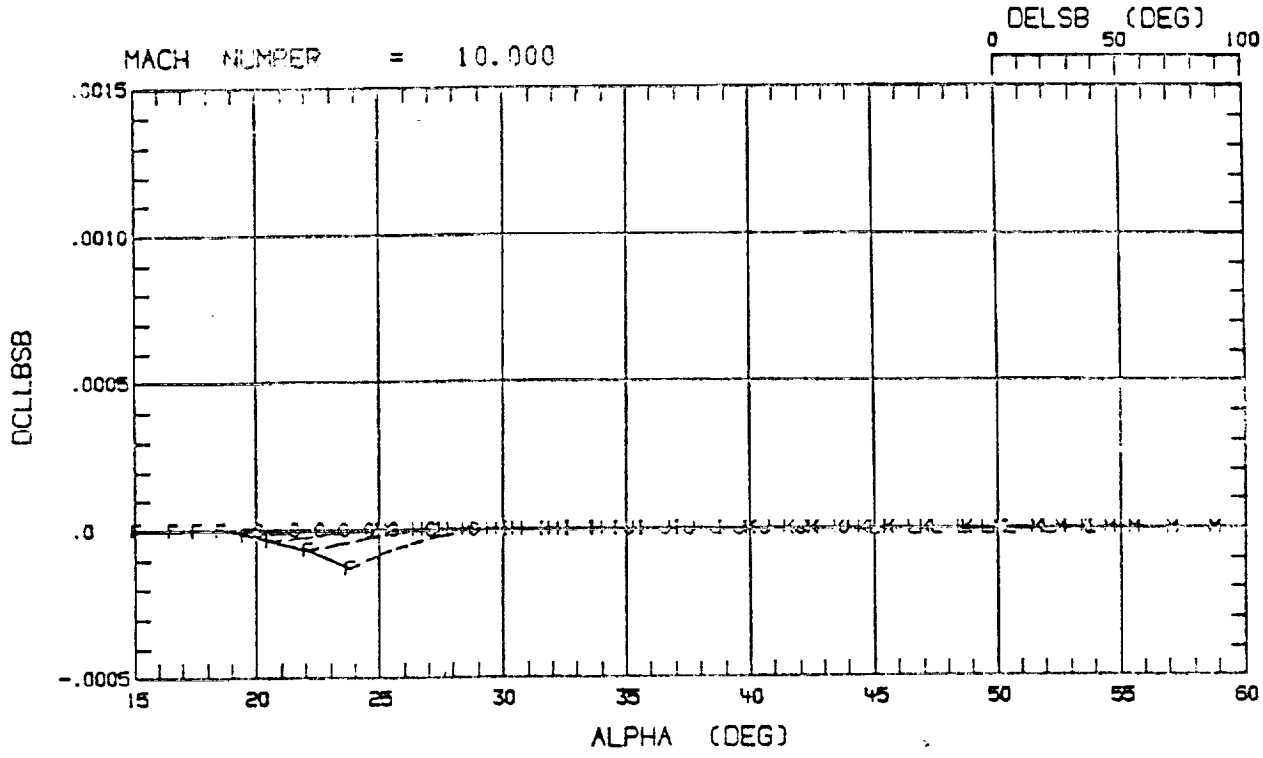


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00013	0.00013	0.00013	0.00013	0.0	0.0	0.0	0.0
15.000	0.00007	0.00007	0.00007	0.00007	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00004	-0.00004	-0.00004	-0.00002	0.0	0.0	0.0	0.0
45.000	-0.00011	-0.00012	-0.00011	-0.00007	-0.00004	-0.00002	0.0	0.0
55.000	-0.00017	-0.00018	-0.00017	-0.00012	-0.00008	-0.00004	0.0	0.0
70.000	-0.00027	-0.00029	-0.00027	-0.00021	-0.00014	-0.00007	0.0	0.0
87.200	-0.00040	-0.00042	-0.00040	-0.00035	-0.00026	-0.00013	0.0	0.0

ENGINEER LL
DATE 9-14-82

FIGURE 4.2.1.3-143
EFFECT OF SPEEDBRAKE



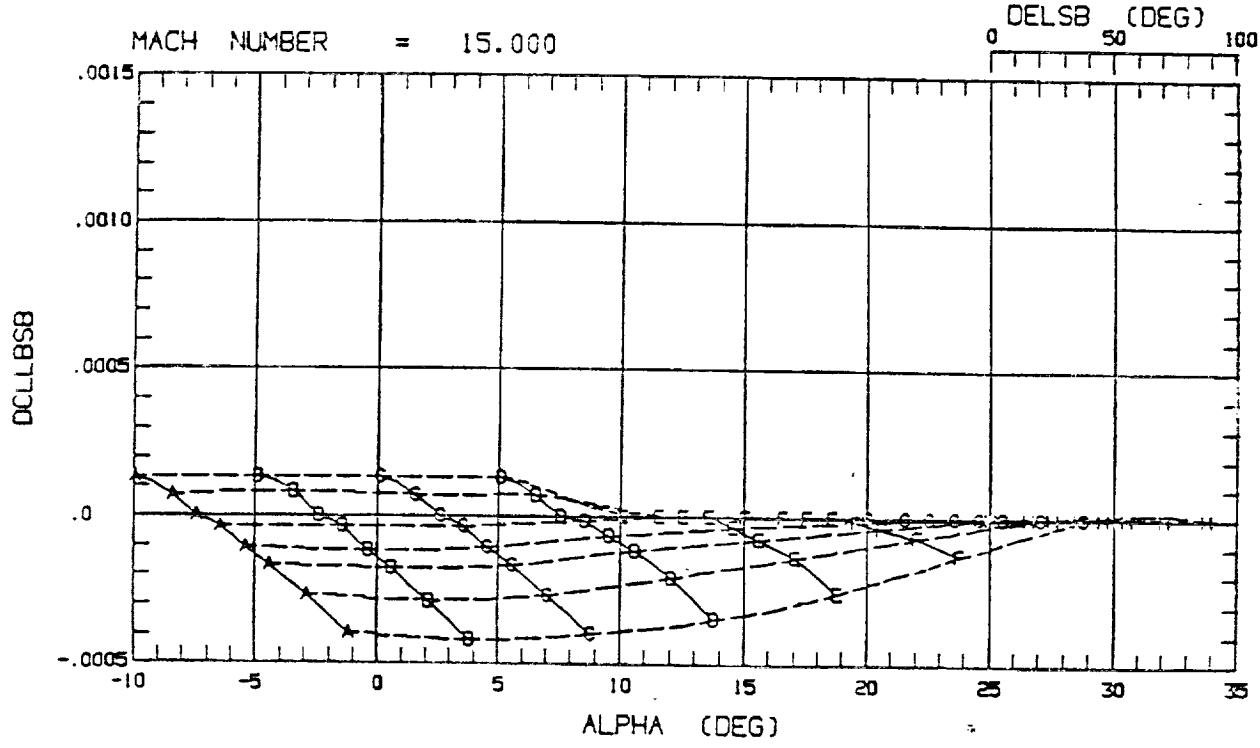
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00004	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00007	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	-0.00013	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER LL
DATE 9-14-82

FIGURE 4.2.1.3-144
EFFECT OF SPEEDBRAKE



CONFIGURATION

BASELINE ORBITER VEHICLE

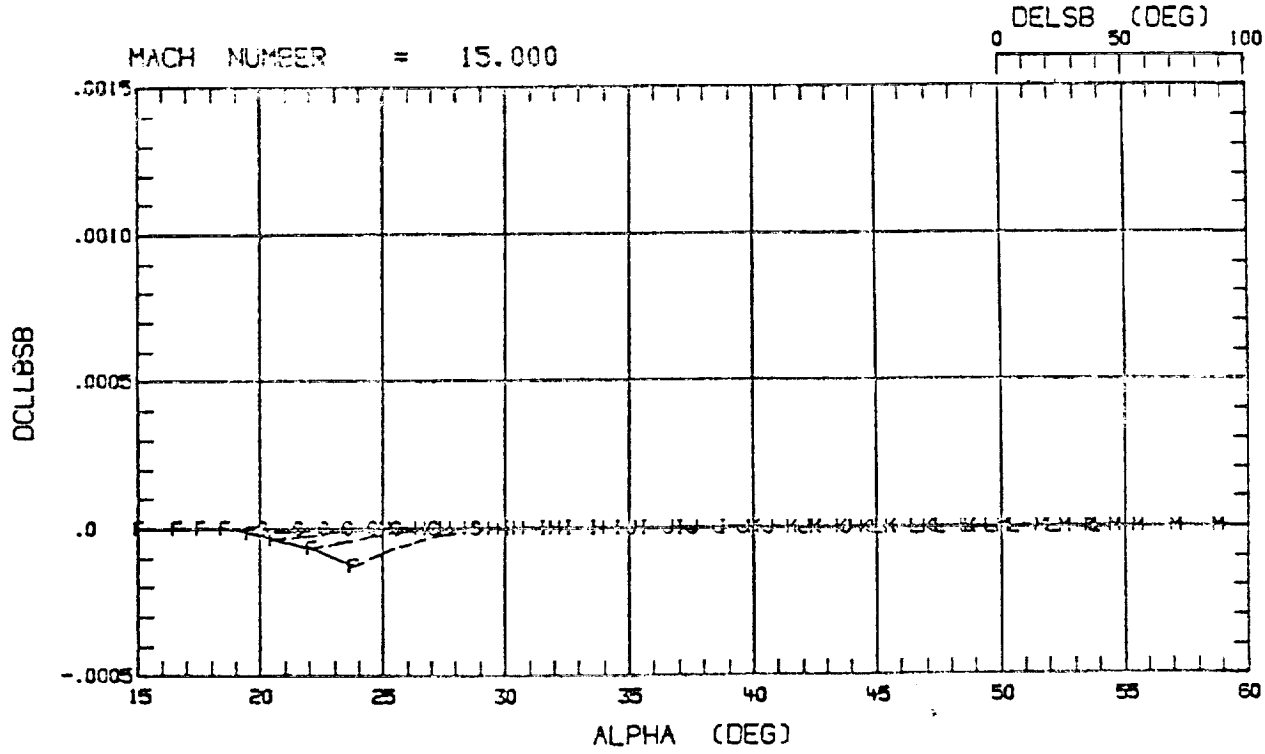
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

REFERENCE DIMENSIONS

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB DEG	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00013	0.00013	0.00013	0.00013	0.0	0.0	0.0	0.0
15.000	0.00007	0.00008	0.00007	0.00007	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00004	-0.00004	-0.00004	-0.00002	0.0	0.0	0.0	0.0
45.000	-0.00011	-0.00012	-0.00011	-0.00007	-0.00004	-0.00002	0.0	0.0
55.000	-0.00017	-0.00018	-0.00017	-0.00012	-0.00008	-0.00004	0.0	0.0
70.000	-0.00027	-0.00029	-0.00027	-0.00021	-0.00014	-0.00007	0.0	0.0
87.200	-0.00040	-0.00042	-0.00040	-0.00035	-0.00026	-0.00013	0.0	0.0

ENGINEER
DATE 9-16-85

FIGURE 4.2.1.3-145
EFFECT OF SPEEDBRAKE

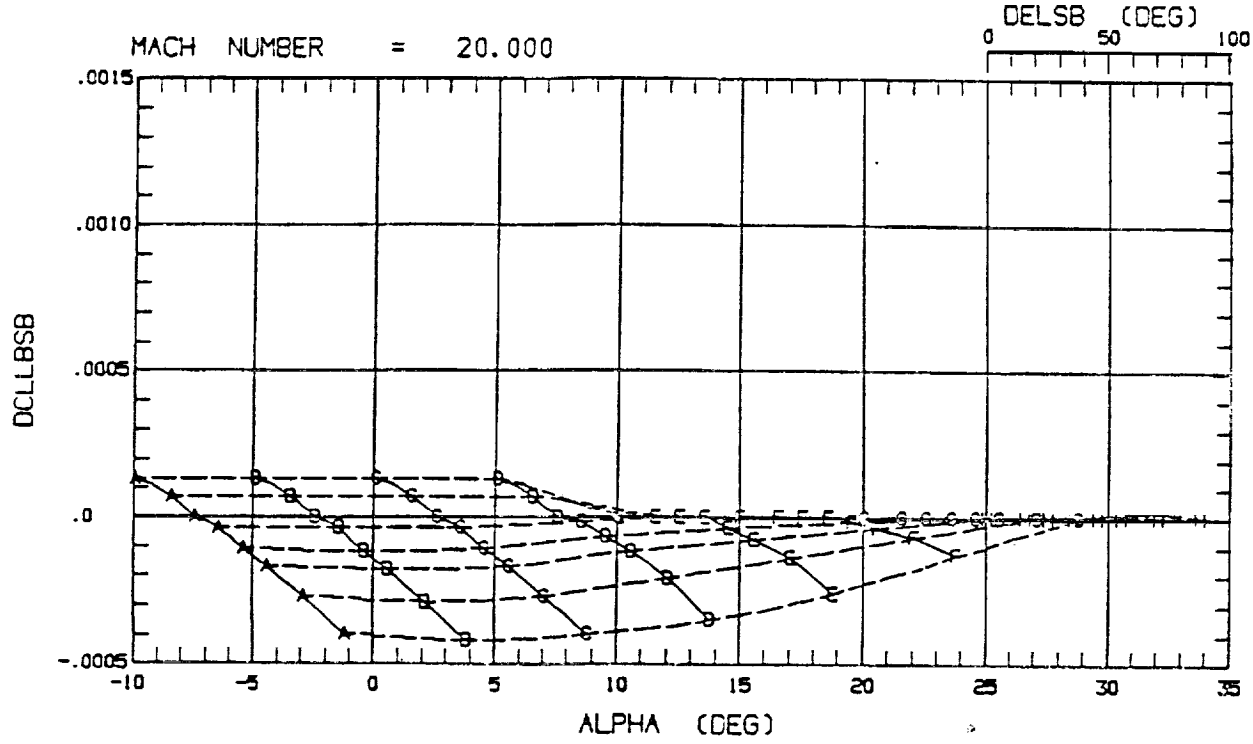


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00004	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00007	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	-0.00013	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER [illegible]
DATE 9-14-73

FIGURE 4.2.1.3-146
EFFECT OF SPEEDBRAKE

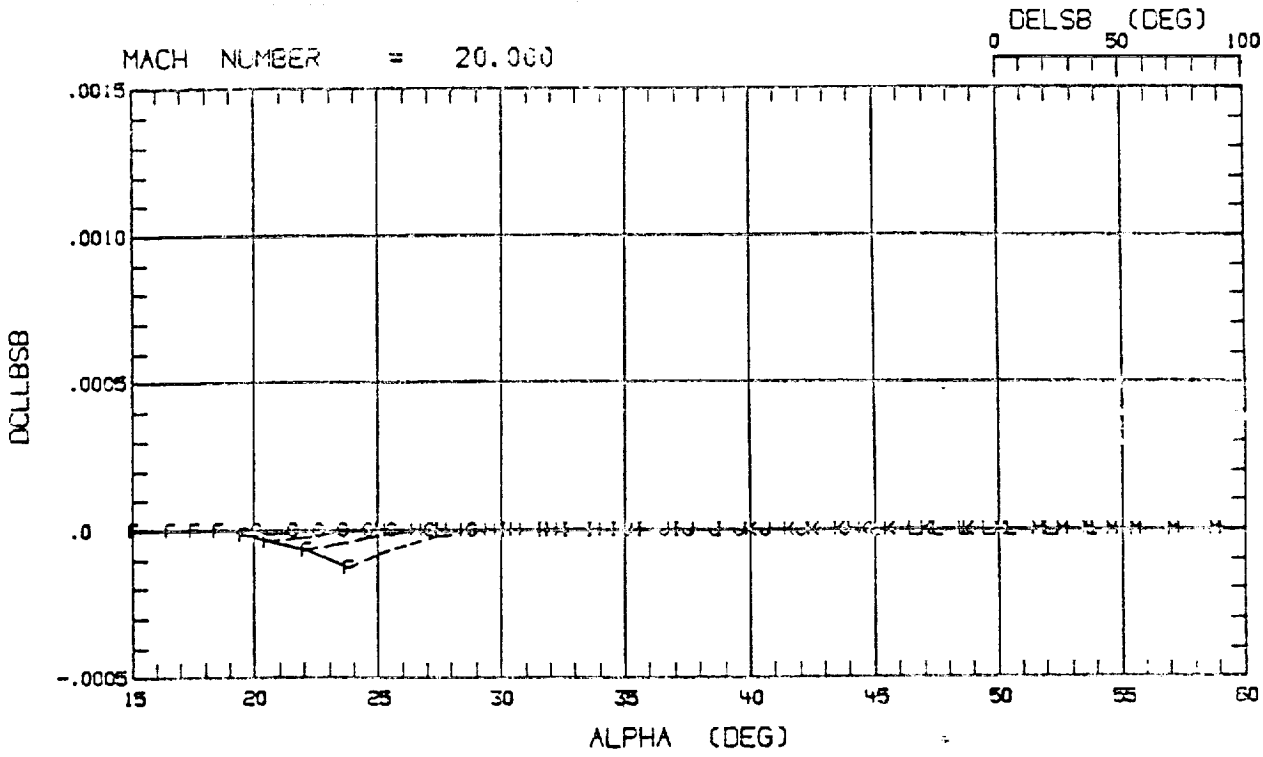


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.00013	0.00013	0.00013	0.00013	0.0	0.0	0.0	0.0
15.000	0.00007	0.00007	0.00007	0.00007	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00004	-0.00004	-0.00004	-0.00002	0.0	0.0	0.0	0.0
45.000	-0.00011	-0.00012	-0.00011	-0.00007	-0.00004	-0.00002	0.0	0.0
55.000	-0.00017	-0.00018	-0.00017	-0.00012	-0.00008	-0.00004	0.0	0.0
70.000	-0.00027	-0.00029	-0.00027	-0.00021	-0.00014	-0.00007	0.0	0.0
87.200	-0.00040	-0.00042	-0.00040	-0.00035	-0.00026	-0.00013	0.0	0.0

ENGINEER LLL
DATE 9-14-78

FIGURE 4.2.1.3-147
EFFECT OF SPEEDBRAKE

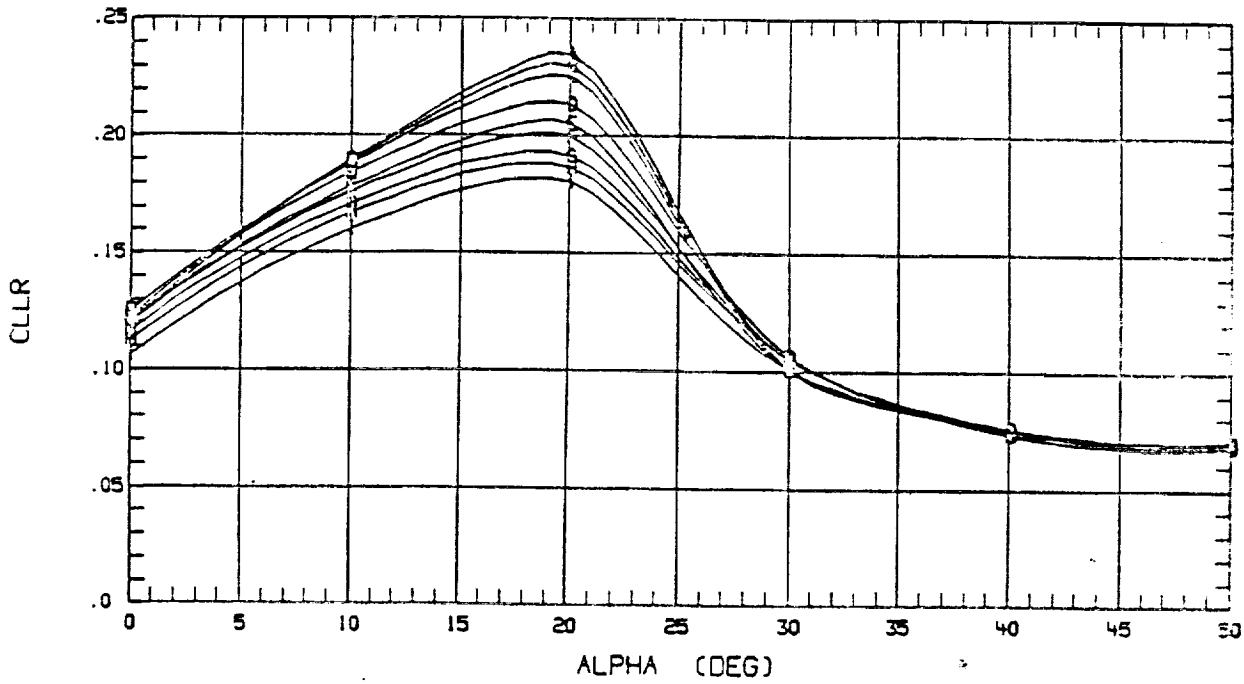


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE ROLLING MOMENT INCR.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	-0.00002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	-0.00004	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	-0.00007	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	-0.00013	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER LLL
DATE 9-14-78

FIGURE 4.2.1.3-148
EFFECT OF SPEEDBRAKE

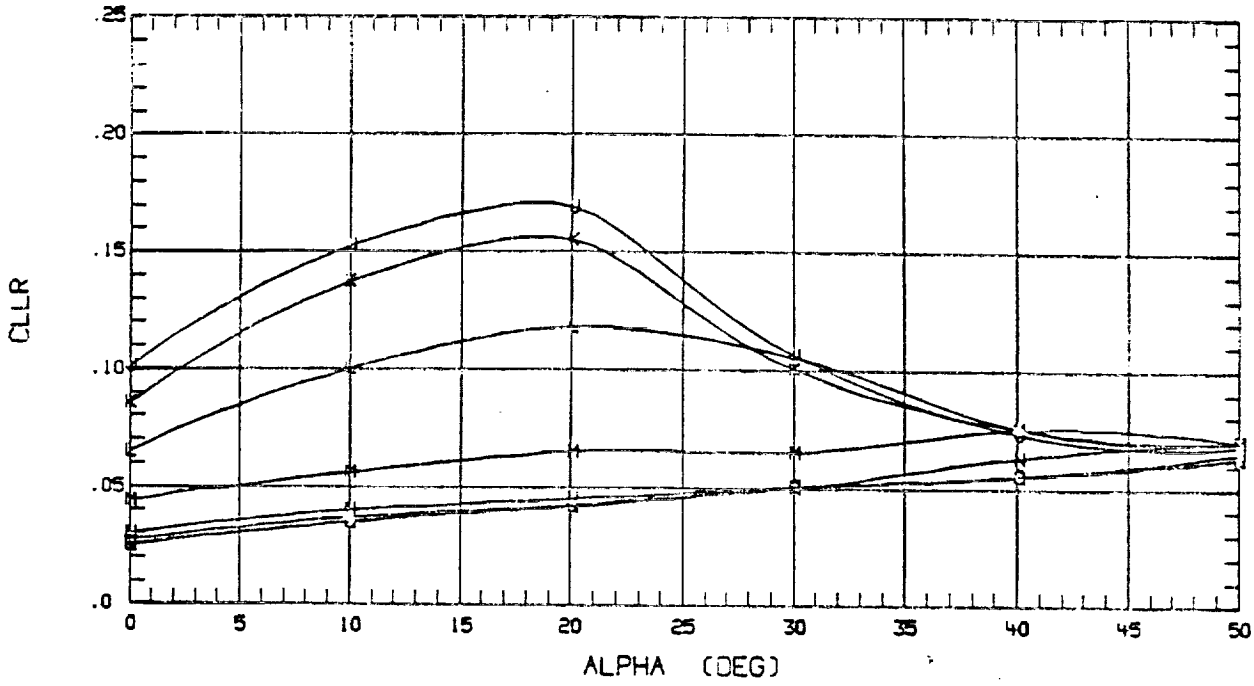


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	0.250	0.400	0.600	0.800	0.900	0.950	1.050	1.100	1.200
	A	B	C	D	E	F	G	H	I
ALPHA (DEG)	ROLLING MOMENT DUE TO YAW RATE								
0.0	0.12000	0.12200	0.12500	0.12500	0.12100	0.12000	0.11600	0.11200	0.10600
10.000	0.19000	0.18900	0.18800	0.18400	0.17800	0.17600	0.17100	0.16700	0.16000
20.000	0.23500	0.23000	0.22500	0.21300	0.20500	0.19900	0.19100	0.18600	0.18000
30.000	0.10000	0.10000	0.10000	0.10600	0.10000	0.10500	0.10500	0.10500	0.10000
40.000	0.07500	0.07500	0.07500	0.07300	0.07500	0.07500	0.07300	0.07300	0.07500
50.000	0.07000	0.07000	0.07000	0.06800	0.07000	0.06800	0.07000	0.06800	0.07000

ENGINEER_____
DATE_____

FIGURE 4.2.1.3-149
ROLLING MOMENT DUE TO YAW RATE



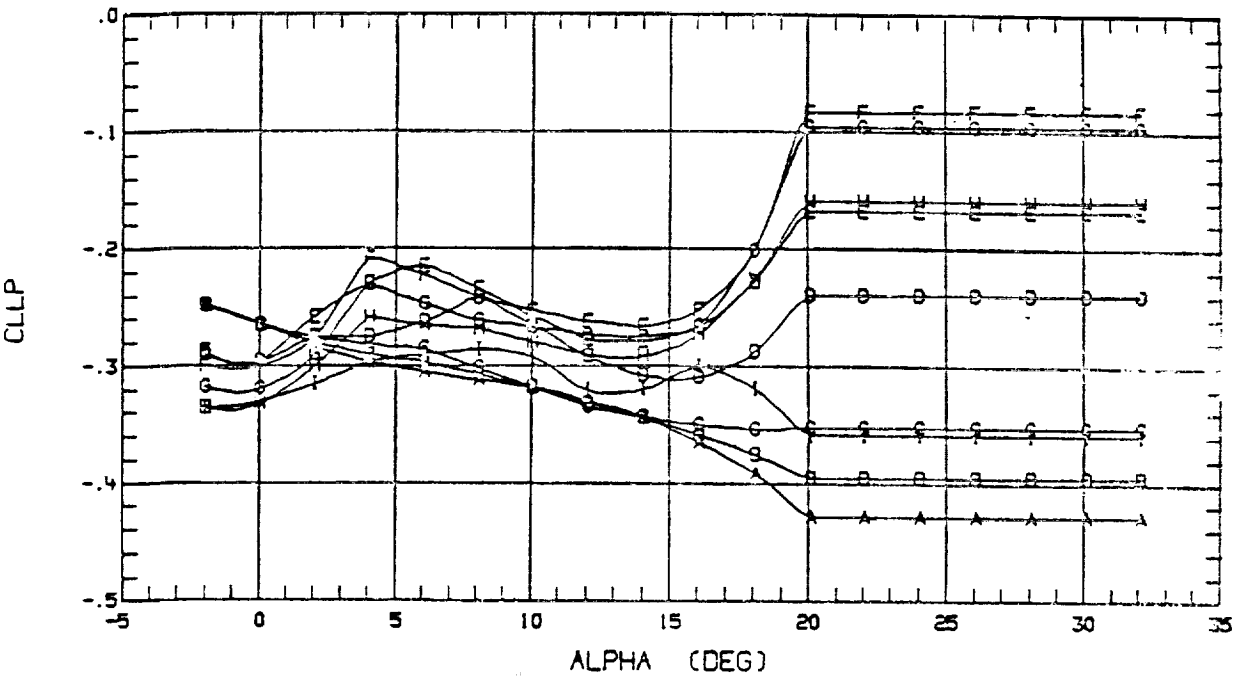
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	1.300	1.500	2.000	3.000	4.000	5.000	8.000	10.000	20.000
	J	K	L	M	N	O	P	Q	R
ALPHA (DEG)	ROLLING MOMENT DUE TO YAW RATE								
0.0	0.10100	0.08500	0.06500	0.04400	0.03000	0.02700	0.02500	0.02500	0.02500
10.000	0.15200	0.13700	0.10000	0.05600	0.04000	0.03700	0.03500	0.03500	0.03500
20.000	0.16900	0.15500	0.11800	0.06500	0.04500	0.04200	0.04200	0.04200	0.04200
30.000	0.10500	0.10000	0.10500	0.06500	0.05000	0.05000	0.05000	0.05000	0.05000
40.000	0.07300	0.07500	0.07500	0.07500	0.06300	0.05500	0.05500	0.05500	0.05500
50.000	0.05800	0.07000	0.07000	0.07000	0.07000	0.06500	0.06300	0.06300	0.06300

ENGINEER_____
DATE_____

FIGURE 4.2.1.3-150
ROLLING MOMENT DUE TO YAW RATE



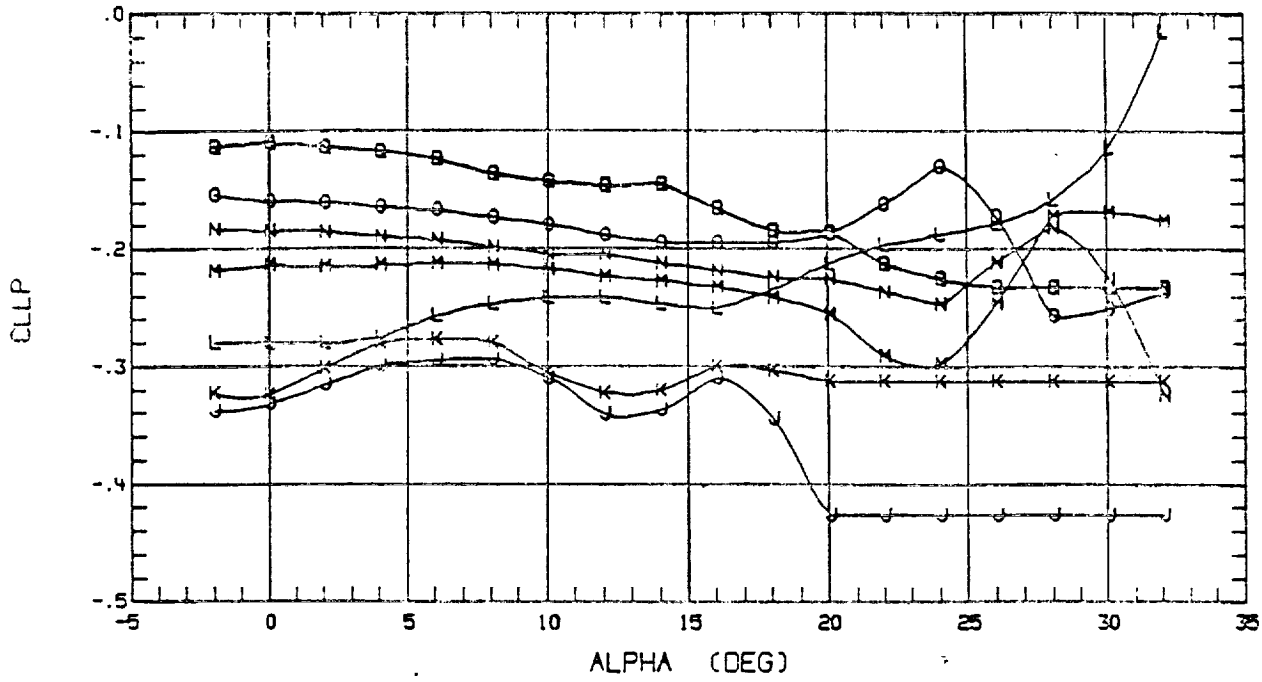
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER								
	0.250	0.400	0.600	0.800	0.900	0.950	1.050	1.100	1.200
ALPHA (DEG)	A	B	C	D	E	F	G	H	I
	ROLL DAMPING								
-2.000	-0.24830	-0.24830	-0.24830	-0.29120	-0.29870	-0.30120	-0.31910	-0.33670	-0.33670
0.0	-0.26470	-0.26470	-0.26470	-0.29740	-0.29750	-0.30000	-0.32020	-0.33280	-0.33030
2.000	-0.28360	-0.28030	-0.27600	-0.27600	-0.26940	-0.27700	-0.29100	-0.30110	-0.31620
4.000	-0.29750	-0.29090	-0.29230	-0.27500	-0.22940	-0.20920	-0.23150	-0.25930	-0.29710
6.000	-0.30630	-0.29760	-0.28610	-0.26300	-0.21550	-0.22310	-0.24780	-0.26540	-0.29070
8.000	-0.31260	-0.30820	-0.30250	-0.24200	-0.23450	-0.24200	-0.26150	-0.26900	-0.29670
10.000	-0.31890	-0.31890	-0.31890	-0.26600	-0.25940	-0.25330	-0.26760	-0.28020	-0.29290
12.000	-0.33020	-0.33230	-0.33530	-0.29240	-0.27730	-0.26220	-0.27370	-0.29140	-0.32160
14.000	-0.34410	-0.34410	-0.34410	-0.30880	-0.27960	-0.26600	-0.27480	-0.29240	-0.32020
16.000	-0.36550	-0.35900	-0.35040	-0.30980	-0.26730	-0.25210	-0.26580	-0.27340	-0.30110
18.000	-0.39200	-0.37580	-0.35420	-0.28860	-0.22920	-0.20290	-0.20130	-0.22650	-0.31980
20.000	-0.42960	-0.39610	-0.35290	-0.23950	-0.16890	-0.08320	-0.09660	-0.15960	-0.35680
22.000	-0.42960	-0.39610	-0.35290	-0.23950	-0.16890	-0.08320	-0.09660	-0.15960	-0.35680
24.000	-0.42960	-0.39610	-0.35290	-0.23950	-0.16890	-0.08320	-0.09660	-0.15960	-0.35680
26.000	-0.42960	-0.39610	-0.35290	-0.23950	-0.16890	-0.08320	-0.09660	-0.15960	-0.35880
28.000	-0.42960	-0.39610	-0.35290	-0.23950	-0.16890	-0.08320	-0.09660	-0.15960	-0.35880
30.000	-0.42960	-0.39610	-0.35290	-0.23950	-0.16890	-0.08320	-0.09660	-0.15960	-0.35880
32.000	-0.42960	-0.39610	-0.35290	-0.23950	-0.16890	-0.08320	-0.09660	-0.15960	-0.35890

ENGINEER_____
DATE_____

FIGURE 4.2.1.3-151
ROLL DAMPING



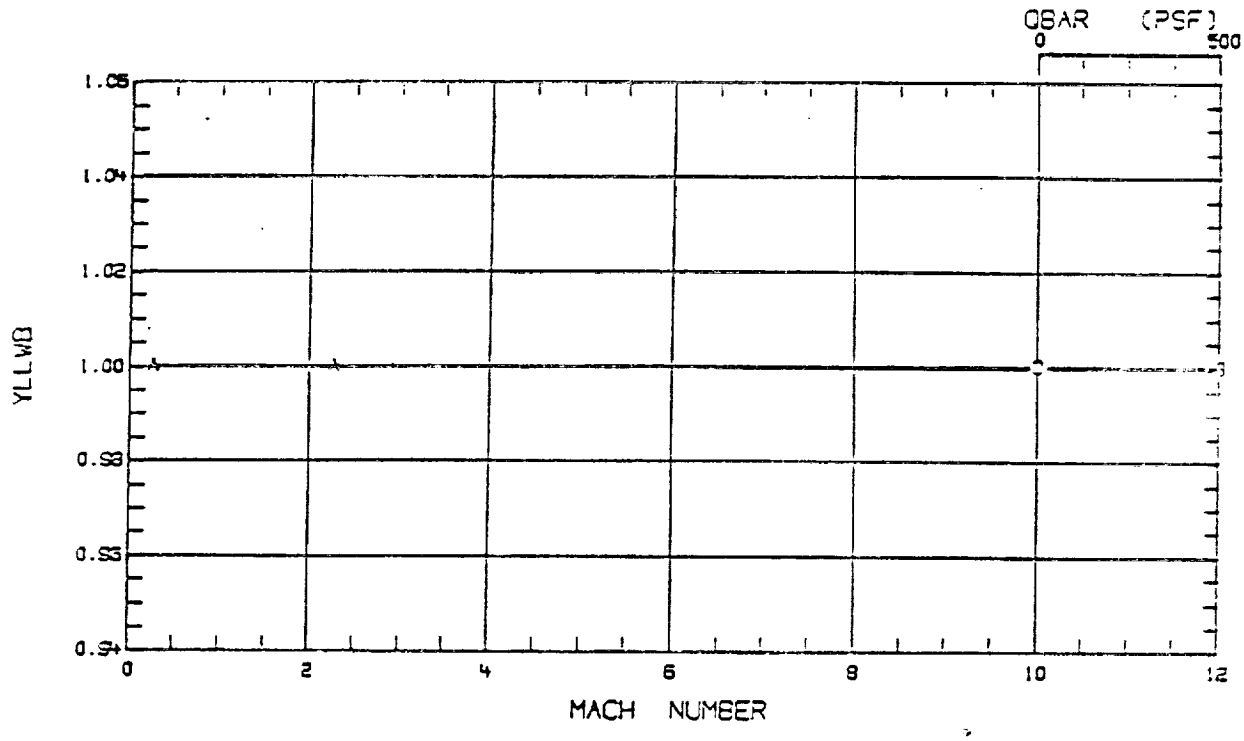
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER								
	1.300	1.500	2.000	3.000	4.000	5.000	8.000	10.000	20.000
	J	K	L	M	N	O	P	Q	R
ALPHA (DEG)	ROLL DAMPING								
-2.000	-0.33920	-0.32400	-0.28100	-0.21900	-0.18400	-0.15500	-0.11440	-0.11440	-0.11440
0.0	-0.33280	-0.32500	-0.28000	-0.21500	-0.18500	-0.16000	-0.11050	-0.11050	-0.11050
2.000	-0.31620	-0.30200	-0.28100	-0.21600	-0.18600	-0.16100	-0.11400	-0.11400	-0.11400
4.000	-0.29960	-0.28000	-0.27500	-0.21500	-0.19000	-0.16500	-0.11760	-0.11760	-0.11760
6.000	-0.29570	-0.27800	-0.25800	-0.21300	-0.19300	-0.16800	-0.12500	-0.12500	-0.12500
8.000	-0.29420	-0.29000	-0.24700	-0.21400	-0.19900	-0.17400	-0.13740	-0.13740	-0.13740
10.000	-0.31040	-0.30500	-0.24300	-0.21800	-0.20500	-0.18000	-0.14350	-0.14350	-0.14350
12.000	-0.34180	-0.32300	-0.24200	-0.22400	-0.20600	-0.18900	-0.14710	-0.14710	-0.14710
14.000	-0.33780	-0.32100	-0.24800	-0.22900	-0.21300	-0.19500	-0.14560	-0.14560	-0.14560
16.000	-0.31120	-0.30100	-0.25100	-0.23400	-0.21900	-0.19600	-0.16670	-0.16670	-0.16670
18.000	-0.34500	-0.30400	-0.23500	-0.24200	-0.22500	-0.19500	-0.16540	-0.16540	-0.16540
20.000	-0.42670	-0.31400	-0.21300	-0.25600	-0.22600	-0.19800	-0.16650	-0.16650	-0.16650
22.000	-0.42670	-0.31400	-0.19700	-0.29200	-0.23700	-0.16200	-0.21270	-0.21270	-0.21270
24.000	-0.42670	-0.31400	-0.18800	-0.29800	-0.24800	-0.13100	-0.22630	-0.22630	-0.22630
26.000	-0.42670	-0.31400	-0.17900	-0.24700	-0.21200	-0.17200	-0.23320	-0.23320	-0.23320
28.000	-0.42670	-0.31400	-0.15800	-0.17300	-0.18300	-0.25800	-0.23320	-0.23320	-0.23320
30.000	-0.42670	-0.31400	-0.11400	-0.16900	-0.22600	-0.25100	-0.23320	-0.23320	-0.23320
32.000	-0.42670	-0.31400	-0.01500	-0.17700	-0.32500	-0.23700	-0.23320	-0.23320	-0.23320

ENGINEER_____
CATE_____

FIGURE 4.2.1.3-152
ROLL DAMPING



CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.550 FT.
			BODY LENGTH	LB = 1290.3 IN.

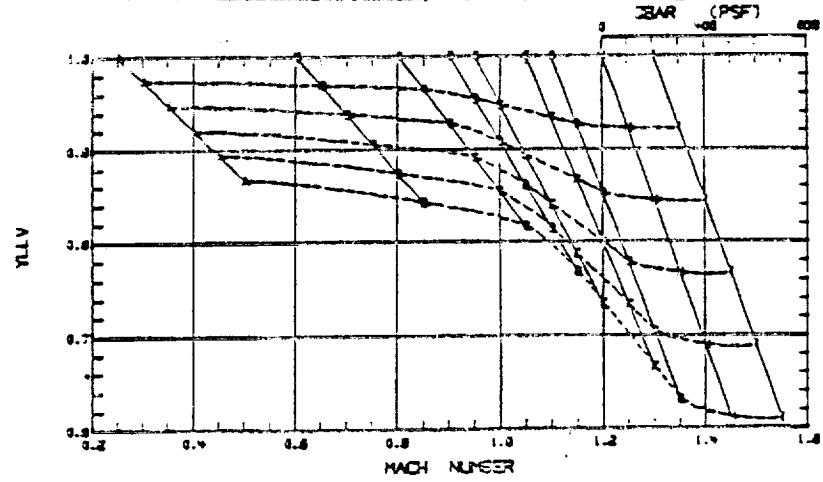
	MACH NUMBER	
	0.250	10.000
	A	B
QBAR (PSF)	F/R WING-BODY ROLLING	
0.0	1.00000	1.00000
500.000	1.00000	1.00000

ENGINEER [illegible]
DATE 2-3-82

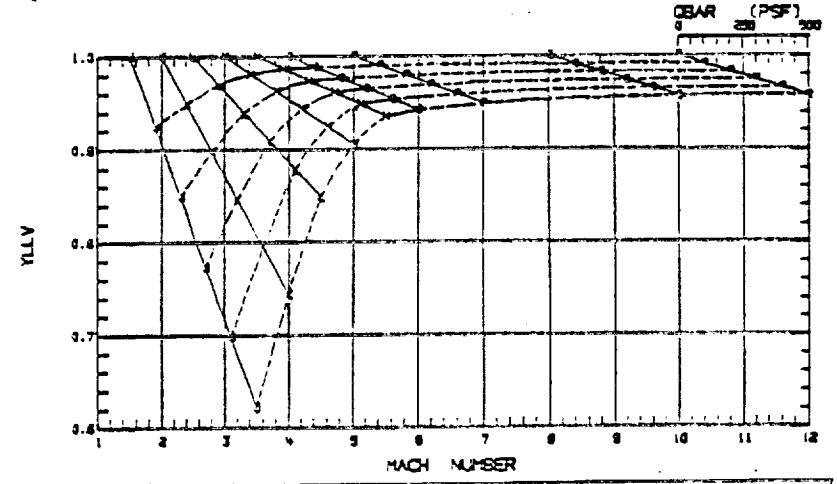
FIGURE 4.2.1.3-153
FLEXIBLE/RIGID WING-BODY ROLLING MOMENT DERIVATIVE

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XB = FS 1078.7 IN.	WING AREA	S = 2690.00 SQ.FT.
OR	YB = BL 0.0 IN.	WING SPAN	B = 78.056 FT.
MOMENT REFERENCE	ZB = WL 378.0 IN.	M.A.C.	C = 38.588 FT.
		BODY LENGTH	L = 236.3 IN.



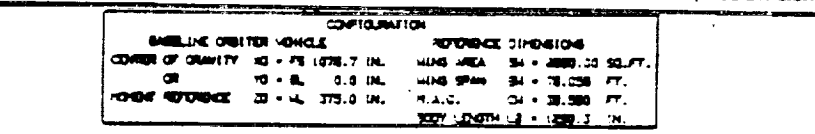
QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	F/R VERT. TAIL ROLLING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97333	0.98833	0.98333	0.98667	0.94667	0.93000	0.93800	0.95800	0.95800
200.000	0.94667	0.93667	0.93667	0.90733	0.88333	0.86800	0.85200	0.84467	0.84400
300.000	0.92000	0.90800	0.89000	0.88100	0.84000	0.79800	0.77800	0.78700	0.78800
400.000	0.89333	0.87333	0.85333	0.81467	0.78667	0.73200	0.70400	0.68833	0.68800
500.000	0.86667	0.84167	0.81667	0.78533	0.73333	0.65800	0.63200	0.61167	0.61000

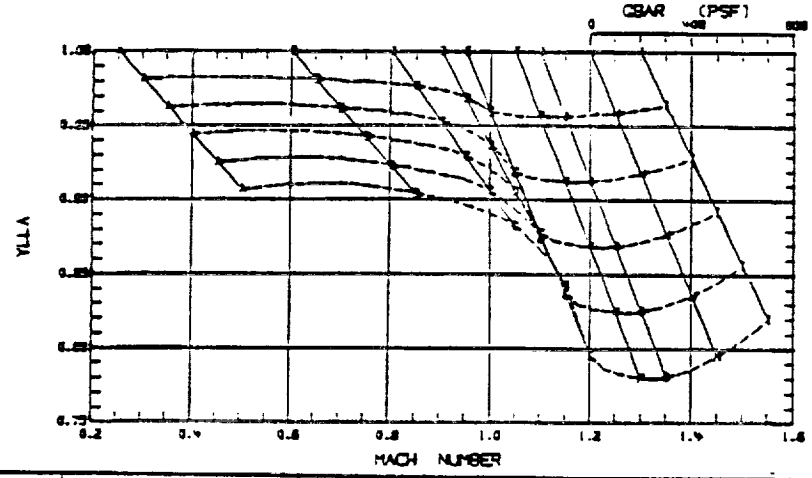


QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
	F/R VERT. TAIL ROLLING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.92433	0.94467	0.93867	0.93100	0.92700	0.90833	0.90867	0.90133	0.90133
200.000	0.84867	0.88733	0.87733	0.86200	0.85400	0.82767	0.82733	0.80267	0.80267
300.000	0.77300	0.82600	0.80800	0.79300	0.78100	0.74800	0.74600	0.70400	0.70400
400.000	0.69733	0.76467	0.73867	0.72400	0.70600	0.66833	0.66667	0.60533	0.60533
500.000	0.62167	0.70333	0.66933	0.65500	0.63200	0.58900	0.58467	0.50667	0.50667

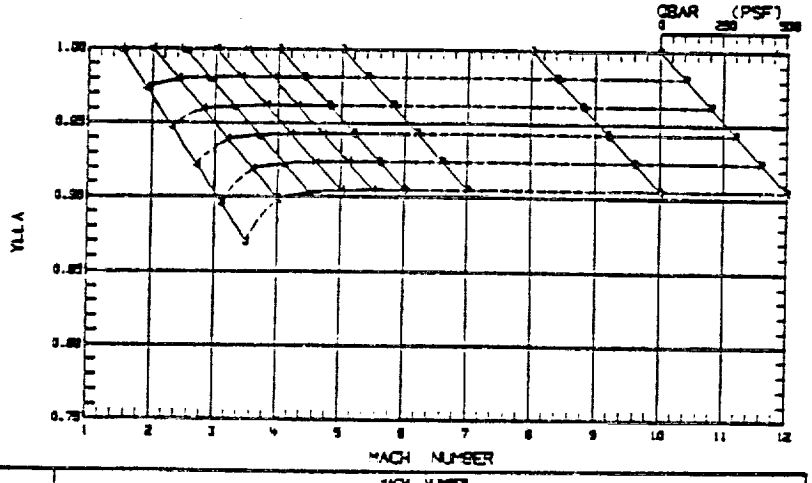
ENGINEER [illegible]
DATE 4-3-72

FIGURE 4.2.1.3-154
FLEXIBLE/RIGID VERTICAL TAIL ROLLING MOMENT DERIVATIVE





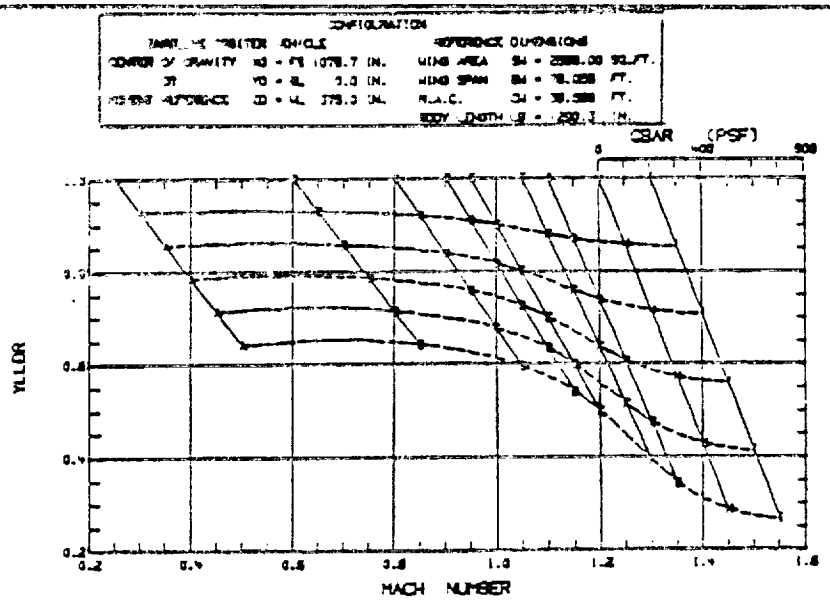
QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	F/B AILERON ROLLING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98133	0.98087	0.97633	0.95840	0.95800	0.93800	0.93887	0.93887	0.93400
200.000	0.98087	0.98133	0.95087	0.93080	0.91800	0.91200	0.91253	0.91793	0.92000
300.000	0.97400	0.97400	0.92500	0.90580	0.87700	0.88000	0.88000	0.87880	0.89000
400.000	0.96533	0.96087	0.90533	0.87380	0.83800	0.82400	0.82087	0.83387	0.83800
500.000	0.95087	0.94133	0.88167	0.84200	0.79000	0.78000	0.78133	0.79400	0.82000



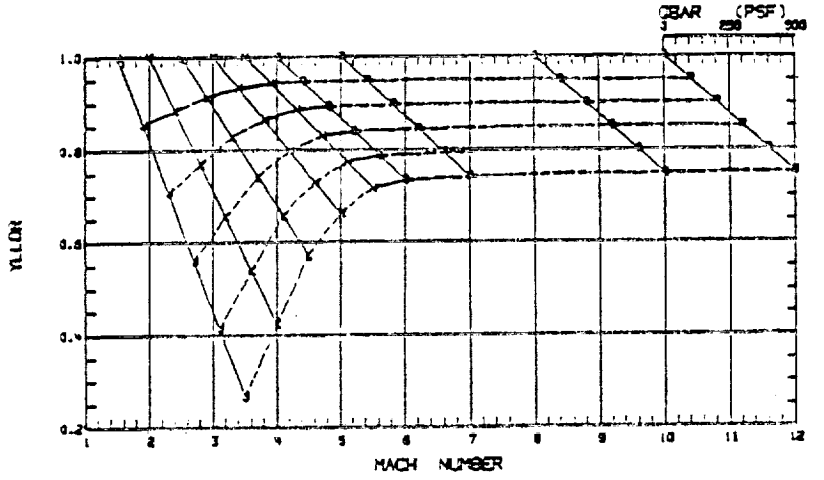
QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
	F/B AILERON ROLLING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97387	0.97887	0.98083	0.98087	0.98083	0.98087	0.98100	0.98100	0.98100
200.000	0.94783	0.95833	0.96167	0.96173	0.96167	0.96133	0.96800	0.96800	0.96800
300.000	0.92150	0.93800	0.94150	0.94488	0.94680	0.94688	0.94200	0.94300	0.94300
400.000	0.89587	0.91867	0.92253	0.92547	0.92773	0.92987	0.92400	0.92400	0.92400
500.000	0.87083	0.89933	0.90317	0.90453	0.90487	0.90493	0.90500	0.90500	0.90500

ENGINEER EAG
DATE 4-3-79

FIGURE 4.2.1.3-155
FLEXIBLE/RIGID AILERON ROLLING MOMENT DERIVATIVE



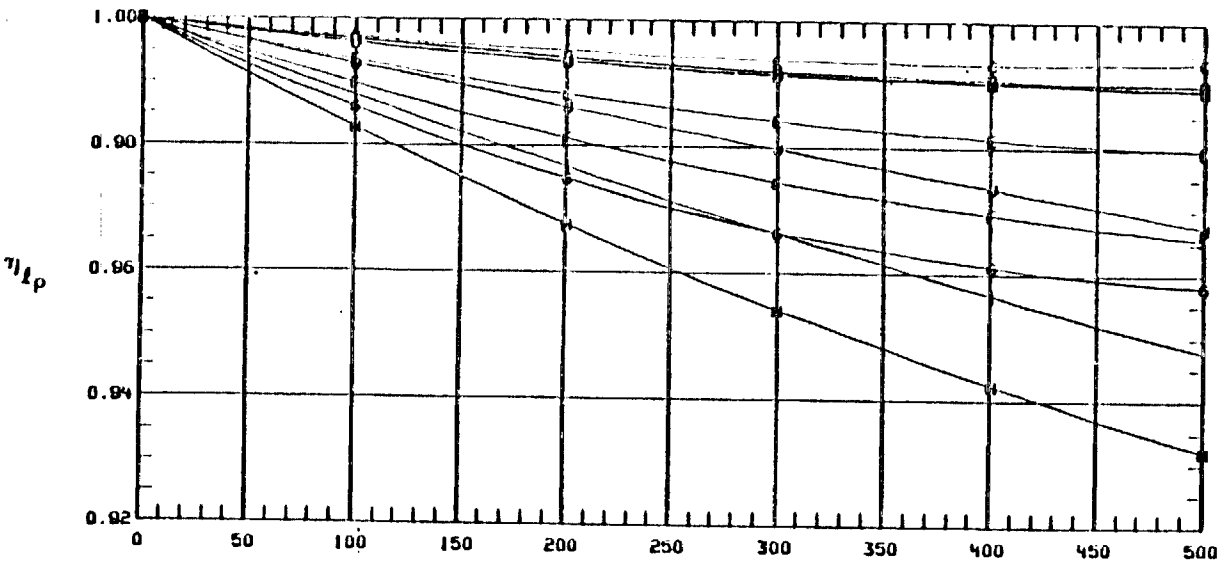
QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	F/R RUDDER ROLLING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.92800	0.92800	0.91867	0.90800	0.88833	0.87833	0.88833	0.85700	0.85333
200.000	0.85800	0.85800	0.83733	0.81600	0.79867	0.75867	0.73867	0.71400	0.70867
300.000	0.78400	0.78400	0.75800	0.72400	0.69800	0.63200	0.60533	0.57100	0.56000
400.000	0.71200	0.71200	0.67467	0.63200	0.59733	0.51333	0.47333	0.42800	0.41333
500.000	0.64000	0.64000	0.59333	0.54000	0.49867	0.39167	0.34167	0.28500	0.26667



QBAR (PSF)	MACH NUMBER 1.500 J	2.200 K	2.500 L	3.000 M	3.500 N	4.200 O	5.000 P	8.000 Q	10.000 R
	F/R RUDDER ROLLING MOM DERIV								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.85333	0.89467	0.91433	0.93800	0.94333	0.94467	0.94800	0.94267	0.95000
200.000	0.70267	0.78933	0.82267	0.86400	0.88667	0.89333	0.89800	0.88133	0.90000
300.000	0.58000	0.69400	0.74200	0.79800	0.83000	0.84400	0.84400	0.84800	0.85000
400.000	0.49333	0.63867	0.69733	0.76800	0.77333	0.79867	0.79200	0.79867	0.80000
500.000	0.39867	0.57333	0.67167	0.58000	0.71867	0.73333	0.74000	0.74933	0.75000

ENGINEER DTG
DATE 4-3-72

FIGURE 4.2.1.3-156
FLEXIBLE/RIGID RUDDER ROLLING MOMENT DERIVATIVE



Roll Rate

$$\eta_{\ell_p} = \frac{C_{\ell_p}'}{C_{\ell_p}^R}$$

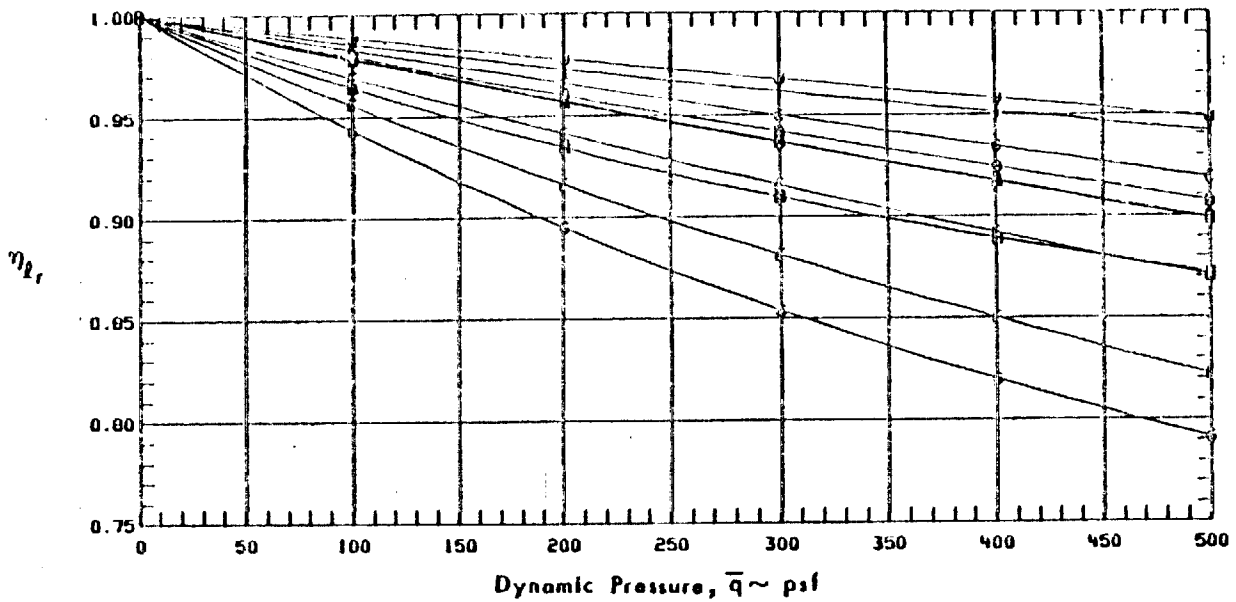
$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, η_{ℓ_p}									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99668	0.99666	0.99712	0.99618	0.99336	0.98960	0.98581	0.98268	0.98778	0.99204
200.000	0.99393	0.99398	0.99501	0.99327	0.98802	0.98104	0.97455	0.96742	0.97649	0.98602
300.000	0.99178	0.99200	0.99369	0.99131	0.98398	0.97427	0.96627	0.95408	0.96610	0.97954
400.000	0.99025	0.99075	0.99326	0.99035	0.98122	0.96918	0.96103	0.94239	0.95657	0.97339
500.000	0.98922	0.99016	0.99364	0.99025	0.97958	0.96552	0.95796	0.93186	0.94758	0.96742

ENGINEER: DTD
DATE: 9/2/77
REVISED:

Figure 4.2.1.3-157
AEROELASTIC RATIOS

4.2.1.3-154

Rockwell International
Space Division



Yaw Rate

$$\eta_{\ell_r} = \frac{C_{\ell_r}^{\ell}}{C_{\ell_r}^{a}}$$

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, η_{ℓ_r}									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97761	0.97768	0.98242	0.97911	0.96873	0.95504	0.94281	0.96396	0.98542	0.98832
200.000	0.95630	0.95643	0.96552	0.95950	0.94044	0.91537	0.89415	0.93370	0.97241	0.97732
300.000	0.93601	0.93623	0.94928	0.94108	0.91490	0.88052	0.85347	0.90086	0.96089	0.96700
400.000	0.91661	0.91703	0.93367	0.92373	0.89164	0.84962	0.81964	0.86866	0.95075	0.95735
500.000	0.89802	0.89852	0.91860	0.90719	0.87000	0.82190	0.79126	0.83798	0.94168	0.94828

ENGINEER: DTD
DATE: 9/2/77
REVISED:

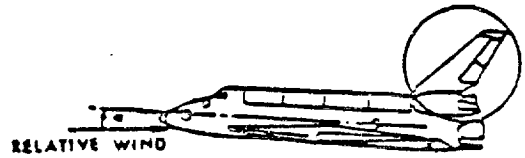
Figure 4.2.1.3-158
AEROELASTIC RATIOS

SD 72-SH-0060 IM

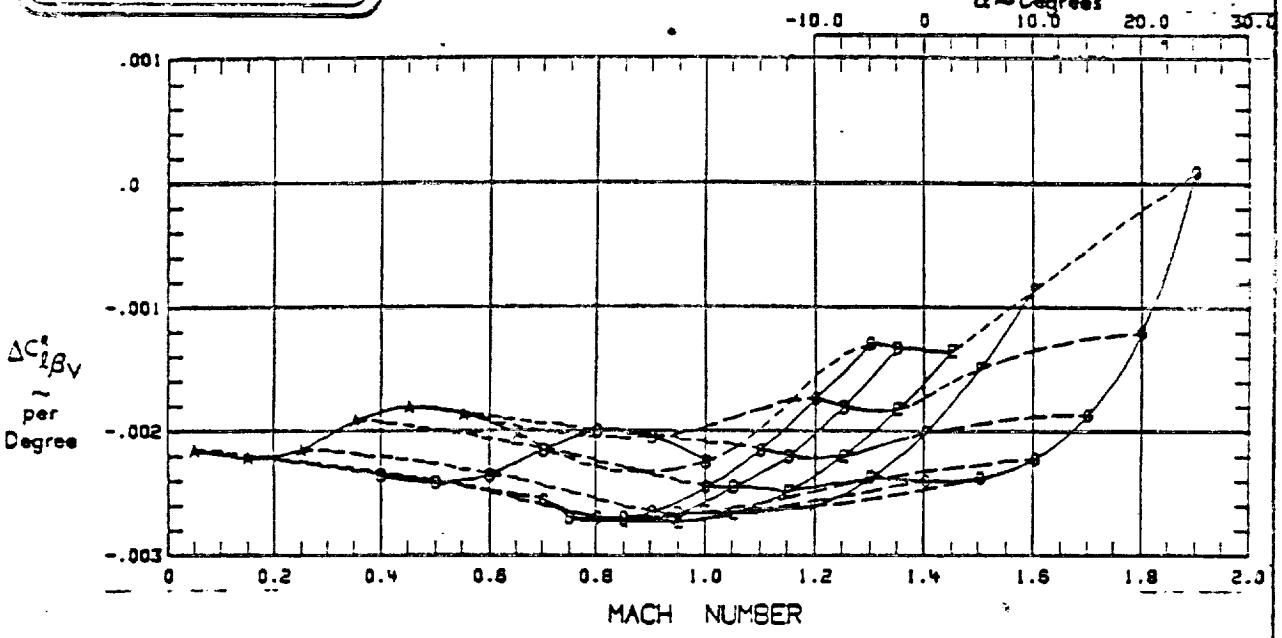
Rockwell International
Space Division

CONFIGURATION
BASELINE ORBITER VEHICLE

$\delta_e = 0°$
$\delta_{BF} = 0°$
$\delta_{SB} = 25°$



VERTICAL TAIL LOAD IN PRESENCE OF WING-BODY



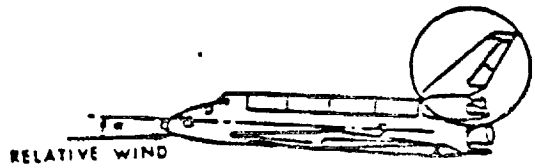
α ~ Degrees	Mach Number						
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500
	RIGID VERTICAL TAIL ROLLING MOMENT COEFF. DERIV.						
-10.000	-0.00215	-0.00236	-0.00255	-0.00270	-0.00272	-0.00265	-0.00237
-5.000	-0.00221	-0.00241	-0.00259	-0.00270	-0.00273	-0.00263	-0.00240
0.0	-0.00215	-0.00235	-0.00255	-0.00266	-0.00266	-0.00250	-0.00238
5.000	-0.00192	-0.00215	-0.00245	-0.00245	-0.00248	-0.00238	-0.00222
10.000	-0.00181	-0.00200	-0.00215	-0.00220	-0.00220	-0.00202	-0.00187
15.000	-0.00187	-0.00205	-0.00175	-0.00181	-0.00183	-0.00150	-0.00121
20.000	-0.00203	-0.00225	-0.00130	-0.00133	-0.00136	-0.00086	0.00009
25.000							
30.000							
35.000							
40.000							

ENGINEER: DTD
DATE: 10/29/77
REVISED:

Figure 4.2.1.3-159
VERTICAL TAIL INCREMENT

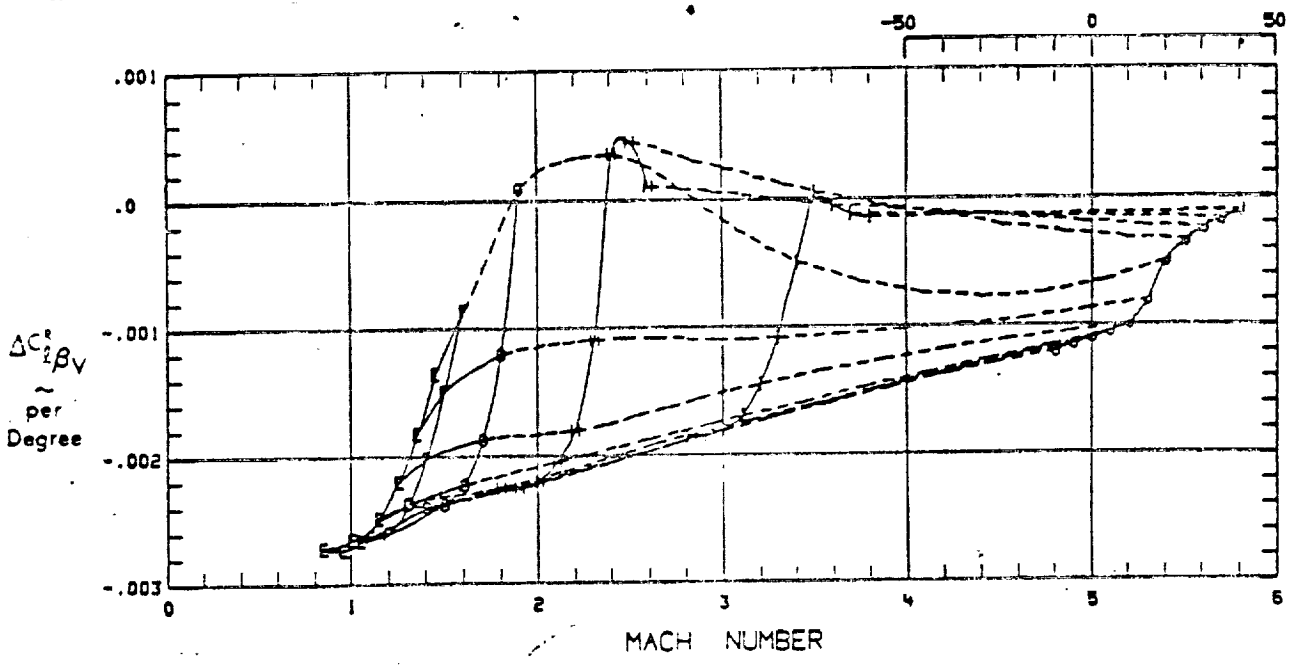
CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 0°$
$\delta_{BF} = 0°$
$\delta_{SB} = 25°$



VERTICAL TAIL LOAD IN PRESENCE OF WING-BODY

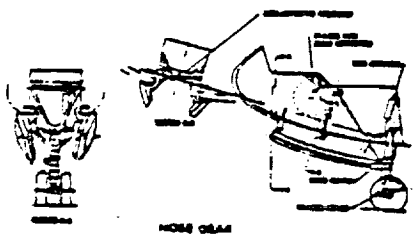
α ~ Degrees

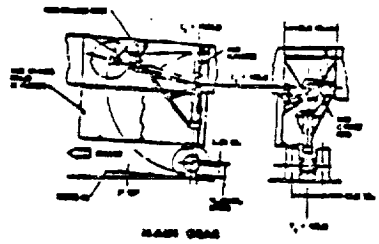


α ~ Degrees	Mach Number						
	E 1.050	F 1.200	G 1.500	H 2.300	I 3.000	J 5.000	
	RIGID VERTICAL TAIL ROLLING MOMENT COEFF. DERIV.						
-10.000	-0.00272	-0.00265	-0.00237	-0.00225	-0.00185	-0.00120	
-5.000	-0.00273	-0.00263	-0.00240	-0.00225	-0.00185	-0.00115	
0.0	-0.00265	-0.00260	-0.00238	-0.00220	-0.00180	-0.00110	
5.000	-0.00248	-0.00238	-0.00222	-0.00205	-0.00170	-0.00105	
10.000	-0.00220	-0.00202	-0.00167	-0.00160	-0.00145	-0.00100	
15.000	-0.00183	-0.00150	-0.00121	-0.00110	-0.00109	-0.00081	
20.000	-0.00136	-0.00095	0.00009	0.00035	-0.00050	-0.00050	
25.000				0.00045	0.00005	-0.00035	
30.000				0.00010	-0.00005	-0.00025	
35.000					-0.00013	-0.00018	
40.000					-0.00015	-0.00012	

ENGINEER DFC
DATE 10/29/77
REVISED

Figure 4.2.1.3-160
VERTICAL TAIL INCREMENT





CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY
OR
MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA
SPAN
MAC
BODY LENGTH

$$\Delta C_{l_{\beta_{\substack{\text{LANDING}\\\text{GEAR}}}}} = C_{l_{\beta_{\substack{\text{GEAR}\\\text{DOWN}}}}} - C_{l_{\beta_{\substack{\text{GEAR}\\\text{UP}}}}}$$

$\underset{\sim}{\alpha}$ Degrees	$\Delta C_{l_{\beta_{LG}}}$
-10.000	-0.00085
-5.000	-0.00042
0.0	-0.00020
5.000	0.00002
10.000	0.00014
15.000	0.00016
20.000	0.00005
25.000	-0.00008

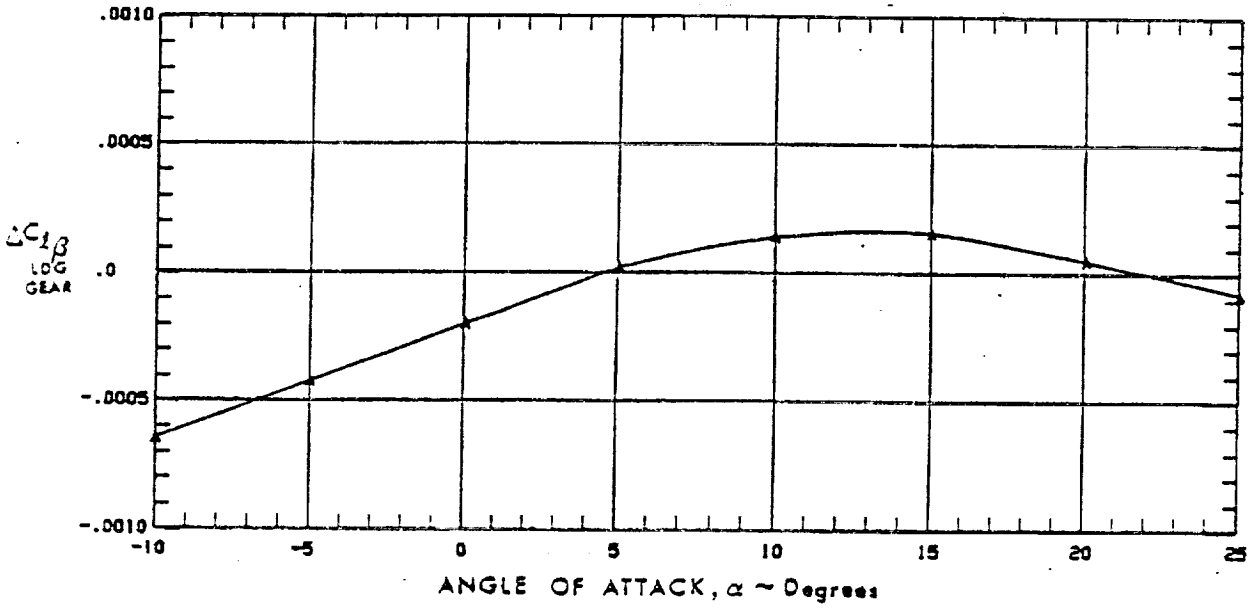
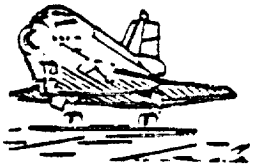


Figure 4.2.1.3-161
EFFECT OF LANDING GEAR

Landing Gear Down

$$\Delta C_{\ell_{\beta_{GROUND\ EFFECT}}} = C_{\ell_{\beta_{GROUND\ EFFECT}}} - C_{\ell_{\beta_{FREE\ STREAM}}}$$



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

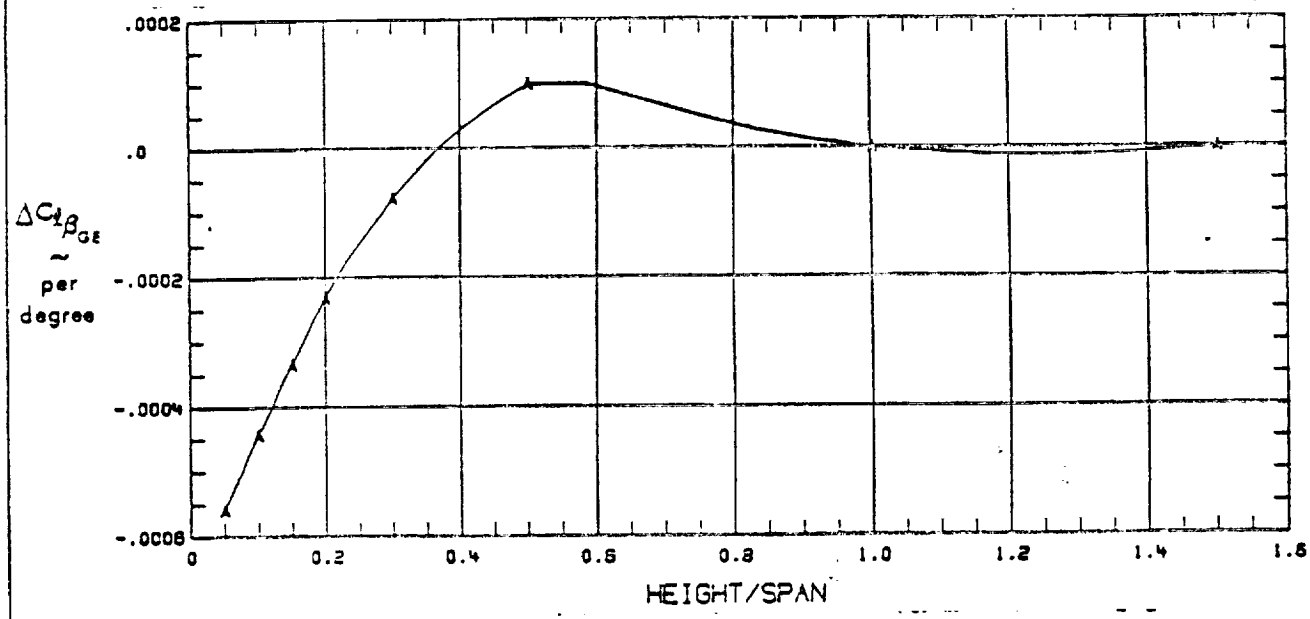
AREA

SPAN

MAC

BODY LENGTH

δ_e = All $\quad \delta_{BF} = -11.7°$ $\quad \delta_{SB} = 25°$



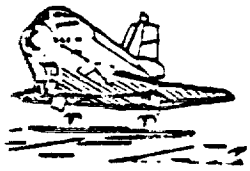
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	-4.000	0.0	4.000	8.000	12.000	16.000	20.000
	Incremental Rolling Moment Derivative, $\Delta C_{\ell_{\beta_{GRND\ EFFECT}}}$						
0.050		-0.00056					
0.100		-0.00044					
0.150		-0.00033					
0.200		-0.00023					
0.300		-0.00008					
0.500		0.00010					
1.000		0.0					
1.500		0.0					

ENGINEER: _____
DATE: _____
REVISED: _____

Figure 4.2.1.3-162
GROUND EFFECT

SH-CC6C IM

Landing Gear Down



$$\Delta C_{l_{\delta_{GROUND\ EFFECT}}} = C_{l_{\delta_{GROUND\ EFFECT}}} - C_{l_{\delta_{FREE\ STREAM}}}$$

CONFIGURATION

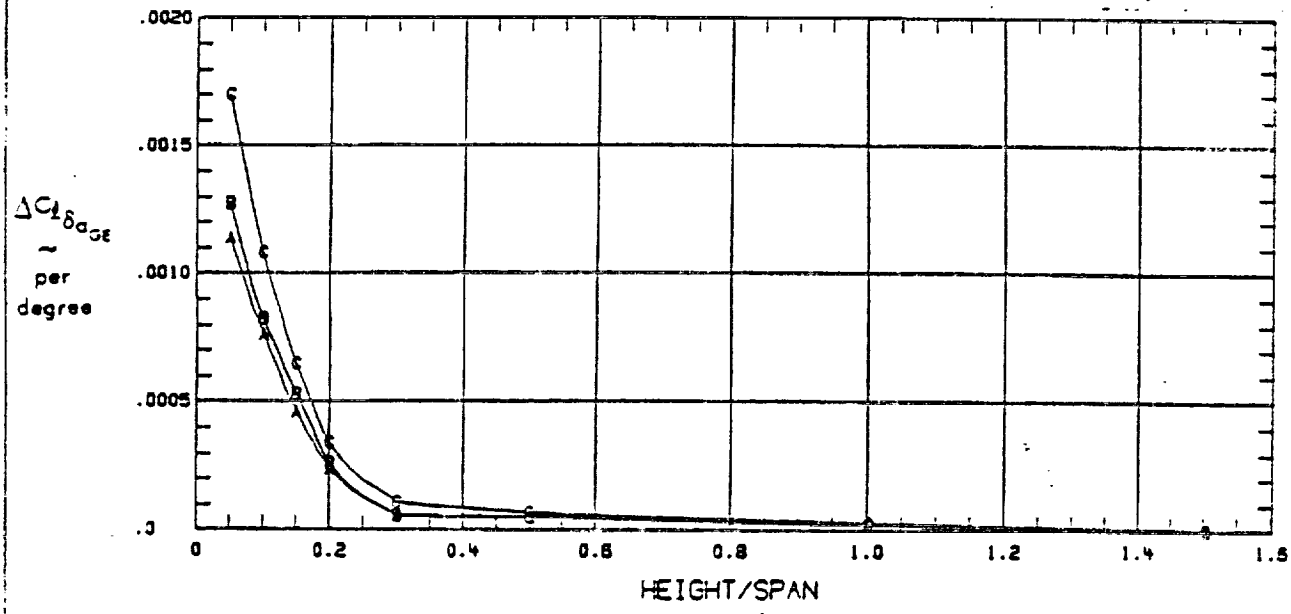
BASELINE ORBITER VEHICLE

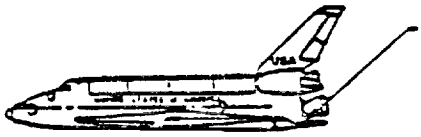
CENTER OF GRAVITY
OR
MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA
SPAN
MAC
BODY LENGTH

δ_e = All $\quad \delta_{BF} = -11.7°$ $\quad \delta_{SB} = 25°$



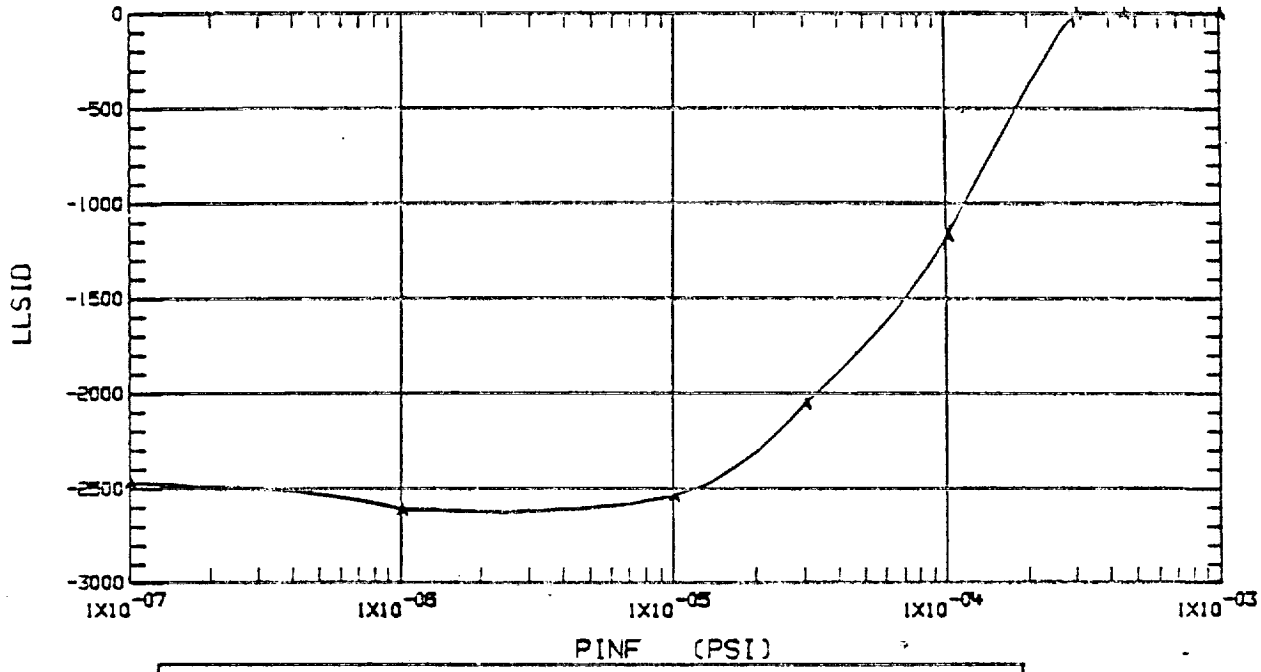


Reference Point for h/b
X_o 1506.54
Z_o 282.71

HEIGHT / SPAN h/b	Roll Angle, ϕ ~ Degrees		
	A 0.0	B 5.000	C 10.000
	$\Delta C_{l_{\delta_a}}$ ~ per degree		
0.050	0.00114	0.00127	0.00170
0.100	0.00076	0.00082	0.00108
0.150	0.00046	0.00053	0.00065
0.200	0.00024	0.00025	0.00034
0.300	0.00006	0.00006	0.00011
0.500	0.00005	0.00005	0.00007
1.000	0.00002	0.00002	0.00003
1.500	0.0	0.0	0.0

ENGINEER: _____
DATE _____
REVISED: _____

Figure 4.2.1.3-163
GROUND EFFECT



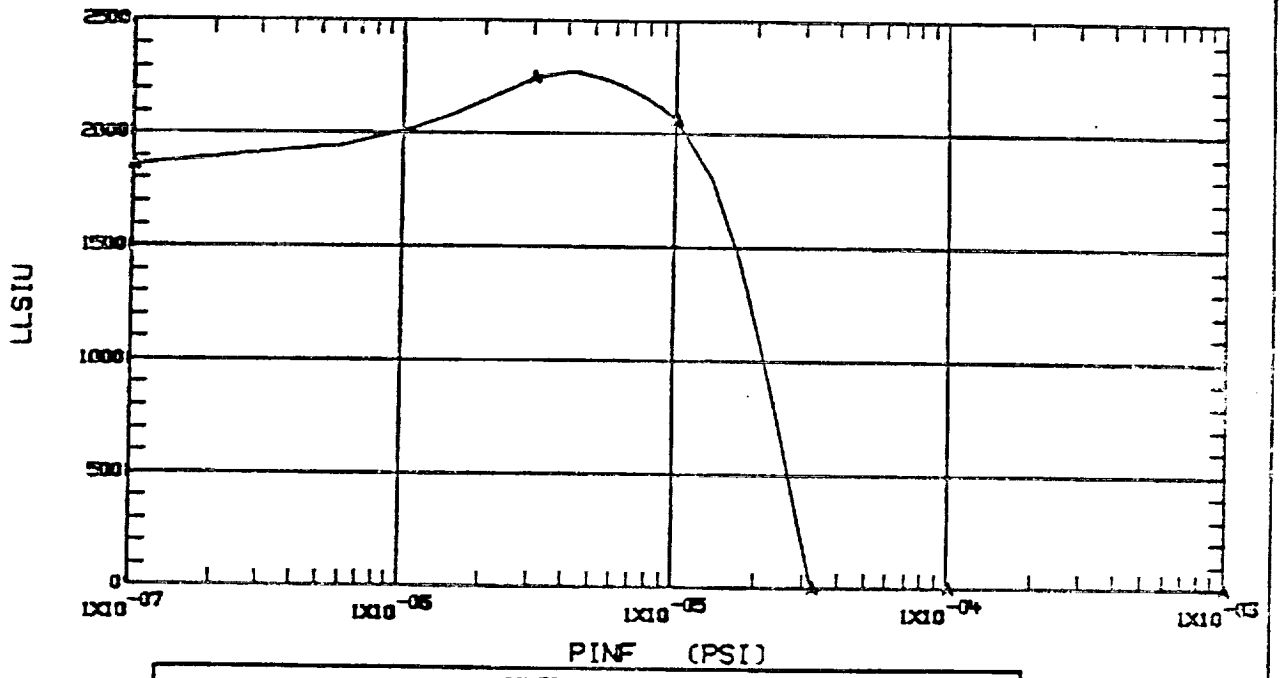
CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.550 FT.
			BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$\mathcal{L}_{SURF\ IMP}$ ft-lb/rad
	ROLLING MO
1.000E-07	-2475.500
1.000E-06	-2612.400
1.000E-05	-2543.400
3.000E-05	-2062.300
1.000E-04	-1169.300
3.000E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

LH SHOWN
RH USE OPPOSITE SIGN

ENGINEER
DATE 10/31/91

FIGURE 4.2.1.3-164
ROLLING MOMENT SURFACE IMPINGEMENT, DOWN-FIRING



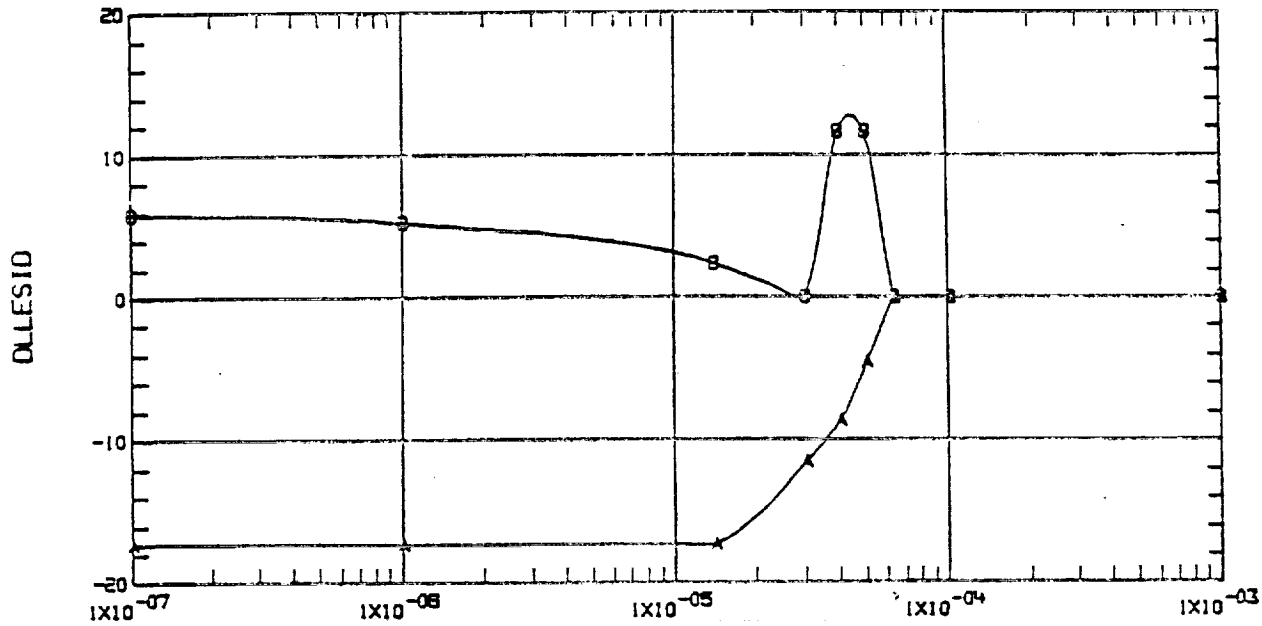
CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.550 FT.
			BODY LENGTH	LB = 1290.3 IN.

LH SHOWN
RH USE OPPOSITE SIGN

PINF (PSI)	$\mathcal{L}$ ft-lb SUPF II IMP ROLLING MO
1.000E-07	1659.89990
3.000E-06	2250.00000
1.000E-05	2060.00000
3.200E-05	0.0
1.000E-04	0.0
1.000E-03	0.0

ENGINEER [illegible]
DATE 3/30/79

FIGURE 4.2.1.3-165
ROLLING MOMENT SURFACE IMPINGEMENT, UP-FIRING



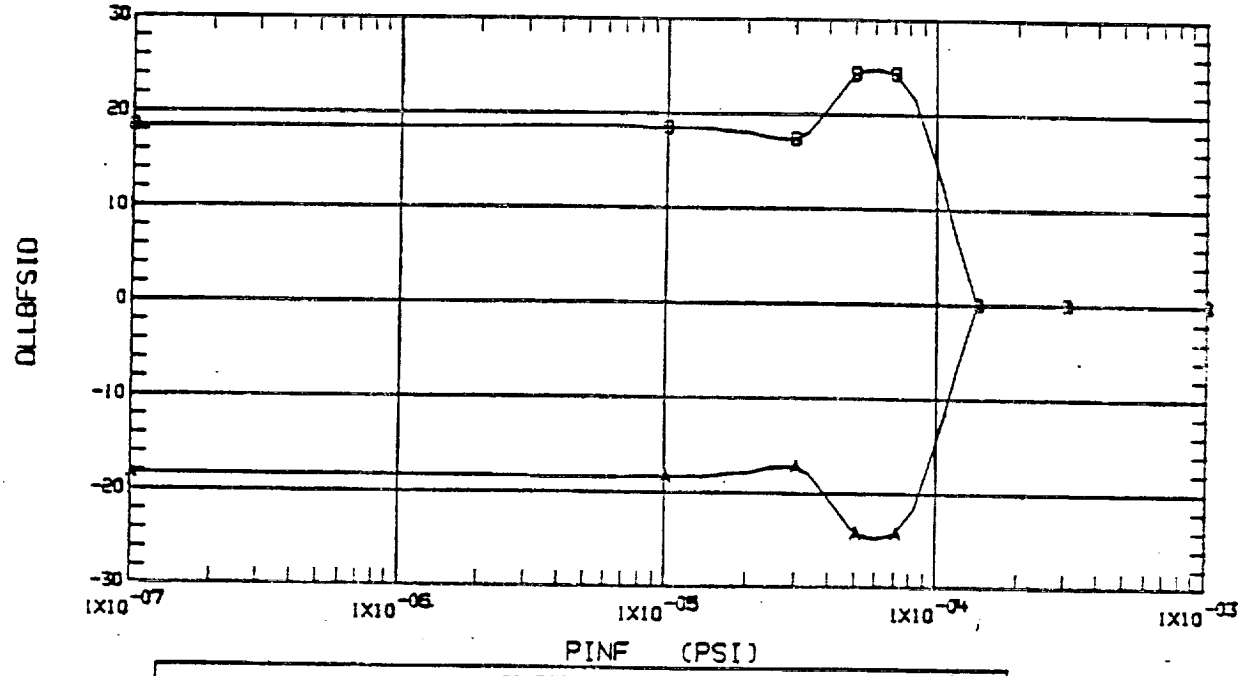
CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.550 FT.
			BODY LENGTH	LB = 1290.3 IN.

LH SHOWN
RH USE OPPOSITE SIGN

	$\partial \mathcal{L}/\partial \delta_e \sim$ ft-lb/n-deg	
	$\delta_e < 0$	$\delta > 0$
PINF (PSI)	DE ROLLING MOMENT SI.	
1.000E-07	-17.320	5.770
1.000E-06	-17.320	5.200
1.400E-05	-17.320	2.310
3.000E-05	-11.550	0.0
4.000E-05	-8.660	11.550
5.000E-05	-4.620	11.550
6.300E-05	0.0	0.0
1.000E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-166
ELEVON ROLLING MOMENT SURFACE IMPINGEMENT, DOWN-FIRING



CONFIGURATION

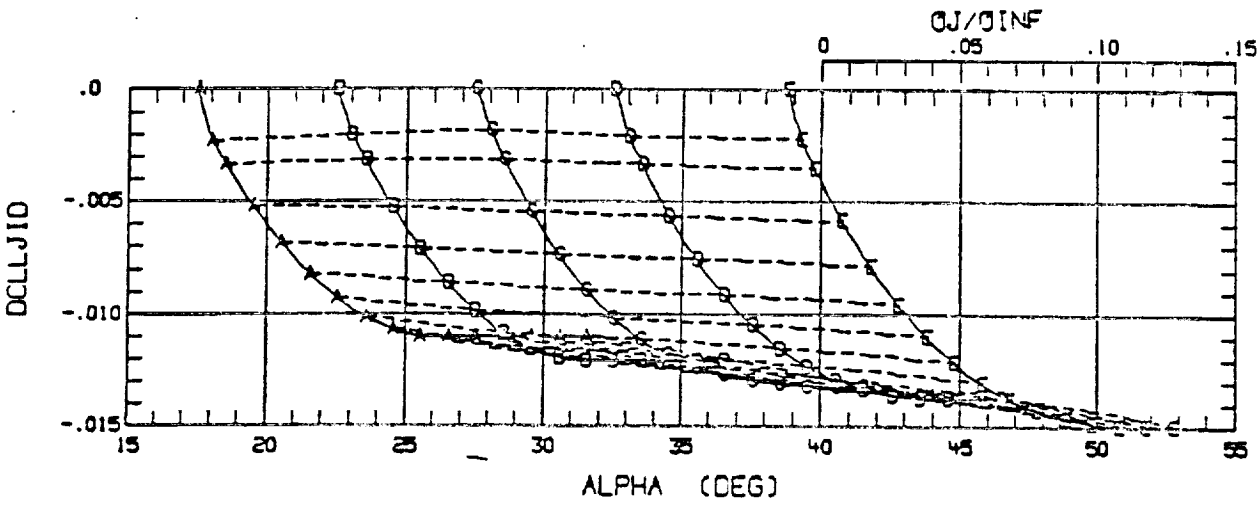
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.550	FT.
			BODY LENGTH	LB = 1290.3	IN.

LH SHOWN
RH USE OPPOSITE SIGN

PINF (PSI)	$\partial C_{RM_j}/\partial \delta_{BF}$ ~ ft-lb/rad/deg	
	$\delta_{BF} < 0$	$\delta_{BF} > 0$
	CBF ROLLING MOMENT SI	
1.000E-07	-18.480	18.480
1.000E-05	-18.480	18.480
3.000E-05	-17.320	17.320
5.000E-05	-24.250	24.250
7.000E-05	-24.250	24.250
1.400E-04	0.0	0.0
3.000E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.2.1.3-167
BODYFLAP ROLLING MOMENT SURFACE IMPINGEMENT, DOWN-FIRING



MJ/MINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	ROLLING MOMENT J1 DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.005	-0.00231	-0.00203	-0.00184	-0.00209	-0.00222
0.010	-0.00335	-0.00320	-0.00317	-0.00338	-0.00354
0.020	-0.00525	-0.00531	-0.00550	-0.00568	-0.00591
0.030	-0.00687	-0.00713	-0.00742	-0.00761	-0.00793
0.040	-0.00823	-0.00867	-0.00897	-0.00921	-0.00953
0.050	-0.00932	-0.00932	-0.01021	-0.01051	-0.01104
0.060	-0.01015	-0.01069	-0.01116	-0.01154	-0.01218
0.070	-0.01071	-0.01157	-0.01166	-0.01233	-0.01309
0.080	-0.01101	-0.01197	-0.01237	-0.01292	-0.01378
0.090	-0.01104	-0.01208	-0.01272	-0.01332	-0.01429
0.100	-0.01104	-0.01208	-0.01295	-0.01358	-0.01464
0.110	-0.01104	-0.01208	-0.01310	-0.01372	-0.01486
0.120	-0.01104	-0.01208	-0.01322	-0.01377	-0.01498
0.130	-0.01104	-0.01208	-0.01322	-0.01377	-0.01498
0.140	-0.01104	-0.01208	-0.01322	-0.01377	-0.01498

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$

$S_{ref} = 2690\ ft^2$

$$\Delta C_{\ell_{JI}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

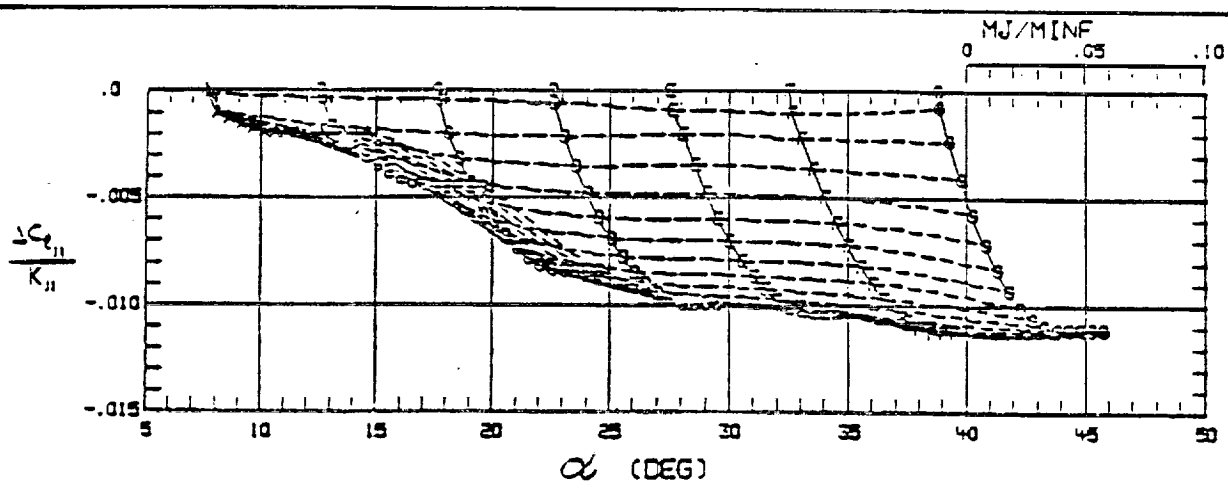
ALPHA (DEG)	ADD3, MIN, MAX A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	ROLLING MOMENT J1 DF					
17.500	-0.00120	-0.22900	1.33000	0.0	0.00500	0.09000
22.500	-0.00080	-0.25400	1.43000	0.0	0.00500	0.09000
27.500	-0.00040	-0.30100	2.44000	-6.98000	0.00500	0.12000
32.500	-0.00070	-0.29900	2.11000	-5.08000	0.00500	0.12000
38.750	-0.00080	-0.29400	2.01000	-4.54000	0.00500	0.12000

Interpolate for α's not shown after calculation of given α's only.

LH SHOWN; RH USE OPPOSITE SIGN

ENGINEER AP
DATE 11/30/79

FIGURE 4.2.1.3-168
ROLLING MOMENT JET INTERACTION, DOWN-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	ROLLING MOMENT JET EF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00021	-0.00034	-0.00045	-0.00062	-0.00090	-0.00105	-0.00030
0.005	-0.00104	-0.00168	-0.00204	-0.00215	-0.00202	-0.00227	-0.00235
0.010	-0.00133	-0.00223	-0.00325	-0.00356	-0.00349	-0.00371	-0.00419
0.015	-0.00157	-0.00271	-0.00433	-0.00483	-0.00483	-0.00503	-0.00591
0.020	-0.00178	-0.00313	-0.00529	-0.00596	-0.00602	-0.00622	-0.00722
0.025	-0.00189	-0.00351	-0.00612	-0.00695	-0.00706	-0.00729	-0.00842
0.030	-0.00197	-0.00382	-0.00683	-0.00780	-0.00797	-0.00824	-0.00940
0.035	-0.00200	-0.00409	-0.00741	-0.00851	-0.00873	-0.00906	-0.01016
0.040	-0.00200	-0.00430	-0.00787	-0.00908	-0.00934	-0.00976	-0.01072
0.045	-0.00200	-0.00445	-0.00820	-0.00951	-0.00982	-0.01033	-0.01105
0.050	-0.00200	-0.00456	-0.00840	-0.00980	-0.01015	-0.01077	-0.01117
0.055	-0.00200	-0.00456	-0.00848	-0.00995	-0.01034	-0.01110	-0.01117
0.060	-0.00200	-0.00456	-0.00848	-0.00996	-0.01038	-0.01130	-0.01117
0.065	-0.00200	-0.00456	-0.00848	-0.00996	-0.01038	-0.01130	-0.01117
0.070	-0.00200	-0.00456	-0.00848	-0.00996	-0.01038	-0.01130	-0.01117

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_{sc}}\right)\left(\frac{v_{sc}}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{a_\infty}\right)$$

$$\Delta C_{\ell_{jj}} = \left[A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3\right] K_{jj}$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the table below.

$K_{jj} = 1.0$

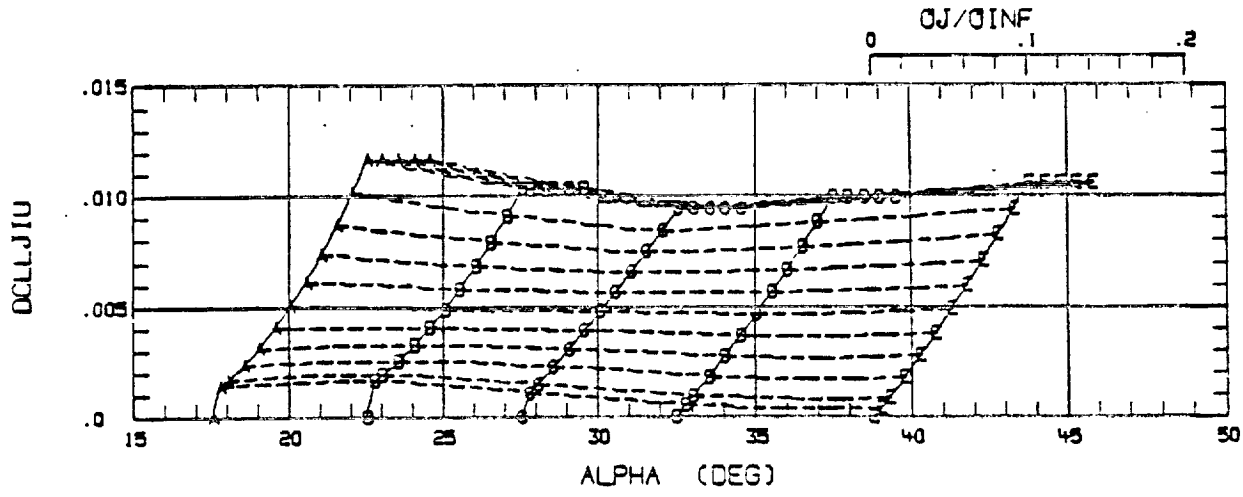
ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	ROLLING MOMENT JET EF					
7.500	-0.00070	-0.07400	1.03800	0.0	0.00500	0.03500
12.500	-0.00110	-0.12340	1.06560	0.0	0.00500	0.05000
17.500	-0.00070	-0.25000	2.52000	0.0	0.00500	0.05500
22.500	-0.00060	-0.32400	2.80000	0.0	0.00500	0.05000
27.500	-0.00040	-0.33600	2.96000	0.0	0.00500	0.06000
32.500	-0.00070	-0.32500	2.49000	0.0	0.00500	0.05000
38.750	-0.00030	-0.43200	2.89000	0.0	0.00500	0.05000

Interpolate for α's not shown after calculation of given α's only.

LH SHOWN; RH USE OPPOSITE SIGN

ENGINEER HD
DATE 4/27/76

FIGURE 4.2.1.3-169
ROLLING MOMENT JET INTERACTION, SIDE-FIRING



DJ/DINF	ALPHA (DEG) 17.300 A	22.300 B	27.500 C	32.300 D	38.750 E
	ROLLING MOMENT JET				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00137	0.00165	0.00108	0.00051	0.00042
0.0100	0.00166	0.00193	0.00146	0.00094	0.00086
0.0200	0.00233	0.00264	0.00223	0.00181	0.00178
0.0300	0.00311	0.00323	0.00305	0.00271	0.00276
0.0400	0.00400	0.00400	0.00389	0.00384	0.00379
0.0500	0.00500	0.00485	0.00474	0.00460	0.00486
0.0600	0.00610	0.00578	0.00562	0.00560	0.00597
0.0700	0.00732	0.00679	0.00662	0.00663	0.00710
0.0800	0.00864	0.00787	0.00774	0.00769	0.00824
0.0900	0.01008	0.00904	0.00939	0.00878	0.00940
0.1000	0.01162	0.01029	0.00936	0.00990	0.01056
0.1100	0.01162	0.01029	0.00936	0.00990	0.01056
0.1200	0.01162	0.01029	0.00936	0.00990	0.01056
0.1300	0.01162	0.01029	0.00936	0.00990	0.01056
0.1400	0.01162	0.01029	0.00936	0.00990	0.01056

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{\ell_{jj}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

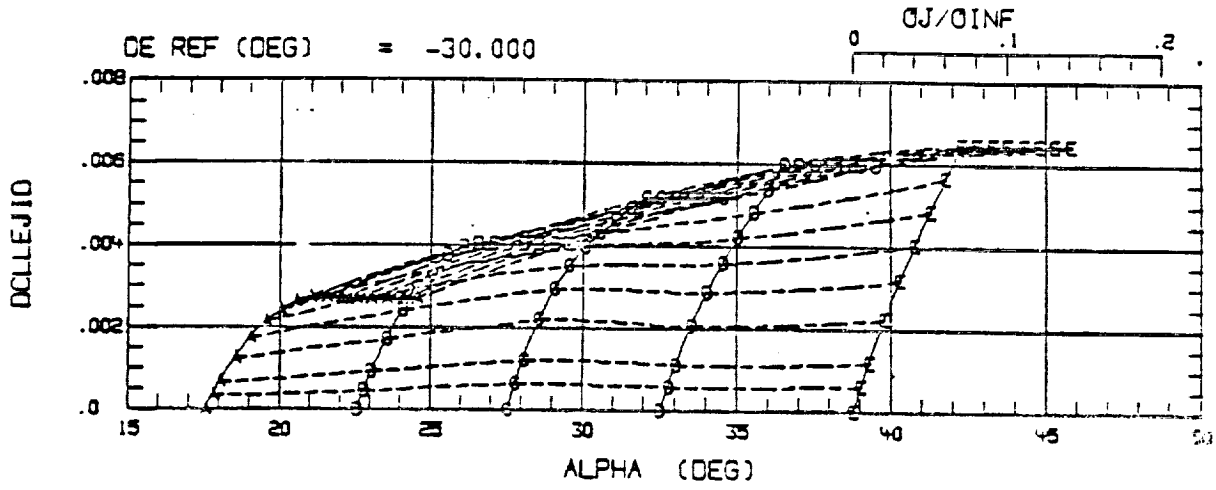
ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	ROLLING MOMENT JET					
17.300	0.0011	0.0507	0.5450	0.0	0.0050	0.1000
22.300	0.0014	0.0490	0.3960	0.0	0.0050	0.1000
27.500	0.0007	0.0750	0.1160	0.0	0.0050	0.1000
32.300	0.0001	0.0822	0.1560	0.0	0.0050	0.1000
38.750	0.0	0.0820	0.3720	-1.3600	0.0050	0.1000

Interpolate for α's not shown after calculation of given α's only.

LH SHOWN; RH USE OPPOSITE SIGN

ENGINEER
DATE

FIGURE 4.2.1.3-170
ROLLING MOMENT JET INTERACTION, UP-FIRING



DJ/DINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE ROLLING MOMENT COEF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00034	0.00047	0.00064	0.00057	0.00061
0.0100	0.00065	0.00091	0.00121	0.00110	0.00118
0.0200	0.00124	0.00170	0.00217	0.00204	0.00222
0.0300	0.00172	0.00238	0.00291	0.00291	0.00316
0.0400	0.00210	0.00294	0.00349	0.00358	0.00403
0.0500	0.00240	0.00339	0.00393	0.00418	0.00484
0.0600	0.00260	0.00372	0.00429	0.00478	0.00554
0.0700	0.00271	0.00393	0.00460	0.00536	0.00611
0.0800	0.00273	0.00403	0.00490	0.00597	0.00661
0.0900	0.00268	0.00403	0.00516	0.00597	0.00661
0.1000	0.00268	0.00403	0.00516	0.00597	0.00661
0.1100	0.00268	0.00403	0.00516	0.00597	0.00661
0.1200	0.00268	0.00403	0.00516	0.00597	0.00661
0.1300	0.00268	0.00403	0.00516	0.00597	0.00661
0.1400	0.00268	0.00403	0.00516	0.00597	0.00661

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$(\Delta C_\ell)_{\delta_{e_{REF}}=-30^\circ} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

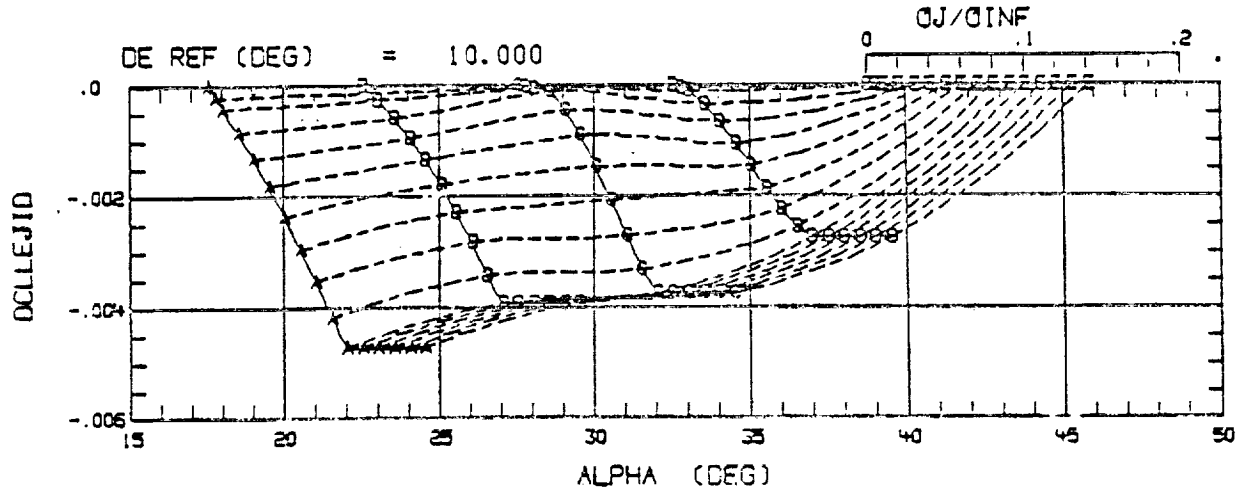
ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE ROLLING MOMENT COEF					
17.5	0.0	0.0710	-0.1610	0.0	0.0050	0.0850
22.5	0.0	0.0988	-0.5800	0.0	0.0050	0.0850
27.5	0.0	0.1448	-1.4700	5.6500	0.0050	0.0850
32.5	0.0	0.1190	-0.9610	5.0800	0.0050	0.0800
38.75	0.0	0.1260	-1.1200	5.4400	0.0050	0.0700

Interpolate for α's not shown after calculation of given α's only.

LH SHOWN, RH USE OPPOSITE SIGN

ENGINEER
DATE 1/25

FIGURE 4.2.1.3-171
ELEVON ROLLING MOMENT JET INTERACTION, DOWN-FIRING



DJ/DINF	ALPHA (DEG) A 17.500	B 22.500	C 27.500	D 32.500	E 38.750
	DE PITCHING MOMENT COEF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00020	-0.00013	-0.00003	-0.00004	0.0
0.0100	-0.00041	-0.00027	-0.00005	-0.00011	0.0
0.0200	-0.00085	-0.00058	-0.00011	-0.00035	0.0
0.0300	-0.00132	-0.00094	-0.00044	-0.00067	0.0
0.0400	-0.00183	-0.00134	-0.00091	-0.00105	0.0
0.0500	-0.00237	-0.00179	-0.00148	-0.00146	0.0
0.0600	-0.00296	-0.00229	-0.00210	-0.00187	0.0
0.0700	-0.00355	-0.00284	-0.00273	-0.00225	0.0
0.0800	-0.00419	-0.00343	-0.00342	-0.00256	0.0
0.0900	-0.00473	-0.00394	-0.00376	-0.00274	0.0
0.1000	-0.00473	-0.00394	-0.00376	-0.00274	0.0
0.1100	-0.00473	-0.00394	-0.00376	-0.00274	0.0
0.1200	-0.00473	-0.00394	-0.00376	-0.00274	0.0
0.1300	-0.00473	-0.00394	-0.00376	-0.00274	0.0
0.1400	-0.00473	-0.00394	-0.00376	-0.00274	0.0

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$(\Delta C_\ell)_{\delta_{e_{REF}}=+10^\circ} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

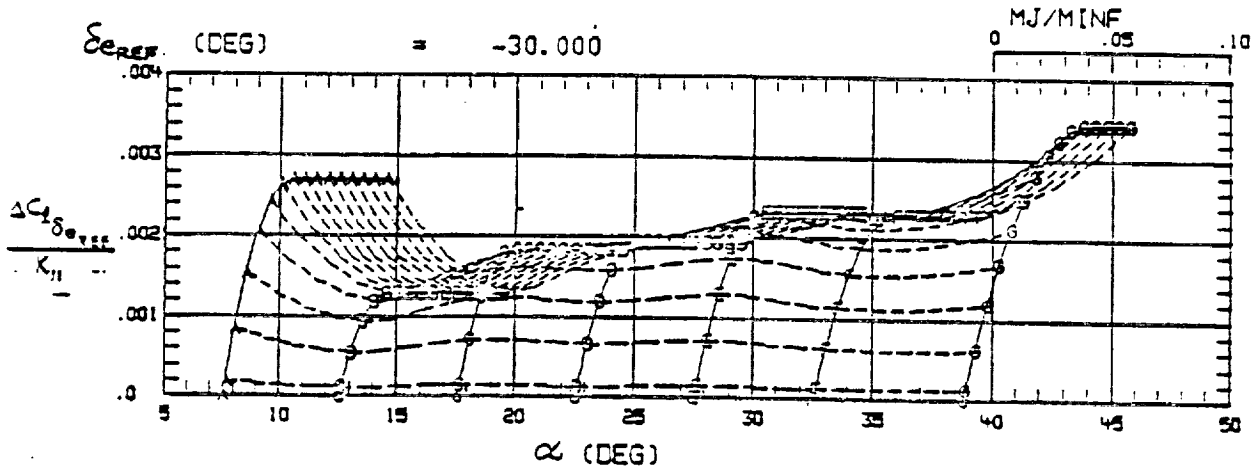
ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE ROLLING MOMENT COEF					
17.500	0.0	-0.3362	-0.1650	0.0	0.0050	0.0990
22.500	0.0	-0.0248	-0.0240	0.0	0.0050	0.0880
27.500	0.0	0.0178	-1.2500	6.3500	0.0200	0.0880
32.500	0.0	-0.0044	-0.7810	5.0800	0.0050	0.0880
38.750	0.0	0.0	0.0	0.0	0.0050	0.1000

Interpolate for α's not shown *after* calculation of given α's only.

LH SHOWN; RH USE OPPOSITE SIGN

ENGINEER
DATE

FIGURE 4.2.1.3-172
ELEVON ROLLING MOMENT JET INTERACTION, DOWN-FIRING



MJ/MINF	A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
		DE ROLLING MOMENT JET SF						
0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001		0.00017	0.00011	0.00014	0.00013	0.00014	0.00012	0.00012
0.005		0.00083	0.00053	0.00070	0.00066	0.00071	0.00061	0.00062
0.010		0.00151	0.00091	0.00123	0.00118	0.00129	0.00112	0.00118
0.015		0.00203	0.00116	0.00159	0.00157	0.00173	0.00154	0.00167
0.020		0.00241	0.00127	0.00178	0.00181	0.00205	0.00186	0.00211
0.025		0.00262	0.00127	0.00181	0.00192	0.00224	0.00209	0.00248
0.030		0.00269	0.00127	0.00181	0.00192	0.00230	0.00223	0.00279
0.035		0.00269	0.00127	0.00181	0.00192	0.00230	0.00227	0.00304
0.040		0.00269	0.00127	0.00181	0.00192	0.00230	0.00227	0.00323
0.045		0.00269	0.00127	0.00181	0.00192	0.00230	0.00227	0.00336
0.050		0.00269	0.00127	0.00181	0.00192	0.00230	0.00227	0.00342
0.055		0.00269	0.00127	0.00181	0.00192	0.00230	0.00227	0.00342
0.060		0.00269	0.00127	0.00181	0.00192	0.00230	0.00227	0.00342
0.065		0.00269	0.00127	0.00181	0.00192	0.00230	0.00227	0.00342
0.070		0.00269	0.00127	0.00181	0.00192	0.00230	0.00227	0.00342

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\Phi_j}{\Phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{a_\infty}\right)$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\Delta C_{l_{\delta e_{REF}}} = \left[A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3\right] K_{11}$$

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the table below.

$K_{11} = 1.0$

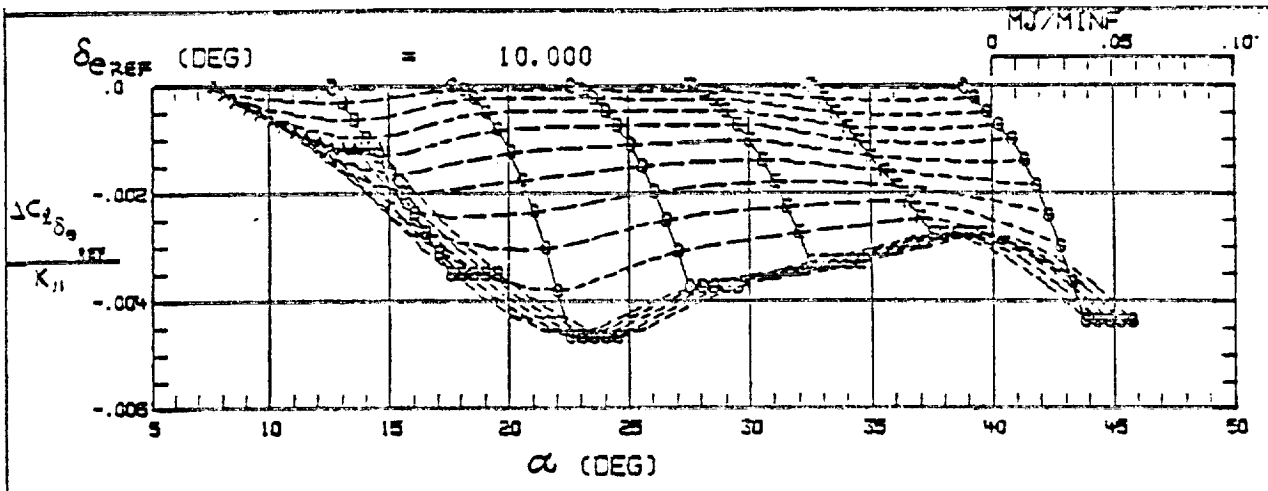
ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE ROLLING MOMENT JET SF					
7.500	0.0	0.18160	-3.08520	0.0	0.00500	0.02960
12.500	0.0	0.11940	-2.79650	0.0	0.00500	0.02130
17.500	0.0	0.15700	-3.41000	0.0	0.00500	0.02310
22.500	0.0	0.14600	-2.77000	0.0	0.00500	0.02580
27.500	0.0	0.15400	-2.59000	0.0	0.00500	0.03000
32.500	0.0	0.13100	-1.89000	0.0	0.00500	0.03460
38.750	0.0	0.13000	-1.23000	0.0	0.00500	0.05000

Interpolate for α's not shown after calculation of given α's only

LH SHOWN; RH USE OPPOSITE SIGN

ENGINEER HP
DATE 4/13/72

FIGURE 4.2.1.3-173
ELEVON ROLLING MOMENT JET INTERACTION, SIDE-FIRING



	α (DEG) OF RE						
	7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
MJ/MINF A	OF ROLLING MOMENT JET SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00003	-0.00006	-0.00001	-0.00002	-0.00002	-0.00005	-0.00005
0.005	-0.00015	-0.00032	-0.00007	-0.00009	-0.00011	-0.00033	-0.00028
0.010	-0.00029	-0.00064	-0.00024	-0.00025	-0.00027	-0.00052	-0.00050
0.015	-0.00042	-0.00098	-0.00049	-0.00047	-0.00048	-0.00079	-0.00075
0.020	-0.00054	-0.00132	-0.00082	-0.00075	-0.00074	-0.00105	-0.00101
0.025	-0.00066	-0.00167	-0.00125	-0.00110	-0.00104	-0.00134	-0.00141
0.030	-0.00077	-0.00202	-0.00176	-0.00150	-0.00140	-0.00162	-0.00188
0.035	-0.00068	-0.00238	-0.00236	-0.00197	-0.00180	-0.00190	-0.00242
0.040	-0.00097	-0.00275	-0.00304	-0.00250	-0.00225	-0.00219	-0.00301
0.045	-0.00106	-0.00313	-0.00382	-0.00310	-0.00276	-0.00248	-0.00367
0.050	-0.00115	-0.00352	-0.00468	-0.00375	-0.00331	-0.00277	-0.00439
0.055	-0.00115	-0.00352	-0.00468	-0.00375	-0.00331	-0.00277	-0.00439
0.060	-0.00115	-0.00352	-0.00468	-0.00375	-0.00331	-0.00277	-0.00439
0.065	-0.00115	-0.00352	-0.00468	-0.00375	-0.00331	-0.00277	-0.00439
0.070	-0.00115	-0.00352	-0.00468	-0.00375	-0.00331	-0.00277	-0.00439

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{a_\infty}\right)$$

$$\Delta C_{l_{\delta_{e_{REF}}}} = \left[A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3\right] K_{jl}$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the table below.

$K_{jl} = 1.0$

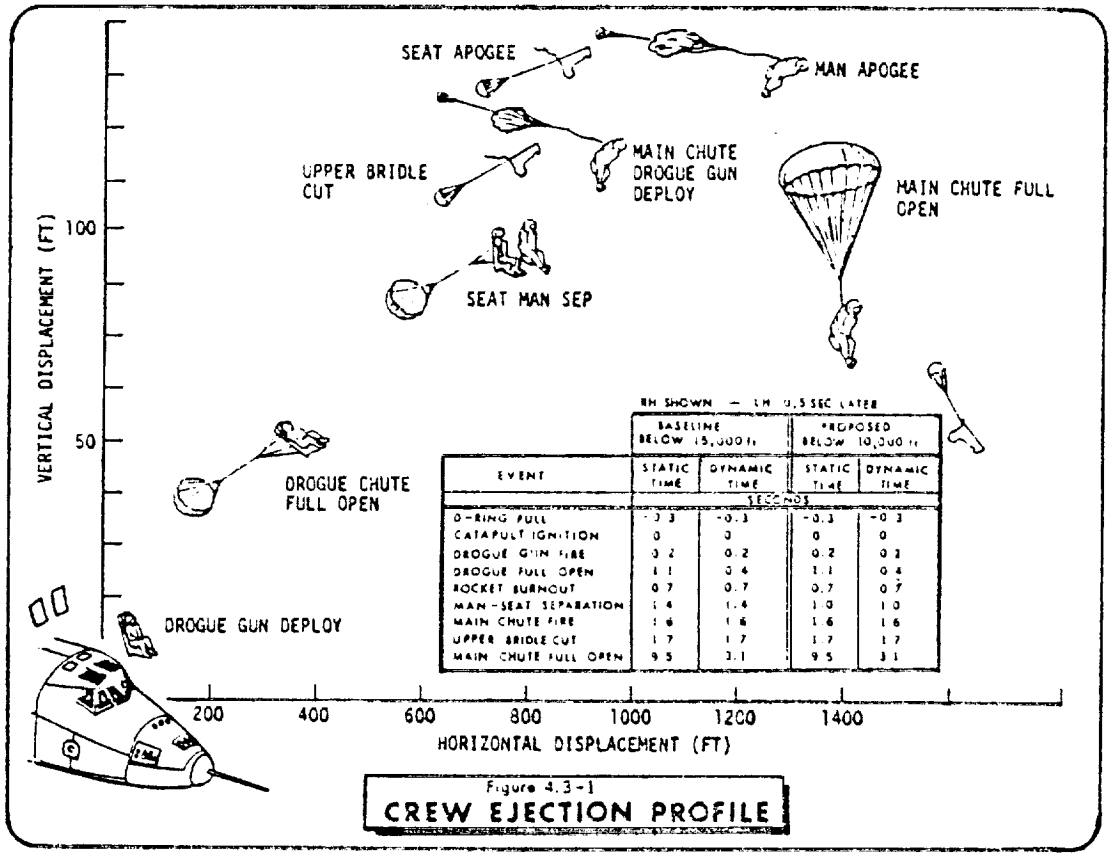
ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	OF ROLLING MOMENT JET SF					
7.500	0.0	-0.02980	0.13630	0.0	0.00500	0.05000
12.500	0.0	-0.06300	-0.14600	0.0	0.00500	0.05000
17.500	0.0	-0.00610	-1.75000	0.0	0.00500	0.05000
22.500	0.0	-0.01260	-1.25000	0.0	0.00500	0.05000
27.500	0.0	-0.01730	-0.97800	0.0	0.00500	0.05000
32.500	0.0	-0.05150	-0.07310	0.0	0.00500	0.05000
38.750	0.0	-0.02530	-1.25000	0.0	0.02000	0.05000

Interpolate for α's not shown after calculation of given α's only

ENGINEER HP
DATE 11/6/75

FIGURE 4.2.1.3-174
ELEVON ROLLING MOMENT JET INTERACTION, SIDE-FIRING

4.3 CREW ESCAPE SYSTEM AERODYNAMIC CHARACTERISTICS. Aerodynamic characteristics pertaining to the Orbiter Vehicle Crew Escape System (CES) are presented in this section. These characteristics are intended for use in computer analyses of the forces and moments acting on the man/seat configuration following ejection. A typical ejection profile is shown in Figure 4.3-1.



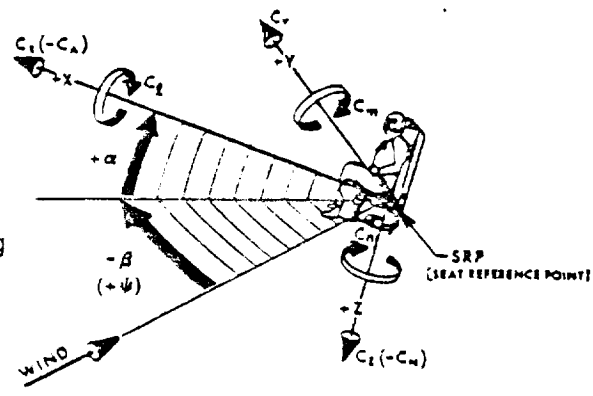
RH SHOWN — LH 0.5 SEC LATER

EVENT	BASELINE BELOW 15,000 ft STATIC TIME	BASELINE BELOW 15,000 ft DYNAMIC TIME	*PROPOSED BELOW 10,000 ft STATIC TIME	*PROPOSED BELOW 10,000 ft DYNAMIC TIME
	SECONDS			
O-RING PULL	-0.3	-0.3	-0.3	-0.3
CATAPULT IGNITION	0	0	0	0
DROGUE GUN FIRE	0.2	0.2	0.2	0.2
DROGUE FULL OPEN	1.1	0.4	1.1	0.4
ROCKET BURNOUT	0.7	0.7	0.7	0.7
MAN-SEAT SEPARATION	1.4	1.4	1.0	1.0
MAIN CHUTE FIRE	1.6	1.6	1.6	1.6
UPPER BRIDLE CUT	1.7	1.7	1.7	1.7
MAIN CHUTE FULL OPEN	9.5	3.1	9.5	3.1

Figure 4.3-1
CREW EJECTION PROFILE

The aerodynamic data are based on the F-106 ejection seat with 50 percentile crewman adjusted to account for the effects of different percentile crewmen and the relatively deeper Orbiter Vehicle seat. Proximity effects are based on B-1 wind tunnel data adjusted to account for hydraulic diameter differences between the B-1 (hydraulic diameter = 9 feet) and the Orbiter Vehicle (hydraulic diameter = 20 feet).

4.3.1 BODY-AXIS DATA. The aerodynamic characteristics of the Orbiter Vehicle ejection seat are given in the body-axis system. The pertinent equation for obtaining the total coefficient precedes the data presentation. Each element of the equation is defined and referenced to the appropriate figures for obtaining numerical values.



4.3.1.1 NORMAL FORCE COEFFICIENT. The Orbiter Vehicle ejection seat normal force coefficient for a given seat angle of attack and Mach number is defined in this section. The total normal force coefficient is obtained by the following equation:

$$C_{N_{\substack{\text{TOTAL}\\\text{MAN/SEAT}}}} = C_{N_{\substack{\text{FREE}\\\text{STREAM}}}} + \Delta C_{N_{\substack{\text{FOOT}\\\text{REST}}}} + \Delta C_{N_{\text{PROXIMITY}}}$$

where,

$C_{N_{\substack{\text{FREE}\\\text{STREAM}}}}$ = Freestream normal force coefficient acting on the man/seat combination

$\alpha = \beta = 0°$ (Figure 4.3.1.1-1)

$C_{N_{\substack{\text{FREE}\\\text{STREAM}}}} = -C_{Z_{F-106}}$; $\alpha = \alpha$, $\beta = \beta$ (Reference 4-1 p 65 & following)

$\Delta C_{N_{\substack{\text{FOOT}\\\text{REST}}}}$ = Incremental normal force coefficient resulting from rotation of the foot rests (145° from ejection position) (Figure 4.3.1.1-2)

$\Delta C_{N_{\text{PROX MITY}}}$ = Incremental normal force coefficient due to proximity of the Orbiter Vehicle. Given as a function of distance from ejection rail tip-off. (Figure 4.3.1.1-3)

The normal force coefficient is applicable for 10 through 95 percentile crewmen.

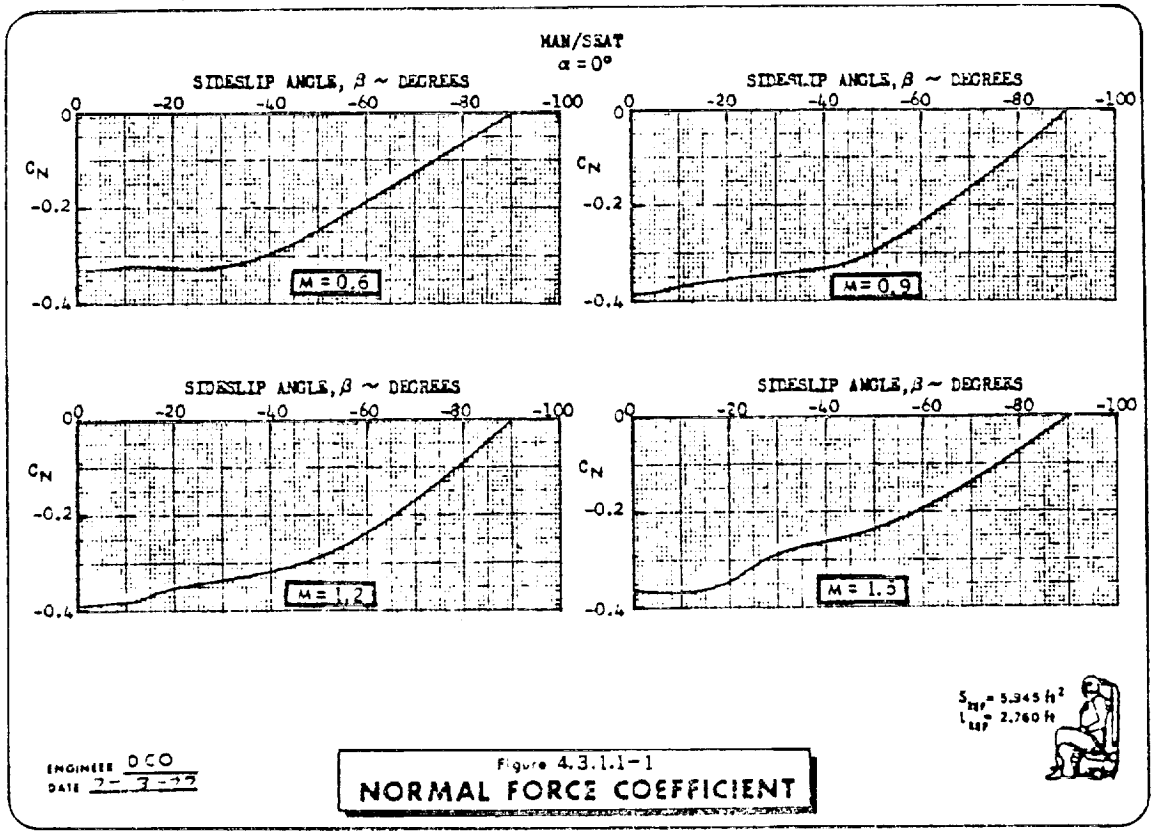


Figure 4.3.1.1-1
NORMAL FORCE COEFFICIENT

Figure 4.3.1.1-3
NORMAL FORCE PROXIMITY INCREMENT

Figure 4.3.1.1-2
INCREMENTAL NORMAL FORCE DUE TO ROTATED FOOT RESTS

4.3.1.2 AXIAL FORCE COEFFICIENT. The Orbiter Vehicle ejection seat axial force coefficient for a given seat angle of attack and Mach number is defined in this section. The total axial force coefficient is obtained by the following equation:

$$C_{A_{\substack{TOTAL \\ MAN/SEAT}}} = C_{A_{\substack{FREE \\ STREAM}}} + \Delta C_{A_{\substack{FOOT \\ REST}}} + \Delta C_{A_{PROXIMITY}}$$

where,

$C_{A_{\substack{FREE \\ STREAM}}}$ = Freestream axial force coefficient acting on the man/seat combination.

$\alpha = \beta = 0°$ (Figure 4.3.1.2-1)

$C_{A_{\substack{FREE \\ STREAM}}} = -C_{X_{F-106}}$; $\alpha = \alpha$, $\beta = \beta$ (Reference 4-1 p 65 & following)

$\Delta C_{A_{\substack{FOOT \\ REST}}}$ = Incremental axial force coefficient resulting from rotation of the foot rests (145° from ejection position). (Figure 4.3.1.2-2)

$\Delta C_{A_{PROXIMITY}}$ = Incremental axial force coefficient due to proximity of the Orbiter Vehicle. Given as a function of distance from ejection rail tip-off). (Figure 4.3.1.2-3)

The axial force coefficient is applicable for 10 through 95 percentile crewmen.

Additional data in the form of drag coefficients of the individual components which comprise the ejected configuration(s) are also given in this section. These drag data were derived theoretically and analytically as described in Reference 4-2. The data are presented as functions of Mach number for angles of attack and sideslip of zero degree.

$C_{D_{MAN/SEAT}}$ = Drag coefficient of the man/seat configuration. (Figure 4.3.1.2-4)

$C_{D_{\substack{MAN/SEAT \\ + DROGUE}}}$ = Drag coefficient for the man/seat plus drogue chute configuration. Given for rocket-on and rocket-off. (Figure 4.3.1.2-4)

$C_{D_{\substack{SEAT + \\ DROGUE}}}$ = Drag coefficient for the empty seat plus drogue chute. (Figure 4.3.1.2-5)

$C_{D_{\substack{DROGUE \\ BEHIND \\ SEAT}}}$ = Drag coefficient for the drogue chute (behind the seat). (Figure 4.3.1.2-5)

$C_{D_{SEAT}}$ = Drag coefficient of the empty seat (Figure 4.3.1.2-6)

$\frac{C_{D_{SEAT}}}{C_{D_\infty}}$ = Factor for reducing seat drag to account for wake or blockage effect of crewman in vicinity of seat. Based on frontal area of 90 percentile man (9.6 ft^2). Used to adjust seat drag for distance between man and seat, L. (Figure 4.3.1.2-6)

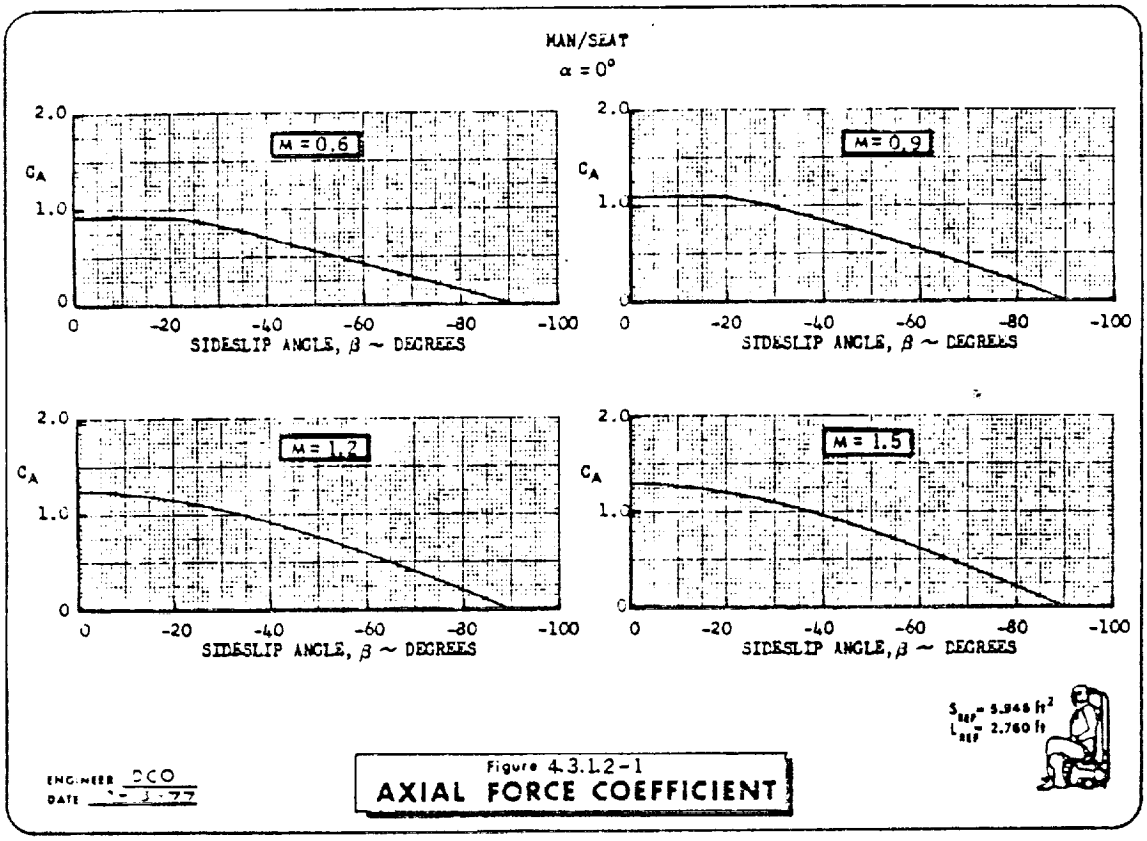
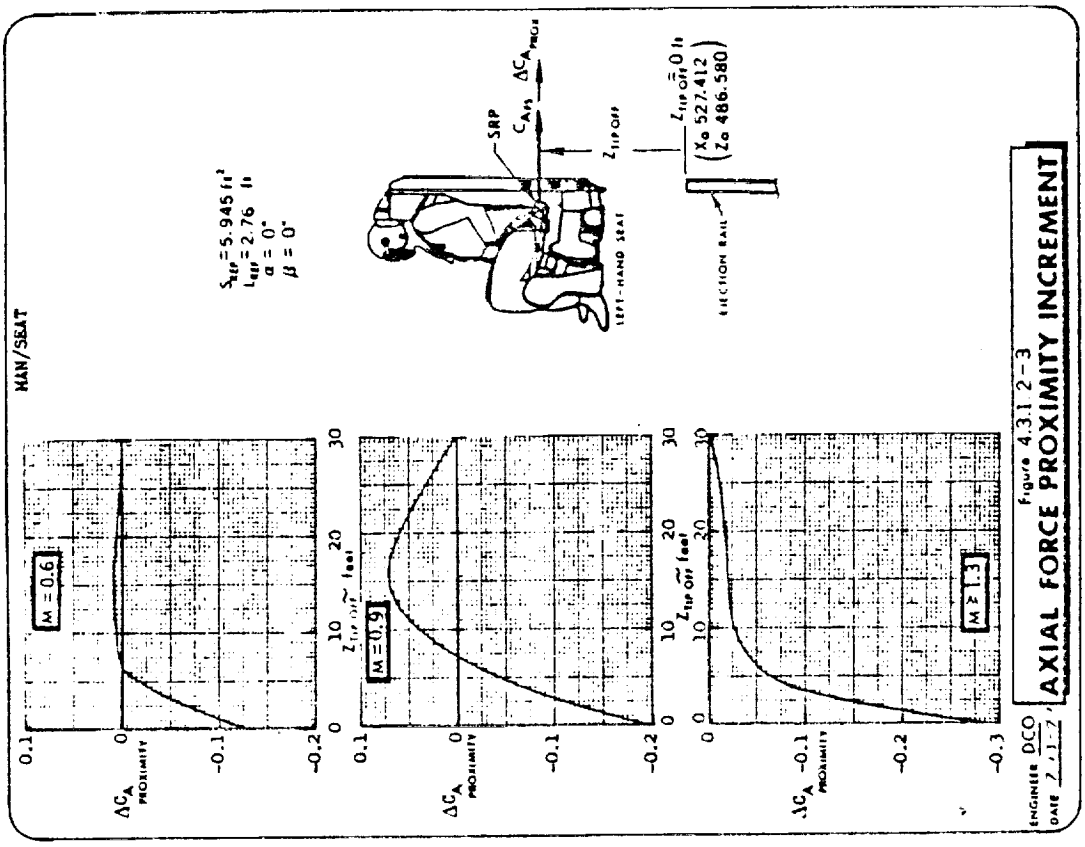
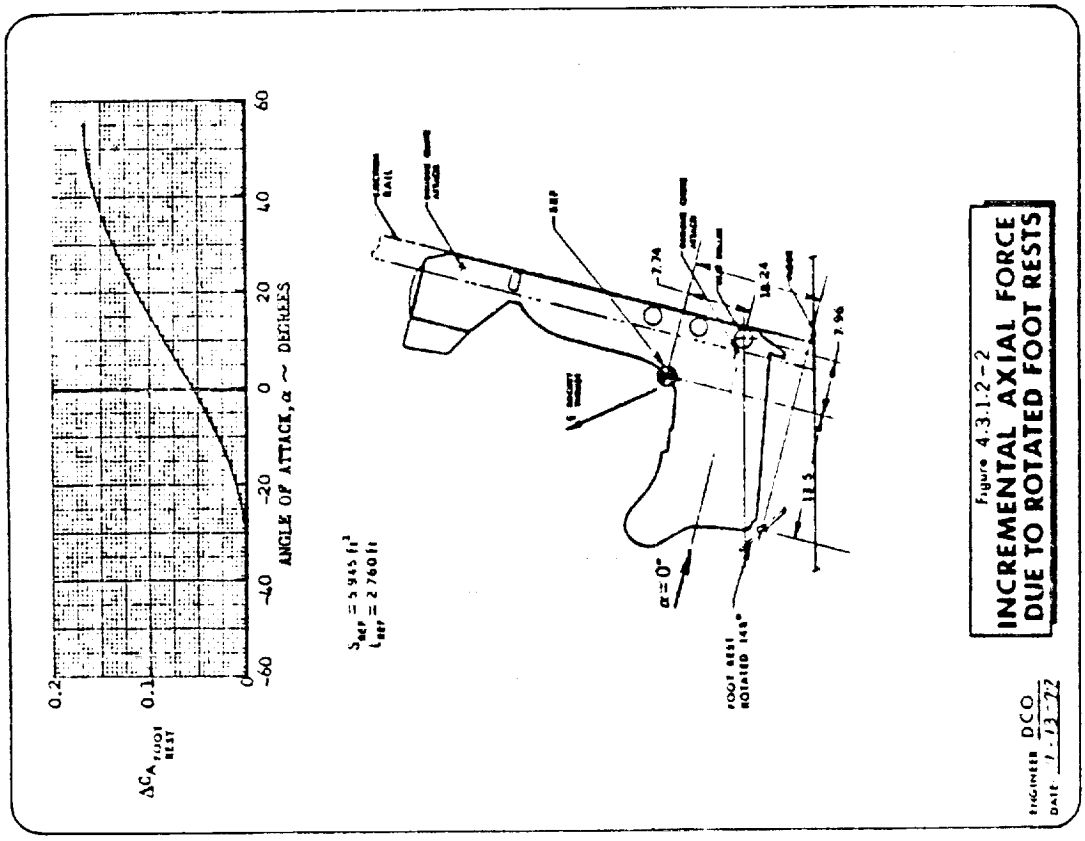


Figure 4.3.1.2-1
AXIAL FORCE COEFFICIENT


MAN/SEAT
S_{REF} = 5.945 ft²
l_{REF} = 2.76 ft
α = 0°
β = 0°
SRP
$C_{A_{PROX}}$
$\Delta C_{A_{PROX}}$
$Z_{TIP\ OFF}$
$L_{TIP\ OFF} \cong 0$ ft
X_o 527.412
Z_o 486.580
EJECTION RAIL
LEFT-HAND SEAT
M = 0.6
M = 0.9
M ≥ 1.3
ΔC_A PROXIMITY
$Z_{TIP\ OFF} \sim$ feet
ENGINEER DCO
DATE 7-13-72
Figure 4.3.1.2-3
AXIAL FORCE PROXIMITY INCREMENT


$\Delta C_{A_{FOOT\ REST}}$
ANGLE OF ATTACK, α ~ DEGREES
S_{REF} = 5.945 ft²
l_{REF} = 2.760 ft
SRP
α = 0°
FOOT REST ROTATED 144°
ENGINEER DCO
DATE 7-13-72
Figure 4.3.1.2-2
INCREMENTAL AXIAL FORCE DUE TO ROTATED FOOT RESTS

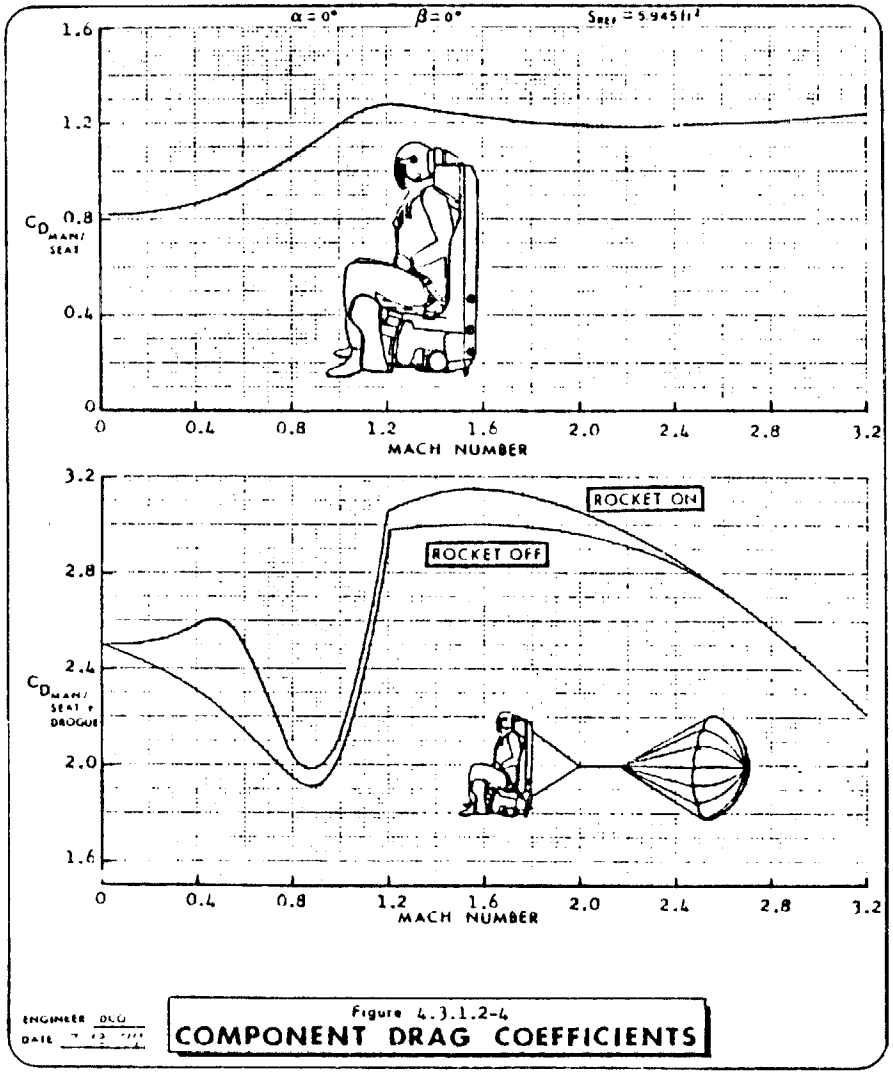


Figure 4.3.1.2-4
COMPONENT DRAG COEFFICIENTS

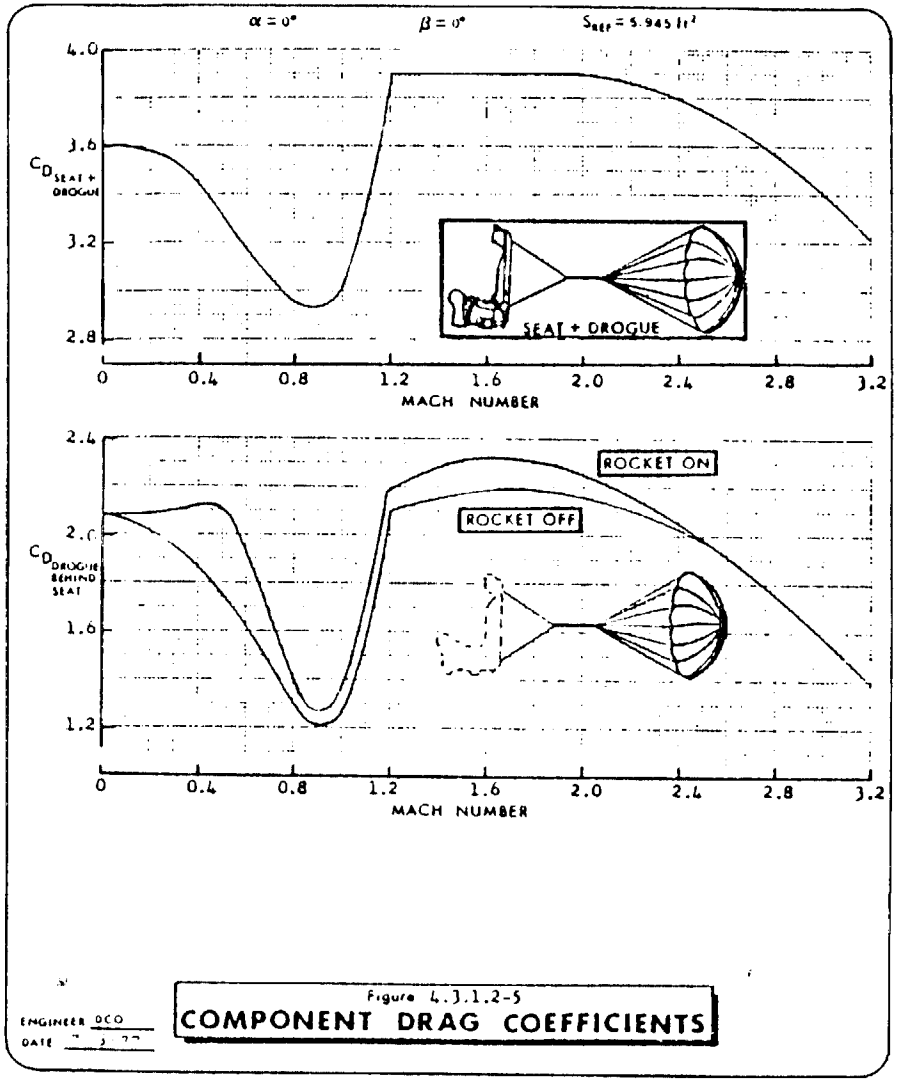
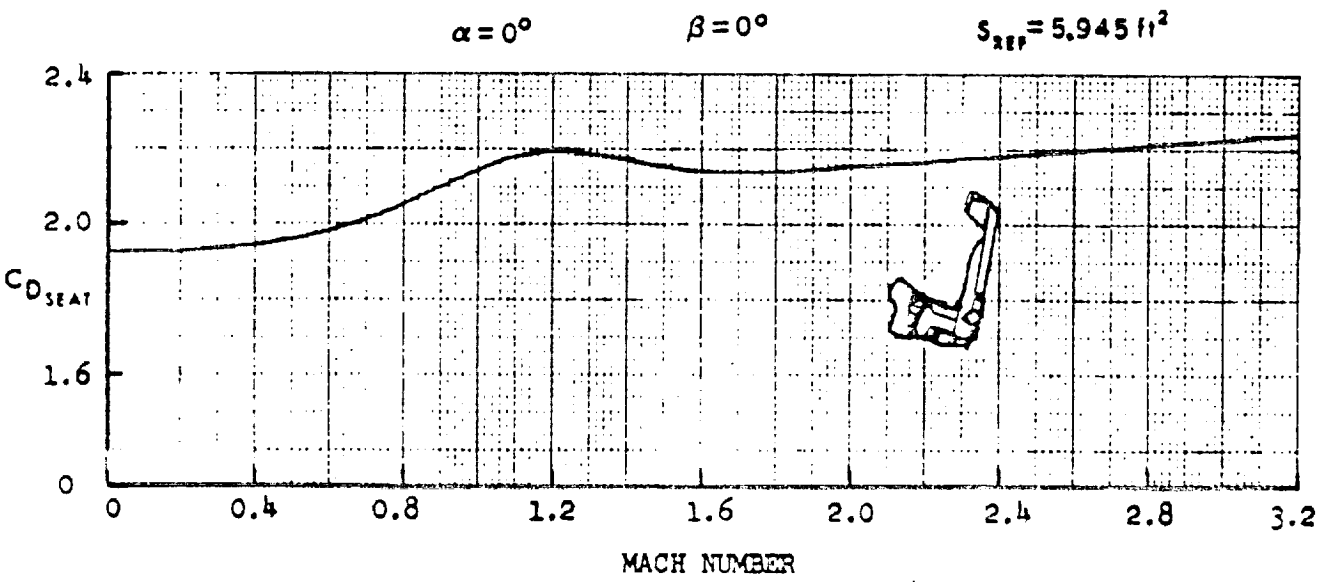
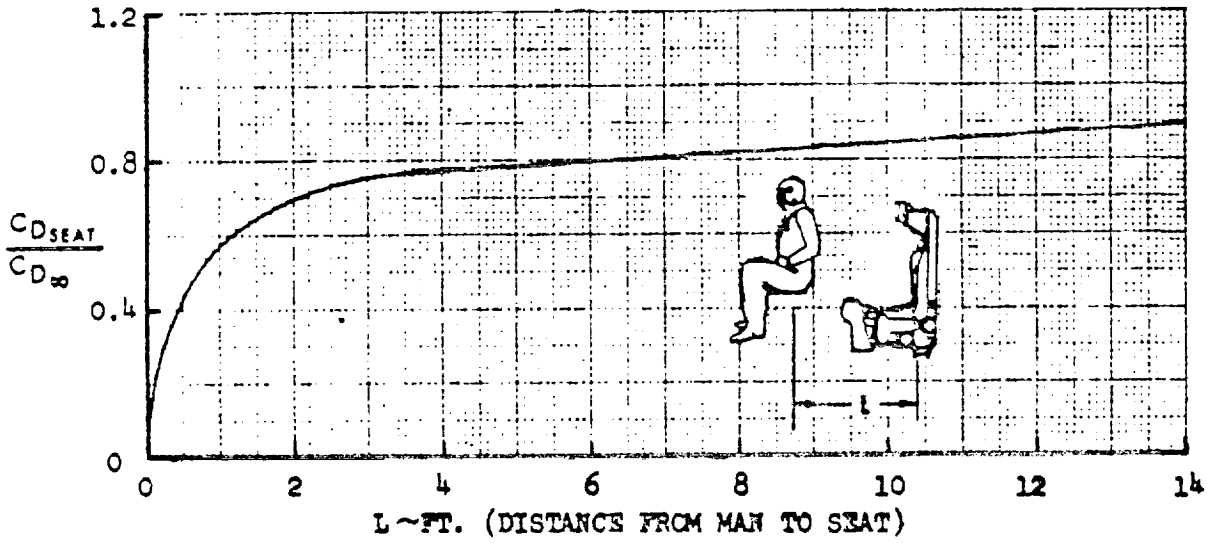


Figure 4.3.1.2-5
COMPONENT DRAG COEFFICIENTS

Rockwell International
Space Division





ENGINEER DCO
DATE 1-13-72

Figure 4.3.1.2-6
COMPONENT DRAG COEFFICIENTS

4.3.1.3 PITCHING MOMENT COEFFICIENT. The Orbiter Vehicle ejection seat pitching moment coefficient for a given seat angle of attack and Mach number is defined in this section. Moments are given about the Seat Reference Point (SRP) located 7.74 inches above and 7.96 inches forward of the center of the lowest seat roller (see Figure 4.3.1.3-2) measured normal and parallel, respectively, to the $\alpha = 0°$ vector. The total pitching moment coefficient is obtained by the following equation:

$$C_{m_{\substack{TOTAL \\ MAN/SEAT}}} = C_{m_{\substack{FREE \\ STREAM}}} + \Delta C_{m_{\substack{FOOT \\ REST}}} + \Delta C_{m_{\substack{CREW \\ CORRECT}}} + \Delta C_{m_{PROXIMITY}}$$

where,

$C_{m_{\substack{FREE \\ STREAM}}}$ = Freestream pitching moment coefficient acting on the man/seat combination.

$\alpha = \beta = 0$ (Figure 4.3.1.3-1)

$C_{m_{\substack{FREE \\ STREAM}}} = 1.23 \times C_{m_{F-106}}$; $\alpha = \alpha$, $\beta = \beta$ (Reference 4-1 p 65 & following)

$\Delta C_{m_{\substack{FOOT \\ REST}}}$ = Incremental pitching moment coefficient resulting from rotation of the foot rests (145° from ejection position) (Figure 4.3.1.3-2)

$\Delta C_{m_{\substack{CREWMAN \\ CORRECTION}}}$ = Incremental pitching moment coefficient resulting from percentile man other than 50.

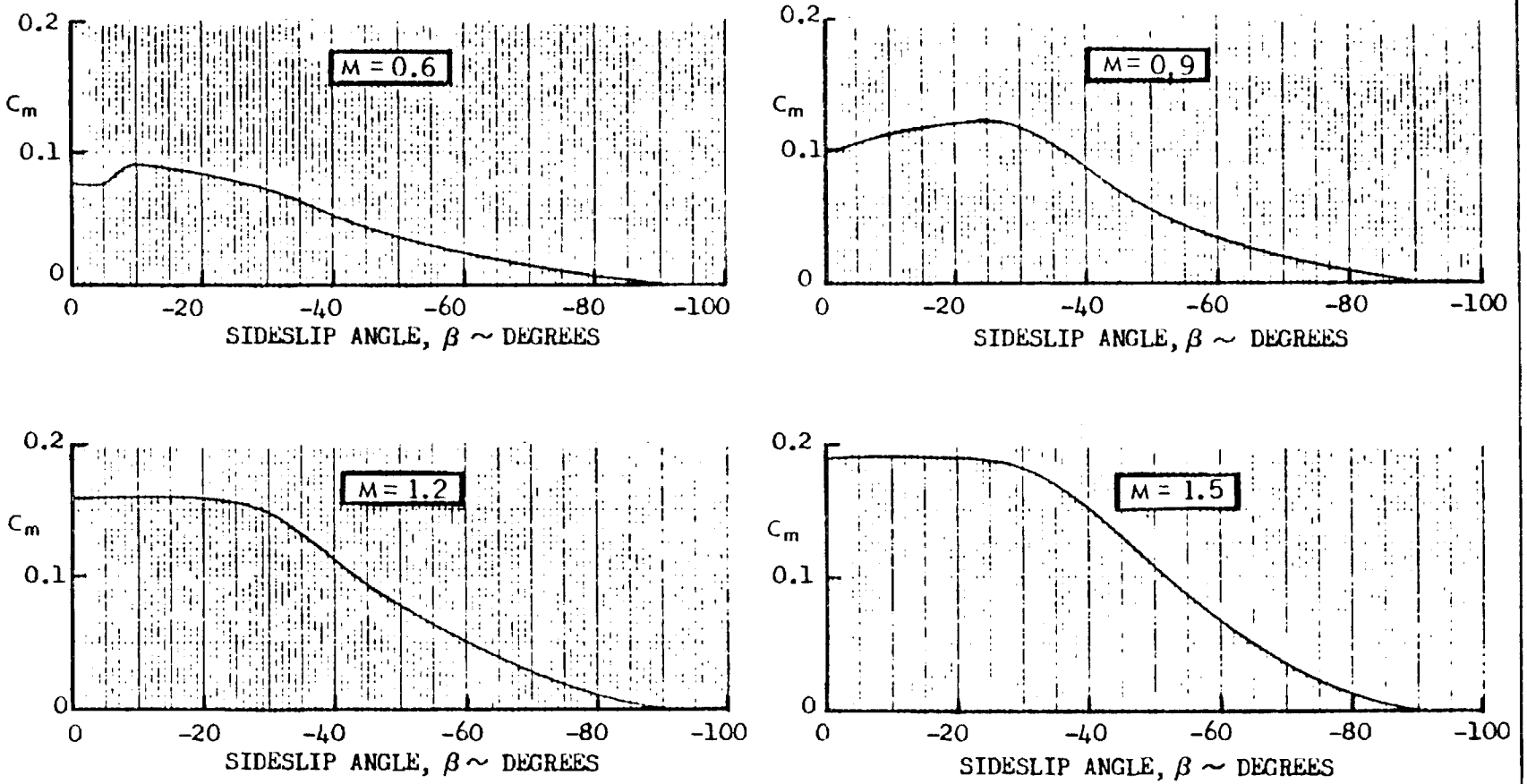
$= K C_{A_{\substack{TOTAL \\ MAN\ SEAT}}}$ ($C_{A_{TOTAL}}$ is obtained from Section 4.3.1.2)

where K = 0.01953 (95 percentile)
= 0.01736 (90 percentile)
= 0 (50 percentile)
= -0.01736 (10 percentile)

$\Delta C_{m_{PROXIMITY}}$ = Incremental pitching moment coefficient due to proximity of the Orbiter Vehicle. Given as a function of distance from ejection rail tip-off. (Figure 4.3.1.3-3)

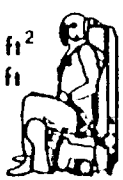
MAN/SEAT

$\alpha = 0^{\circ}$



$S_{REF} = 5.945\ ft^2$

$L_{REF} = 2.760\ ft$



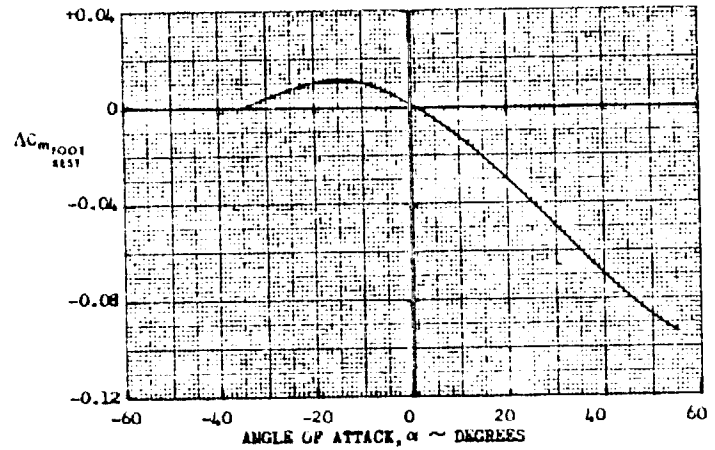
ENGINEER: DCO

DATE: 7-13-72

Figure 4.3.1.3-1

PITCHING MOMENT COEFFICIENT

Rockwell International
Space Division



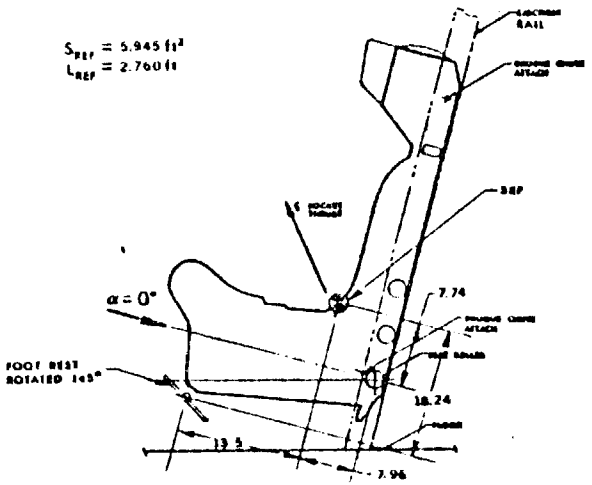


Figure 4.3.1.3-2
INCREMENTAL PITCHING MOMENT DUE TO ROTATED FOOT RESTS

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DATE 7/13/77

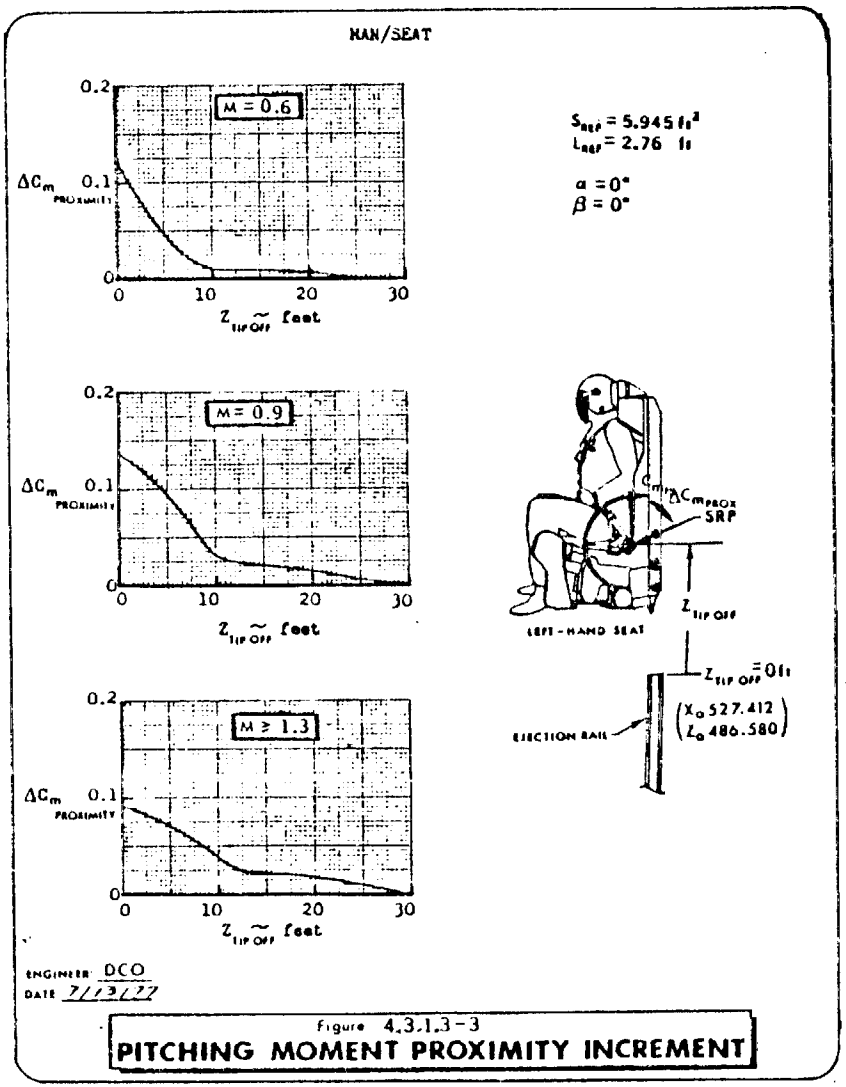

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Figure 4.3.1.3-3
PITCHING MOMENT PROXIMITY INCREMENT

Rockwell International
Space Division

4.3.1.4 SIDE FORCE COEFFICIENT. The Orbiter Vehicle ejection seat side force coefficient for a given seat angle of attack and Mach number is defined in this section. The total side force coefficient is obtained by the following equation:

$$C_{Y_{\substack{TOTAL \\ MAN/SEAT}}} = C_{Y_{\substack{FREE \\ STREAM}}} \frac{\beta}{|\beta|} + \Delta C_{Y_{\substack{FOOT \\ REST}}} + S\Delta C_{Y_{PROXIMITY}}$$

where,

$C_{Y_{\substack{FREE \\ STREAM}}}$ = Freestream side force coefficient acting on the man/seat combination

$\alpha = \beta = 0°$ (Figure 4.3.1.4-1)

$C_{Y_{\substack{FREE \\ STREAM}}} = 1.5 \times C_{Y_{F-106}}$; $\alpha = \alpha$, $\beta = \beta$ (Reference 4-1 p 65 & following)

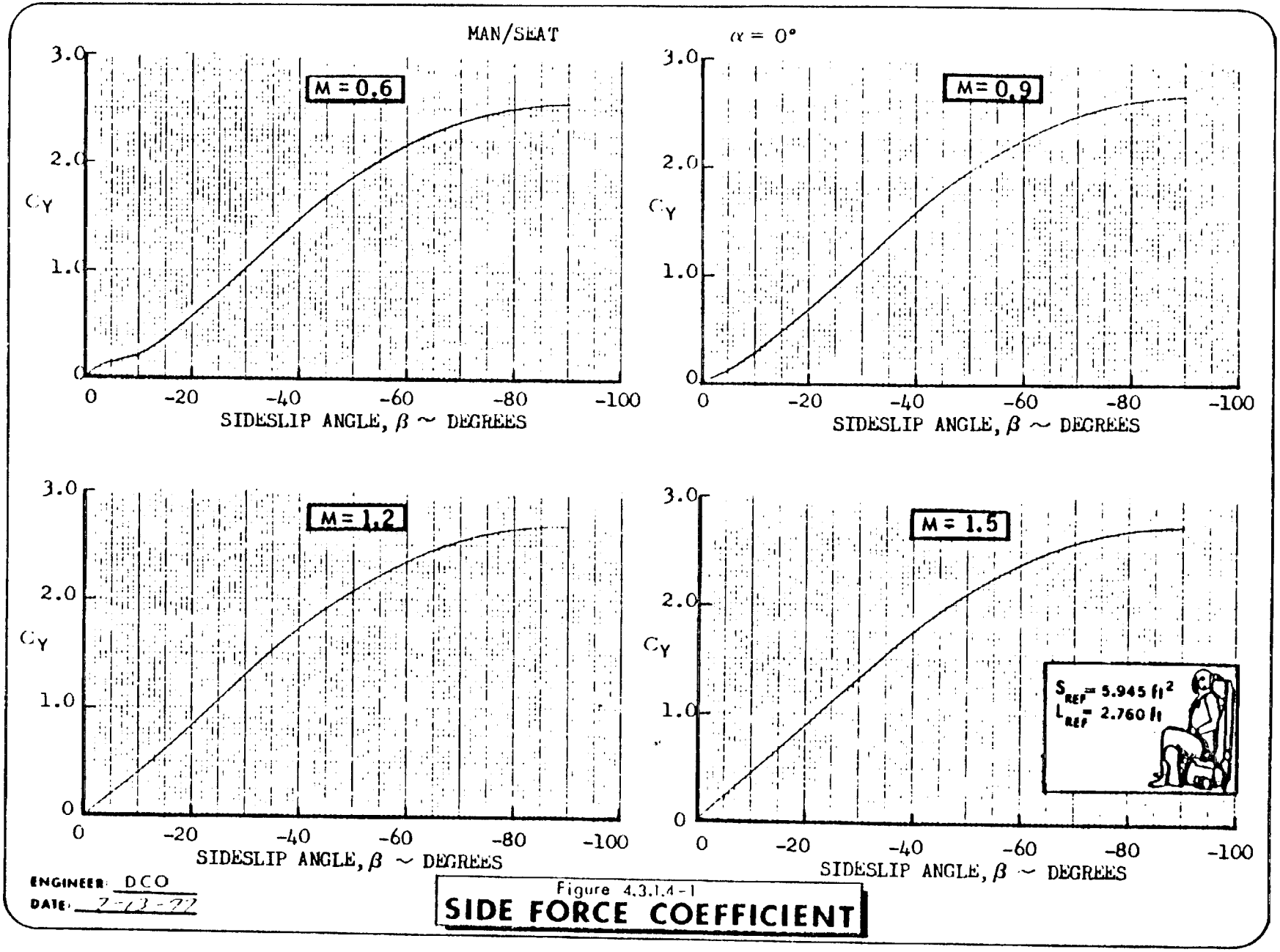
$\frac{\beta}{|\beta|}$ = Sideslip direction indicator.

$\Delta C_{Y_{\substack{FOOT \\ REST}}}$ = Incremental side force coefficient due to rotation of foot rests. (145° from ejection position) (Assume zero)

S = Seat determination indicator. (- = R.H. seat + = L.H. seat)

$\Delta C_{Y_{PROXIMITY}}$ = Incremental side force coefficient due to proximity of the Orbiter Vehicle. Given as a function of distance from ejection rail tip-off. (Figure 4.3.1.4-2)

The side force coefficient is applicable for 10 through 95 percentile crewmen.



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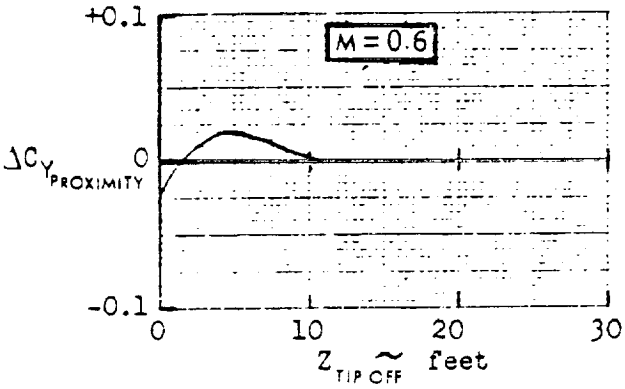
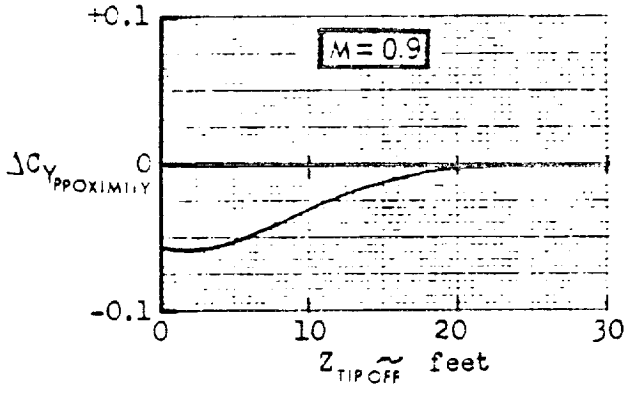
DATE 2-23-72

Figure 4.3.1.4-1
SIDE FORCE COEFFICIENT

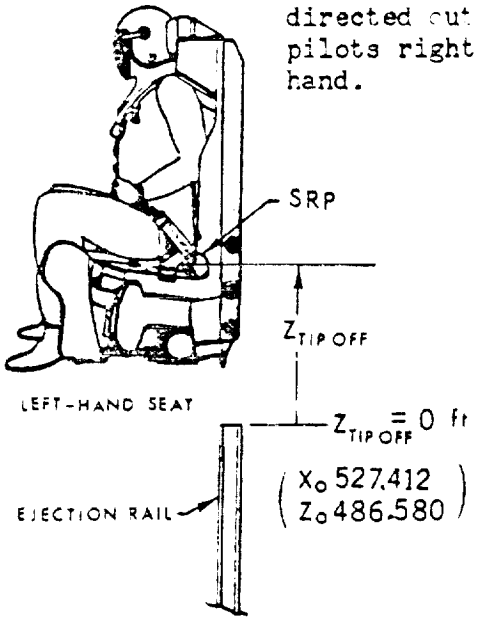
MAN/SEAT

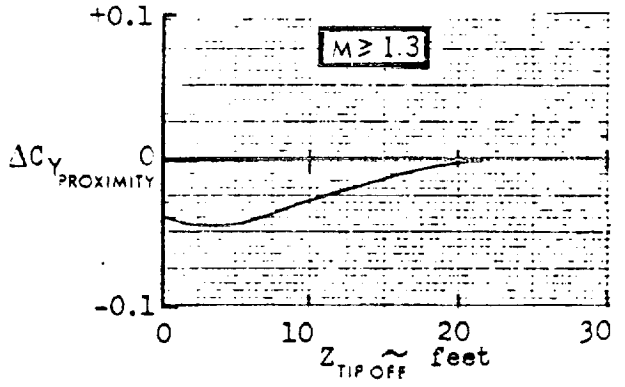


$S_{REF} = 5.945\ ft^2$
$L_{REF} = 2.76\ ft$
$\alpha = 0°$
$\beta = 0°$



Positive Y directed cut pilots right hand.





ENGINEER: DCO
DATE 7-13-77

Figure 4.3.1.4-2
SIDE FORCE PROXIMITY INCREMENT

4.3.1.5 YAWING MOMENT COEFFICIENT. The Orbiter Vehicle ejection seat yawing moment coefficient for a given seat angle of attack and Mach number is defined in this section. Moments are given about the Seat Reference Point (SRP) located 7.74 inches above and 7.96 inches forward of the center of the lowest seat roller (see Figure 4.3.1.3-2) measured normal and parallel, respectively, to the $\alpha = 0°$ vector. The total yawing moment coefficient is obtained by the following equation:

$$C_{n_{\substack{\text{TOTAL}\\\text{MAN/SEAT}}}} = C_{n_{\substack{\text{FREE}\\\text{STREAM}}}} \frac{\beta}{|\beta|} + \Delta C_{n_{\substack{\text{FOOT}\\\text{REST}}}} + S\Delta C_{n_{\text{PROXIMITY}}}$$

where,

$C_{n_{\substack{\text{FREE}\\\text{STREAM}}}}$ = Freestream yawing moment coefficient acting on the man/seat combination.

$\alpha = \beta = 0°$ (Figure 4.3.1.5-1)

$C_{n_{\substack{\text{FREE}\\\text{STREAM}}}} = 2.0 \times C_{n_{F-106}}, \alpha = \alpha, \beta = \beta$ (Reference 4-1 p 65 & following)

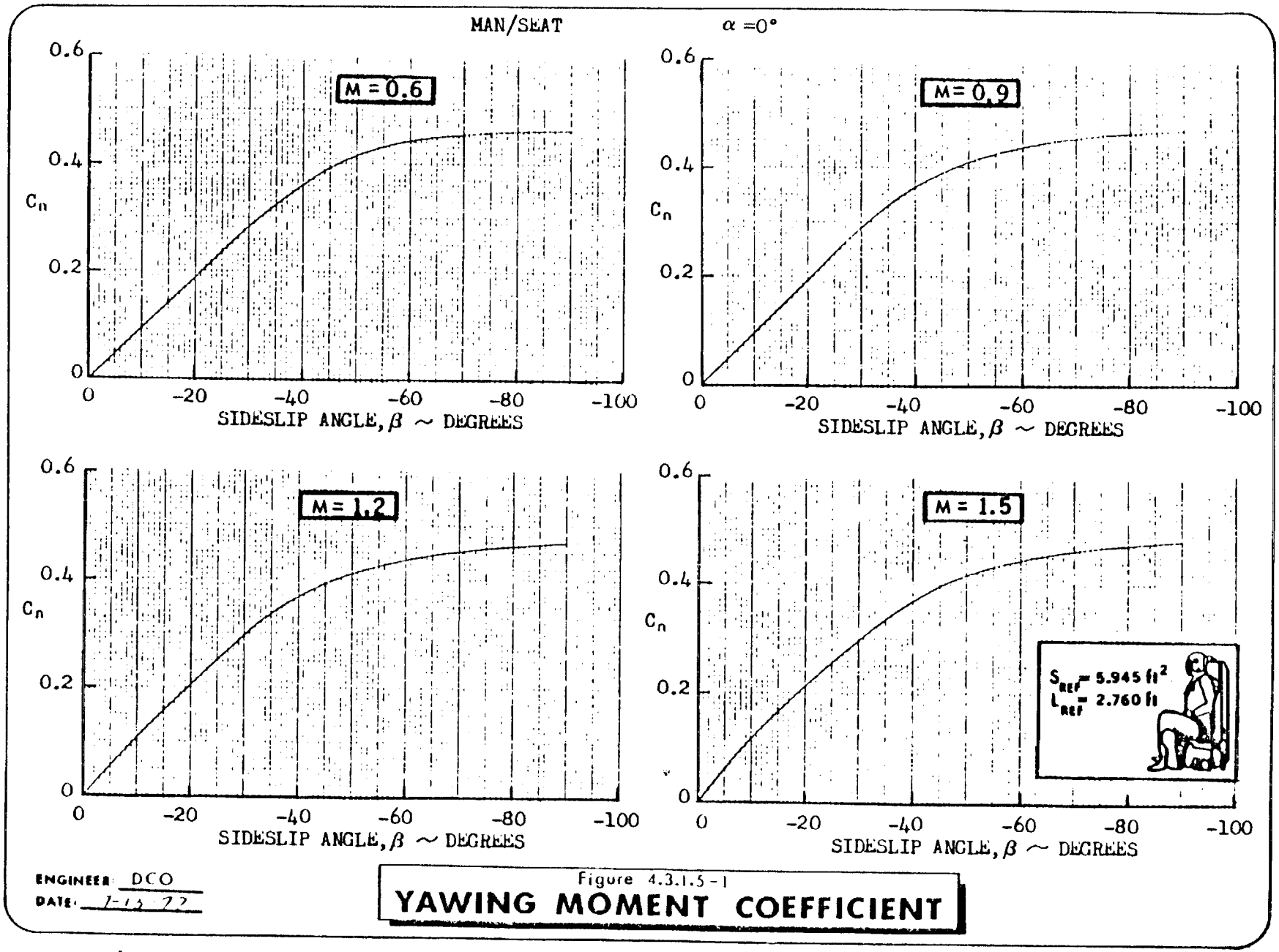
$\frac{\beta}{|\beta|}$ = Sideslip direction indicator

$\Delta C_{n_{\substack{\text{FOOT}\\\text{REST}}}}$ = Incremental yawing moment coefficient due to rotation of the foot rests. (145° from the ejection position) (Assume zero)

S = Seat determination indicator. (- = R.H. seat + = L.H. seat)

$\Delta C_{n_{\text{PROXIMITY}}}$ = Incremental yawing moment coefficient due to proximity of the Orbiter Vehicle. Given as a function of distance from ejection rail tip-off. (Figure 4.3.1.5-2)

The yawing moment coefficient is applicable for 10 through 95 percentile crewmen.



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DATE 1-13-72

Figure 4.3.1.5-1
YAWING MOMENT COEFFICIENT

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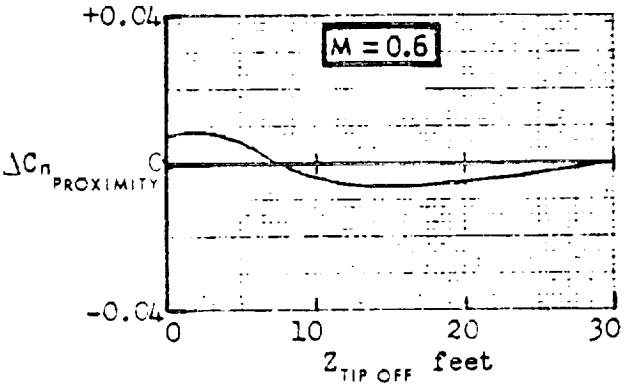
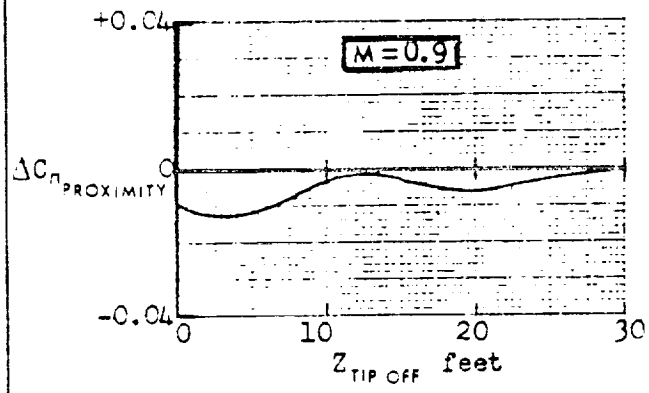
Space Division

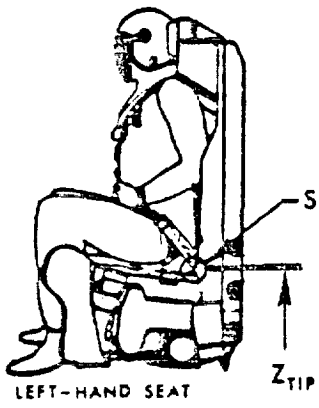
MAN/SEAT

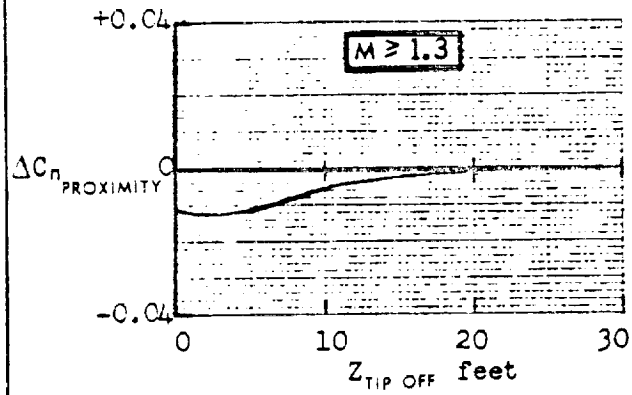


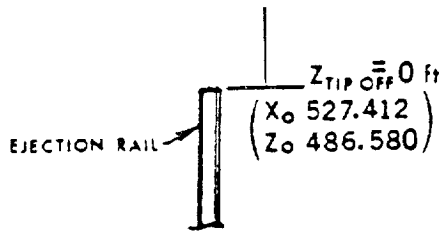
$S_{REF} = 5.945\ ft^2$
$L_{REF} = 2.76\ ft$
$\alpha = 0°$
$\beta = 0°$



Positive yawing moment is pilot's left side forward.







ENGINEER DCO
DATE 7-13-77

Figure 4.3.1.5-2
YAWING MOMENT PROXIMITY INCREMENT

4.3.1.6 ROLLING MOMENT COEFFICIENT. The Orbiter Vehicle ejection seat rolling moment coefficient for a given seat angle of attack and Mach number is defined in this section. Moments are given about the Seat Reference Point (SRP) located 7.74 inches above and 7.96 inches forward of the center of the lowest seat roller (see Figure 4.3.1.3-2) measured normal and parallel, respectively, to the $\alpha = 0°$ vector. The total rolling moment coefficient is obtained by the following equation:

$$\Delta C_{\ell_{\substack{\text{TOTAL}\\\text{MAN/SEAT}}}} = C_{\ell_{\substack{\text{FREE}\\\text{STREAM}}}} \frac{\beta}{|\beta|} + \Delta C_{\ell_{\substack{\text{FOOT}\\\text{REST}}}} + S\Delta C_{\ell_{\text{PROXIMITY}}}$$

where,

$C_{\ell_{\substack{\text{FREE}\\\text{STREAM}}}}$ = Freestream rolling moment coefficient acting on the man/seat combination.

$\alpha = \beta = 0$ (Figure 4.3.1.6-1)

$C_{\ell_{\substack{\text{FREE}\\\text{STREAM}}}} = 2.0 \times C_{\ell_{F-106}}$; $\alpha = \alpha$, $\beta = \beta$ (Reference 4-1 p 65 & following)

$\frac{\beta}{|\beta|}$ = Sideslip direction indicator

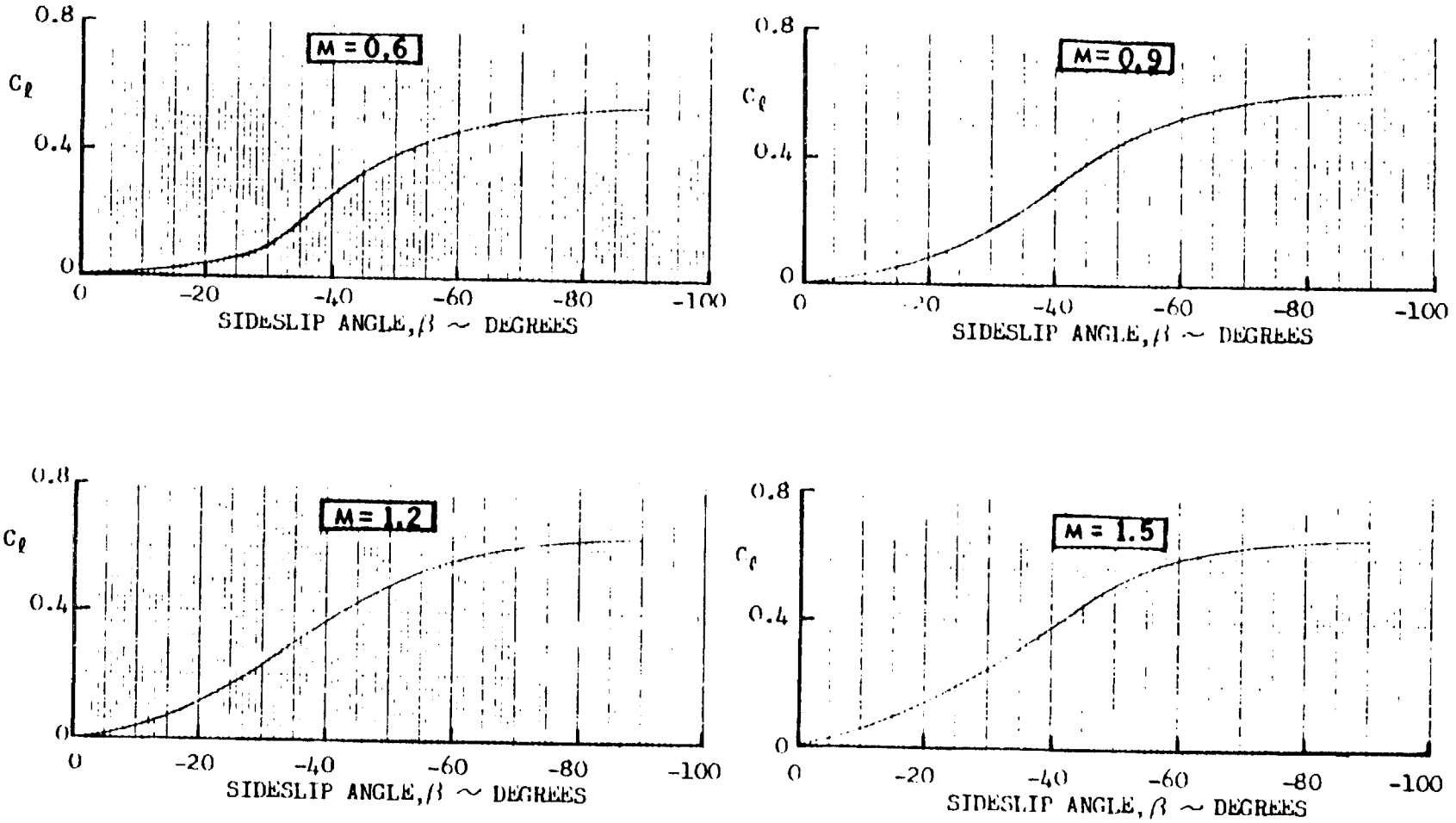
$\Delta C_{\ell_{\substack{\text{FOOT}\\\text{REST}}}}$ = Incremental rolling moment coefficient due to rotation of the foot rests. (145° from ejection position) (Assume zero)

S = Seat determination indicator. (- = R.H. seat, + = L.H. seat)

$\Delta C_{\ell_{\text{PROXIMITY}}}$ = Incremental rolling moment coefficient due to proximity of the Orbiter Vehicle. Given as a function of distance from ejection rail tip-off. (Figure 4.3.1.6-2)

The rolling moment coefficient is applicable for 10 through 95 percentile cremen.

MAN/SEAT $\alpha = 0°$



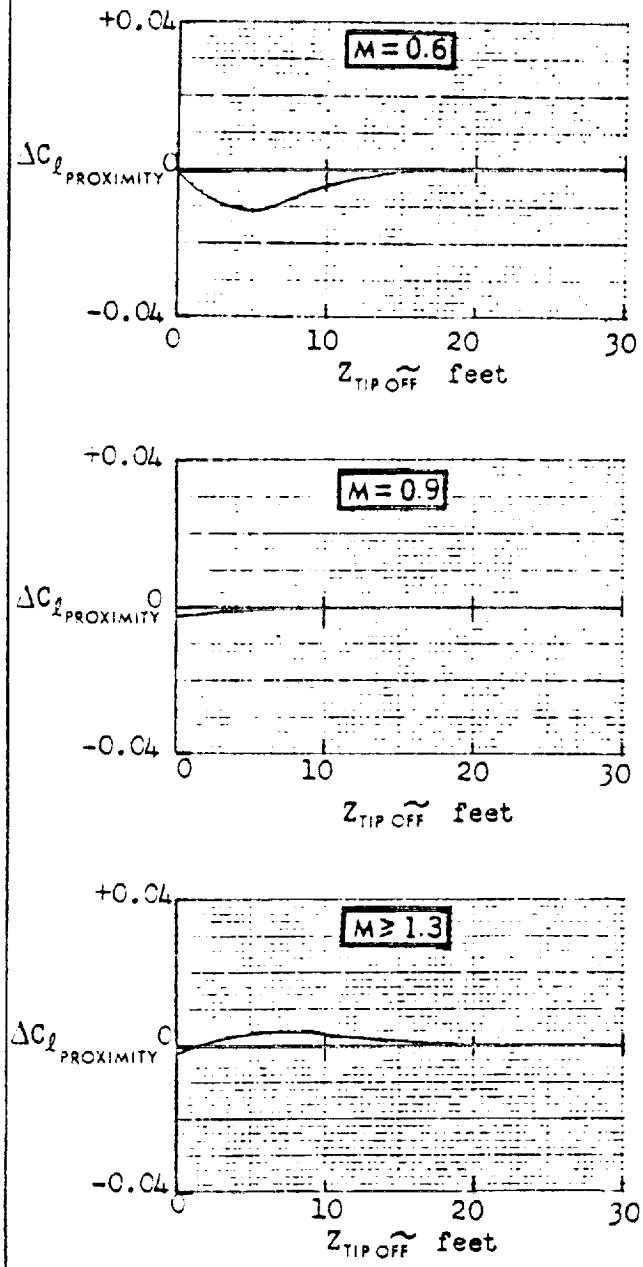
$S_{REF} = 8.945\ ft^2$
$L_{REF} = 2.760\ ft$

ENGINEER DCO
DATE 4/3/72

Figure 4.3.1.6-1

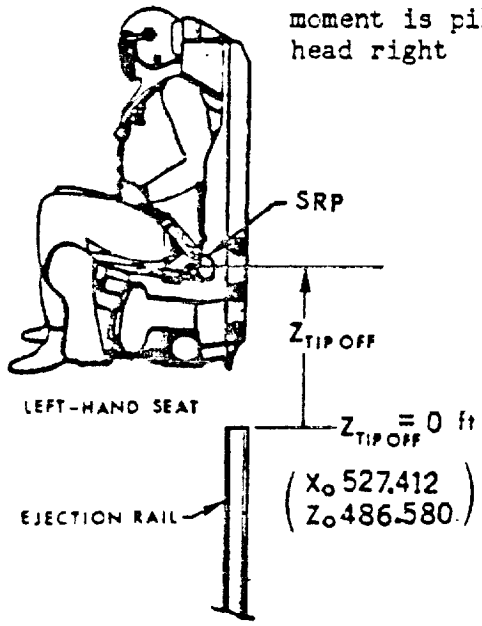
ROLLING MOMENT COEFFICIENT

MAN/SEAT



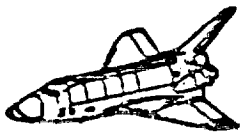
$S_{REF} = 5.945\ ft^2$
$L_{REF} = 2.76\ ft$
$\alpha = 0°$
$\beta = 0°$

Positive rolling moment is pilot's head right



ENGINEER: DCO
DATE 7-13-77

Figure 4.3.1.6-2
ROLLING MOMENT PROXIMITY INCREMENT



5.0 HINGE MOMENT COEFFICIENTS

This section contains the Orbiter Vehicle control hinge moment data to be used for entry trajectory analyses, subsystem design and analyses, flight control analyses, and manned simulation studies. Hinge moment coefficient data are primarily based on wind tunnel test results with analytical methods being applied to bridge the gaps in test data.

5.1 ELEVON CONTROL HINGE MOMENT COEFFICIENT. The elevon control hinge moment coefficients are based on theoretical (not true) reference dimensions. The reference area (per side) is 210.0 ft^2. The reference length (mean aerodynamic chord) is 90.7 inches. These reference values were used for each panel so that the total hinge moment is the sum of the individual panel hinge moments:

$$HM_{e_{TOTAL}} = HM_{e_{INBOARD}} + HM_{e_{OUTBOARD}}$$

where; $HM_e = C_{h_e} (\bar{q}\, S_e\, \bar{c}_e)$

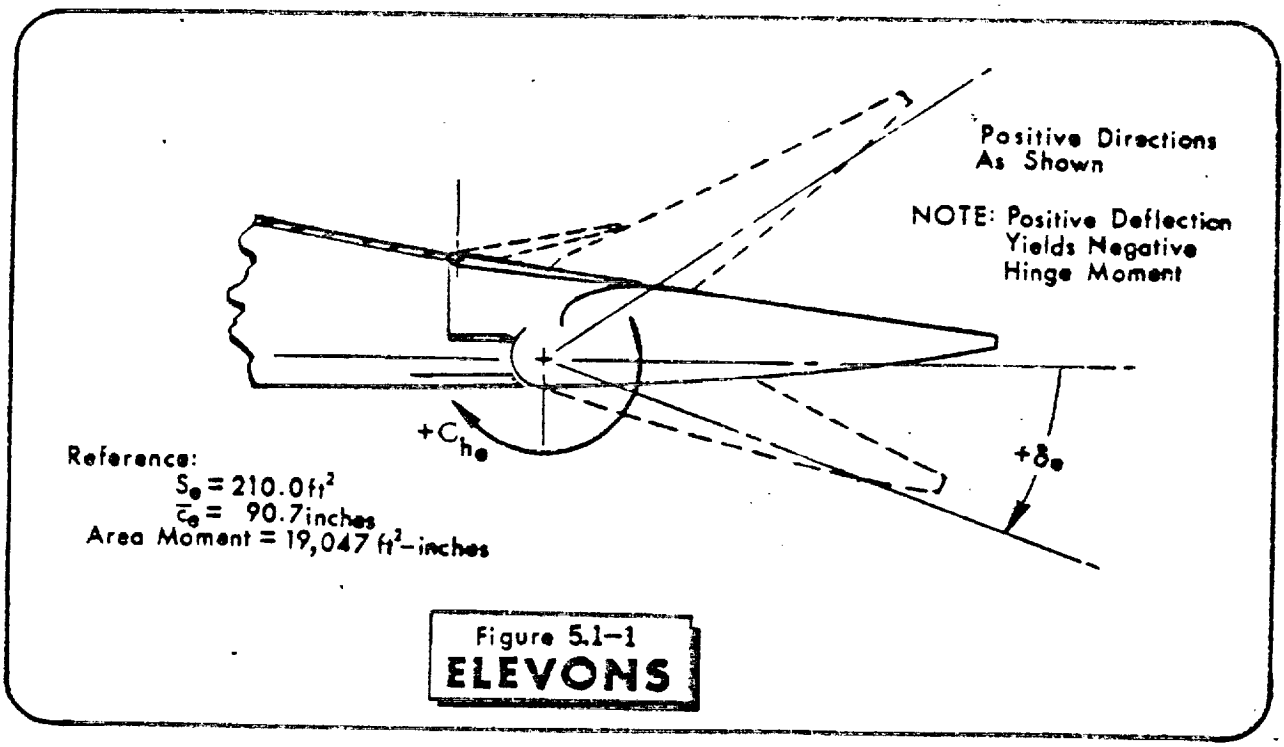


Figure 5.1-1
ELEVONS

or

$$HM_{e_{TOTAL}} = \bar{q} S_e \bar{c}_e \left(C_{h_{e_{INBOARD}}} + C_{h_{e_{OUTBOARD}}}\right)$$

where, S_e and $\bar{c}_e$ are given on Figure 5.1-1 and the rigid body hinge moment coefficients are obtained from: inboard (Figures 5.1-2 through 5.1-28)
outboard (Figures 5.1-29 through 5.1-55)

The effect of aeroelastic deformation on the elevon Hinge Moment coefficient is determined from:

$$C^{F}_{h_{e\,INBOARD}} = C^{R}_{h_{e\,INBOARD}} \cdot \eta_{C_{h_{e_I}}}$$

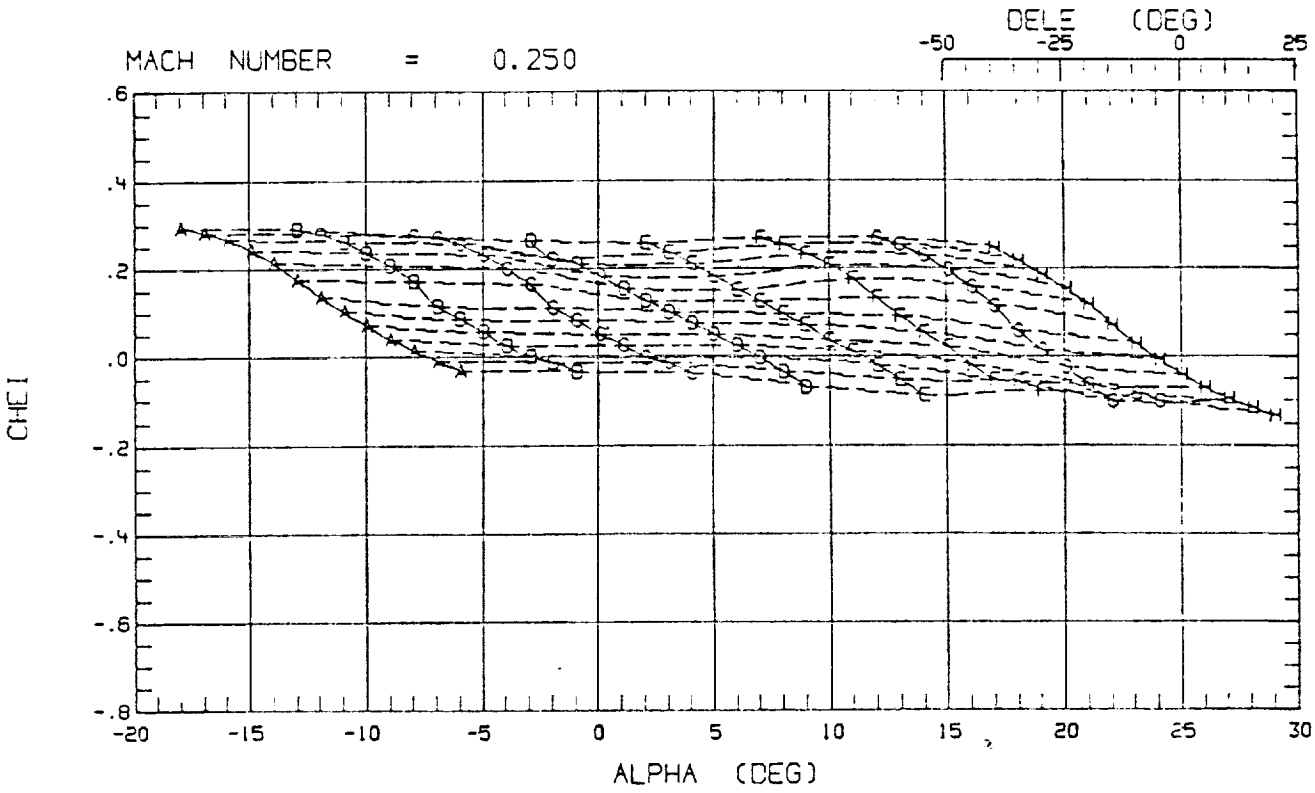
and

$$C^{F}_{h_{e\,OUTBOARD}} = C^{R}_{h_{e\,OUTBOARD}} \cdot \eta_{C_{h_{e_O}}}$$

where,

$C^{R}_{h_e}$ = Rigid elevon Hinge Moment coefficient
INBOARD (Figures 5.1-2 through -28)
OUTBOARD (Figures 5.1-29 through -55)

$\eta_{C_{h_e}}$ = Flexible to Rigid elevon Hinge Moment ratio
INBOARD (Figures 5.1- 56)
OUTBOARD (Figures 5.1- 57)



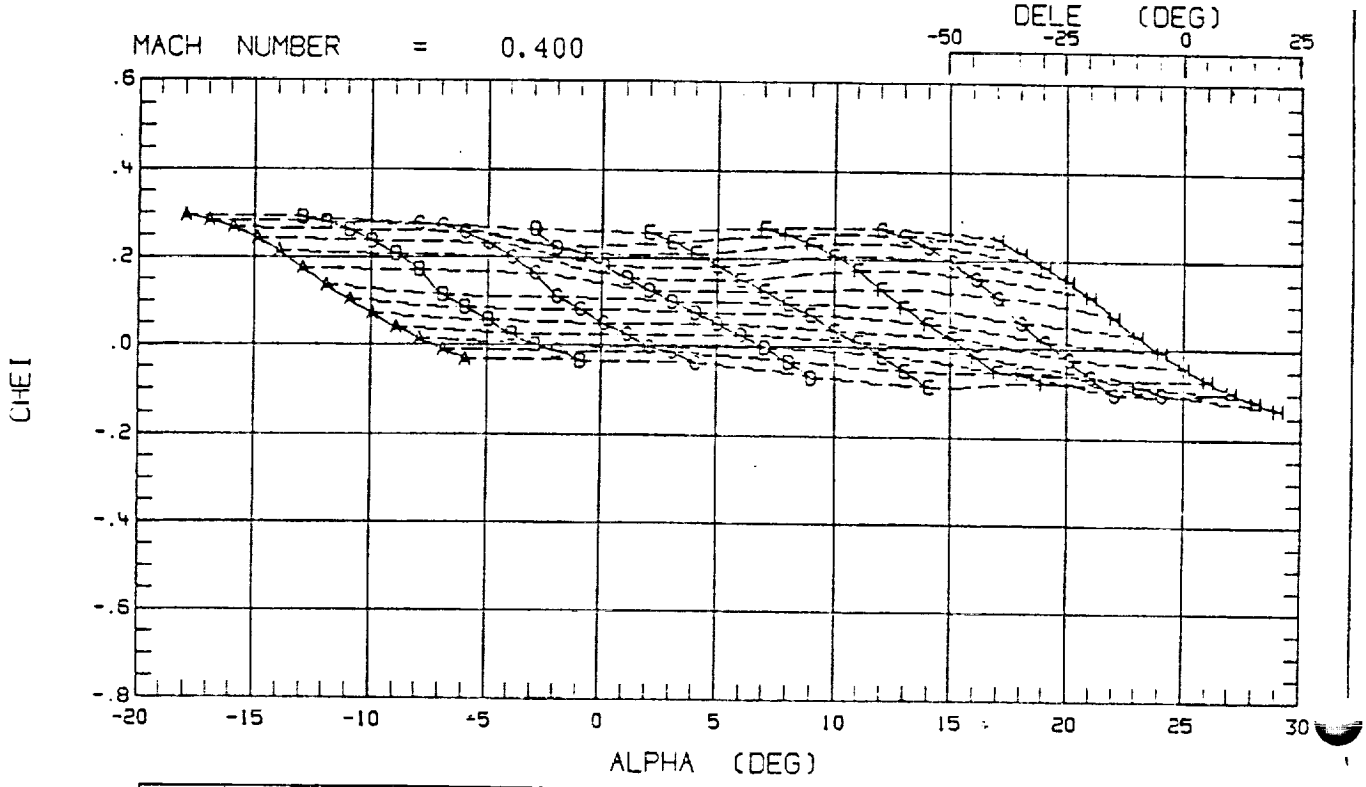
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.29190	0.28750	0.27350	0.26100	0.25710	0.26730	0.26750	0.24370
-35.000	0.28126	0.27696	0.26800	0.22000	0.23500	0.25202	0.25029	0.21554
-30.000	0.26440	0.25980	0.25380	0.21000	0.21000	0.23150	0.22590	0.18480
-25.000	0.24123	0.23557	0.22985	0.18000	0.18000	0.20609	0.19322	0.15182
-20.000	0.21200	0.20560	0.19930	0.15300	0.15000	0.17470	0.15560	0.11560
-15.000	0.17400	0.16835	0.16140	0.12500	0.12500	0.13240	0.11290	0.07230
-10.000	0.13600	0.11200	0.11000	0.10000	0.09500	0.09000	0.05500	0.02900
-5.000	0.10100	0.08300	0.08200	0.07500	0.07000	0.05200	0.01500	-0.00800
0.0	0.06970	0.05500	0.05000	0.04900	0.03500	0.02000	-0.02500	-0.04200
5.000	0.04000	0.02500	0.02500	0.02300	0.01000	-0.02100	-0.06500	-0.07100
10.000	0.01450	0.0	-0.00500	-0.00500	-0.02100	-0.05500	-0.10500	-0.09630
15.000	-0.00950	-0.01357	-0.01563	-0.03500	-0.05500	-0.05693	-0.08427	-0.11763
20.000	-0.03200	-0.03500	-0.03800	-0.07000	-0.09000	-0.07700	-0.10500	-0.13500

ENGINEER H.P.
DATE 10/27/78

FIGURE 5.1-2
ELEVON HINGE MOMENT COEFFICIENT



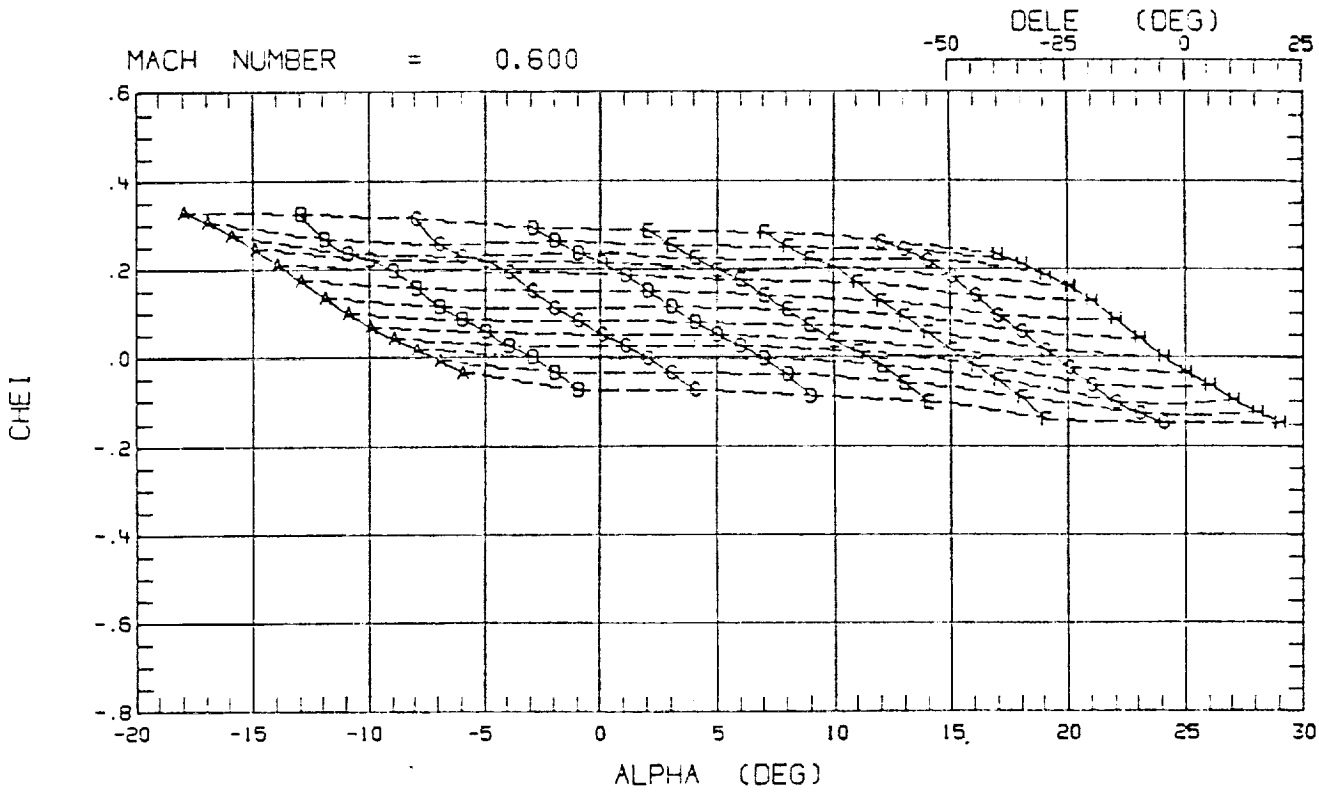
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.		ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.29190	0.28750	0.27350	0.26100	0.25710	0.26730	0.26750	0.24370
-35.000	0.28126	0.27696	0.26800	0.22000	0.23500	0.25202	0.25029	0.21554
-30.000	0.26440	0.25980	0.25380	0.21000	0.21000	0.23150	0.22590	0.18480
-25.000	0.24123	0.23557	0.22985	0.18000	0.18000	0.20609	0.19322	0.15182
-20.000	0.21200	0.20560	0.19930	0.15300	0.15000	0.17470	0.15560	0.11560
-15.000	0.17400	0.16835	0.16140	0.12500	0.12500	0.13240	0.11290	0.07230
-10.000	0.13600	0.11200	0.11000	0.10000	0.09500	0.09000	0.05500	0.02900
-5.000	0.10100	0.08300	0.08200	0.07500	0.07000	0.05200	0.01500	-0.00800
0.0	0.06970	0.05500	0.05000	0.04900	0.03500	0.02000	-0.02500	-0.04200
5.000	0.04000	0.02500	0.02500	0.02300	0.01000	-0.02100	-0.06500	-0.07100
10.000	0.01450	0.0	-0.00500	-0.00500	-0.02100	-0.05500	-0.10500	-0.09630
15.000	-0.00950	-0.01357	-0.01563	-0.03500	-0.05500	-0.05593	-0.08427	-0.11763
20.000	-0.03200	-0.03500	-0.03800	-0.07000	-0.09000	-0.07700	-0.10500	-0.13500

ENGINEER JC/HD
DATE 10/2/78

FIGURE 5.1-3
ELEVON HINGE MOMENT COEFFICIENT



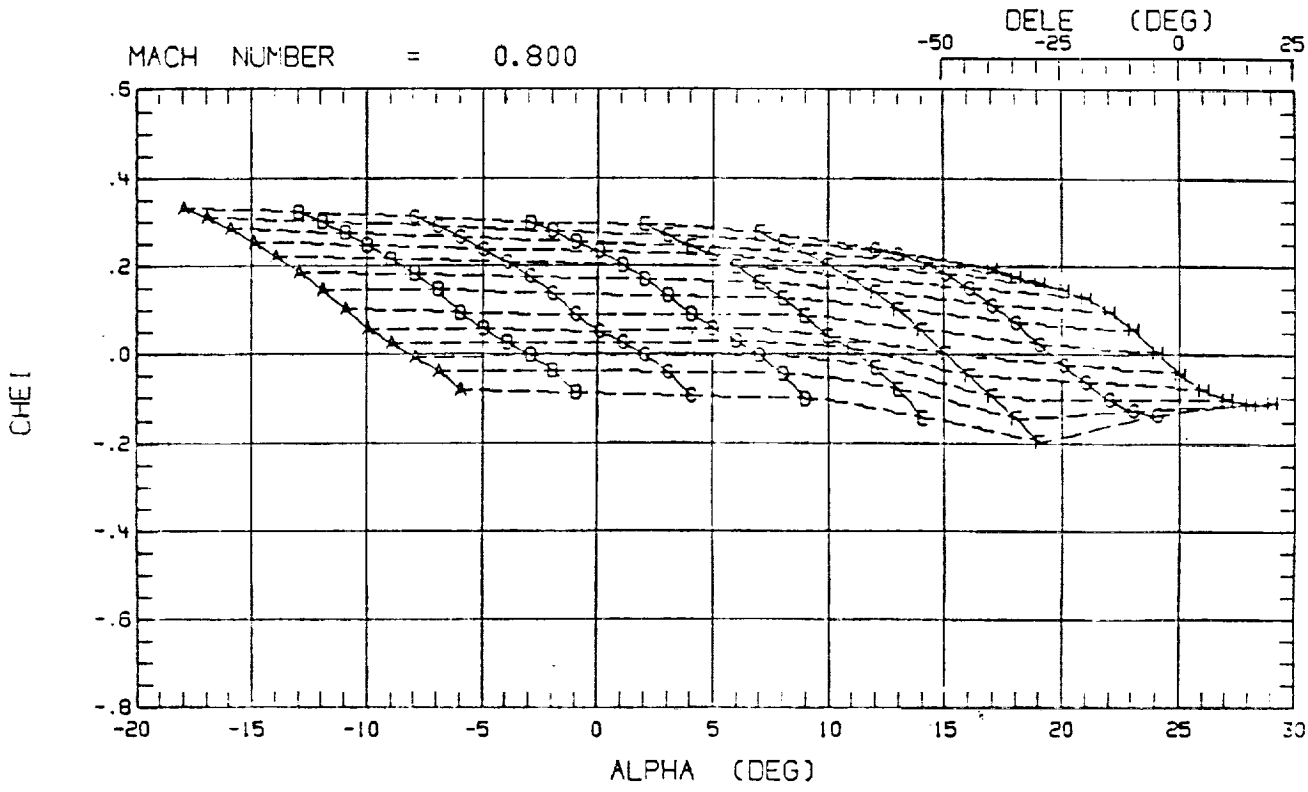
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.32740	0.32150	0.31130	0.29150	0.28470	0.28040	0.26010	0.22920
-35.000	0.30334	0.26700	0.25600	0.26100	0.25200	0.24700	0.24096	0.20945
-30.000	0.27590	0.23500	0.22800	0.23500	0.22200	0.22100	0.21750	0.18590
-25.000	0.24492	0.22000	0.21600	0.21300	0.19600	0.20200	0.17900	0.15905
-20.000	0.21090	0.19500	0.19200	0.18400	0.17200	0.16500	0.13700	0.12740
-15.000	0.17290	0.15500	0.15000	0.14900	0.13800	0.12500	0.09300	0.08597
-10.000	0.13490	0.11200	0.11000	0.11200	0.10500	0.09000	0.05500	0.04280
-5.000	0.09900	0.08300	0.08200	0.07700	0.07000	0.05200	0.01500	-0.00100
0.0	0.06820	0.05500	0.05000	0.04900	0.03500	0.01300	-0.02500	-0.03520
5.000	0.04100	0.02500	0.02500	0.02300	0.01000	-0.02100	-0.06500	-0.06500
10.000	0.01770	0.0	-0.00500	-0.00500	-0.02100	-0.05500	-0.10500	-0.09540
15.000	-0.00763	-0.03500	-0.03700	-0.04100	-0.06000	-0.09400	-0.12900	-0.12373
20.000	-0.03500	-0.07400	-0.07600	-0.09000	-0.10300	-0.14200	-0.15000	-0.15000

ENGINEER HP
DATE 10/27/78

FIGURE 5.1-4
ELEVON HINGE MOMENT COEFFICIENT



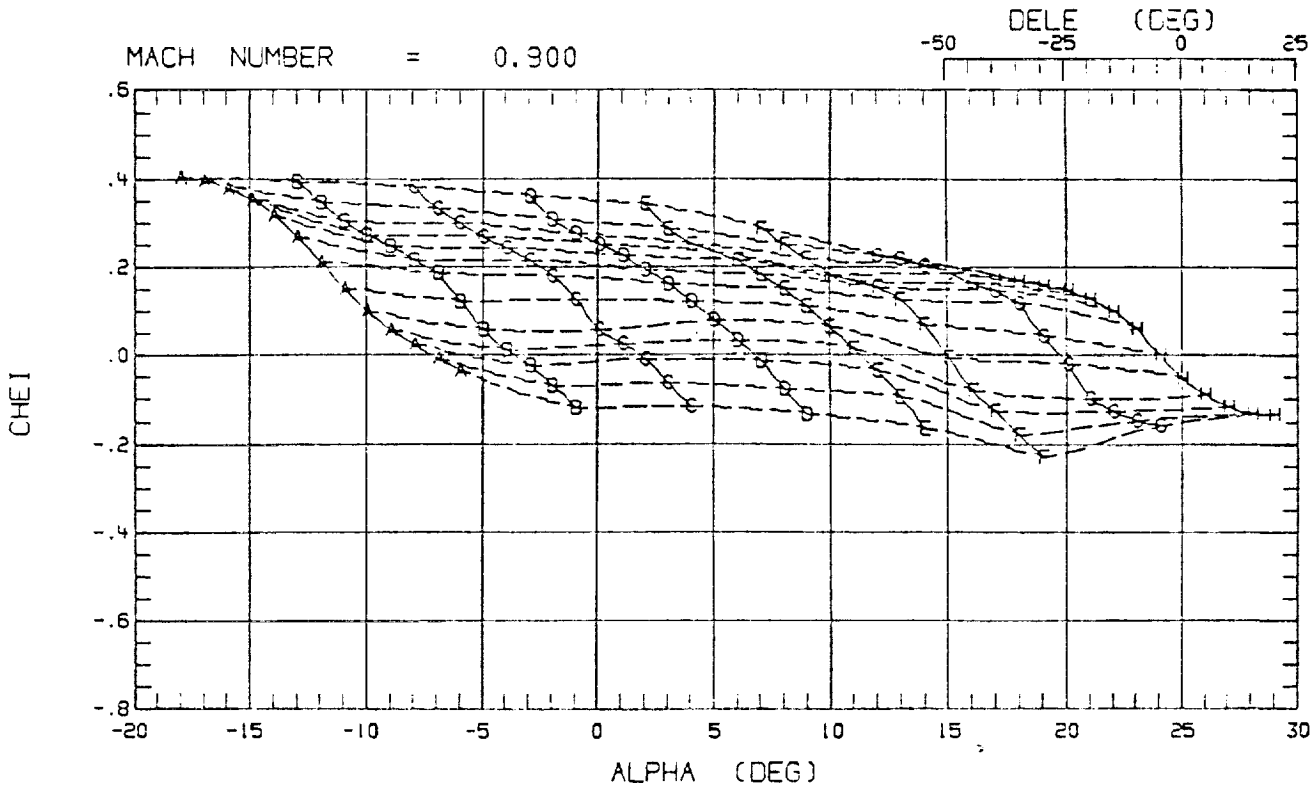
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.33000	0.32000	0.31000	0.29600	0.29000	0.27220	0.23460	0.19050
-35.000	0.30800	0.29800	0.28800	0.27500	0.26600	0.24900	0.22400	0.17511
-30.000	0.28200	0.27200	0.26300	0.25100	0.24100	0.22600	0.20500	0.15940
-25.000	0.25300	0.24400	0.23500	0.23000	0.22200	0.19900	0.18055	0.14351
-20.000	0.22000	0.21300	0.20700	0.20000	0.19600	0.16900	0.14800	0.12700
-15.000	0.18500	0.17900	0.17300	0.16700	0.16100	0.13800	0.11000	0.09637
-10.000	0.14600	0.14400	0.13500	0.13000	0.12500	0.10000	0.07000	0.05570
-5.000	0.10400	0.09300	0.08800	0.08800	0.08500	0.05200	0.02200	0.00450
0.0	0.05600	0.05500	0.05000	0.05800	0.03700	0.0	-0.02500	-0.04540
5.000	0.02500	0.02500	0.02500	0.02700	0.01000	-0.05000	-0.06500	-0.08100
10.000	-0.00900	-0.00500	-0.00500	-0.00500	-0.03200	-0.09800	-0.10500	-0.10240
15.000	-0.03800	-0.04000	-0.04200	-0.04700	-0.08200	-0.14600	-0.12900	-0.11253
20.000	-0.08300	-0.09000	-0.09700	-0.10300	-0.14600	-0.13900	-0.14000	-0.11140

ENGINEER [illegible]
DATE 10/3/78

FIGURE 5.1-5
ELEVON HINGE MOMENT COEFFICIENT



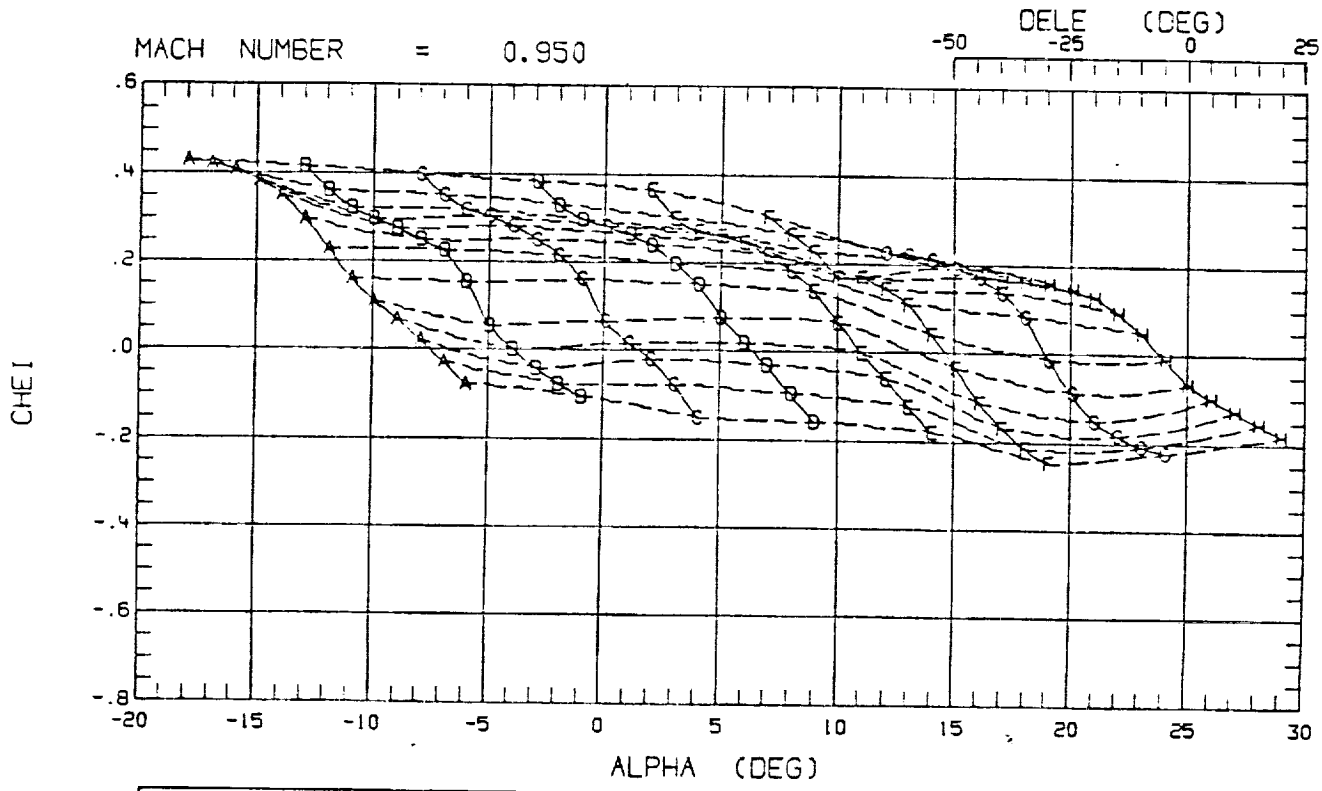
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.40150	0.39180	0.38010	0.35880	0.33990	0.29540	0.22470	0.16900
-35.000	0.39402	0.34400	0.33000	0.30500	0.28500	0.24800	0.21551	0.16495
-30.000	0.37740	0.30100	0.29700	0.27200	0.25000	0.21500	0.20200	0.15650
-25.000	0.35216	0.27100	0.26600	0.25000	0.23100	0.18200	0.18431	0.14440
-20.000	0.31670	0.24500	0.24000	0.22200	0.21100	0.16500	0.16200	0.12640
-15.000	0.26635	0.21400	0.21200	0.19200	0.17900	0.15200	0.14500	0.09965
-10.000	0.20980	0.18300	0.17800	0.16000	0.14700	0.12500	0.11500	0.06060
-5.000	0.15000	0.12200	0.12500	0.12000	0.10900	0.08800	0.04200	-0.00200
0.0	0.09870	0.05500	0.05500	0.07700	0.06200	-0.00800	-0.02150	-0.05420
5.000	0.05700	0.01000	0.02500	0.03300	0.01300	-0.08400	-0.10000	-0.09100
10.000	0.02300	-0.02500	-0.01000	-0.01500	-0.03700	-0.13000	-0.12800	-0.11800
15.000	-0.00767	-0.07000	-0.06400	-0.07800	-0.09600	-0.18200	-0.14867	-0.13267
20.000	-0.03500	-0.12000	-0.11900	-0.13500	-0.16700	-0.23000	-0.16000	-0.13500

ENGINEER JP
DATE 10/22/78

FIGURE 5.1-6
ELEVON HINGE MOMENT COEFFICIENT



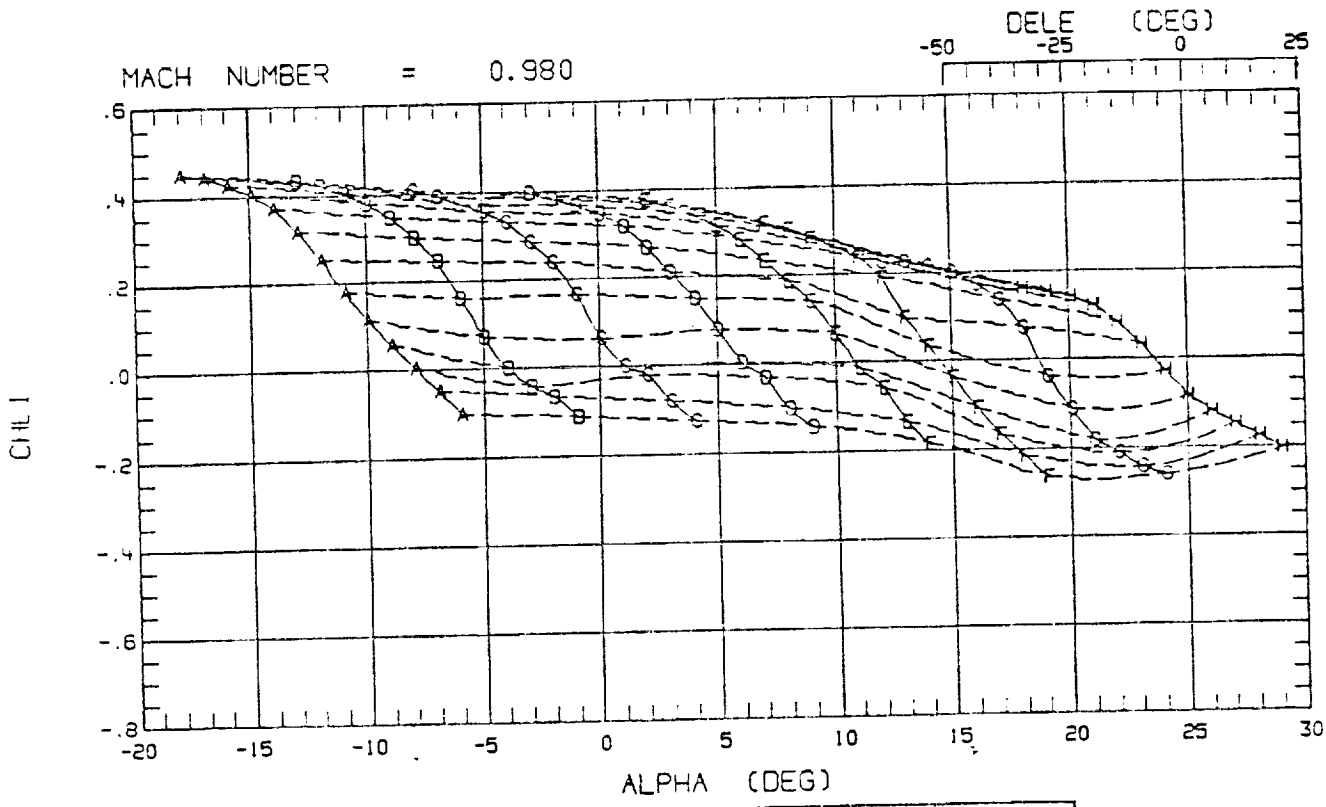
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.42510	0.41340	0.39520	0.38100	0.36030	0.30320	0.22290	0.16200
-35.000	0.41809	0.35900	0.34900	0.32700	0.29900	0.26400	0.21897	0.16069
-30.000	0.40300	0.32100	0.31700	0.29400	0.26800	0.22500	0.20860	0.15420
-25.000	0.38122	0.29400	0.30000	0.28000	0.26000	0.16800	0.19219	0.14362
-20.000	0.34860	0.27400	0.27900	0.26100	0.24400	0.16600	0.16850	0.12570
-15.000	0.29305	0.24700	0.25000	0.23700	0.21700	0.14200	0.13400	0.09251
-10.000	0.22810	0.22400	0.21300	0.19500	0.18000	0.10500	0.06000	0.04670
-5.000	0.15800	0.15300	0.15800	0.14800	0.13500	0.04000	-0.01300	-0.01170
0.0	0.10760	0.05400	0.06500	0.07500	0.06500	-0.03500	-0.09000	-0.06740
5.000	0.06610	0.0	0.01500	0.01600	-0.00500	-0.11300	-0.15200	-0.09980
10.000	0.01940	-0.04200	-0.02300	-0.03300	-0.06000	-0.17000	-0.18700	-0.12960
15.000	-0.02897	-0.07700	-0.08000	-0.09800	-0.12310	-0.21700	-0.21000	-0.15810
20.000	-0.07900	-0.10700	-0.15300	-0.16200	-0.18200	-0.24900	-0.22500	-0.18530

ENGINEER HP
DATE 10/5/78

FIGURE 5.1-7
ELEVON HINGE MOMENT COEFFICIENT



CONFIGURATION

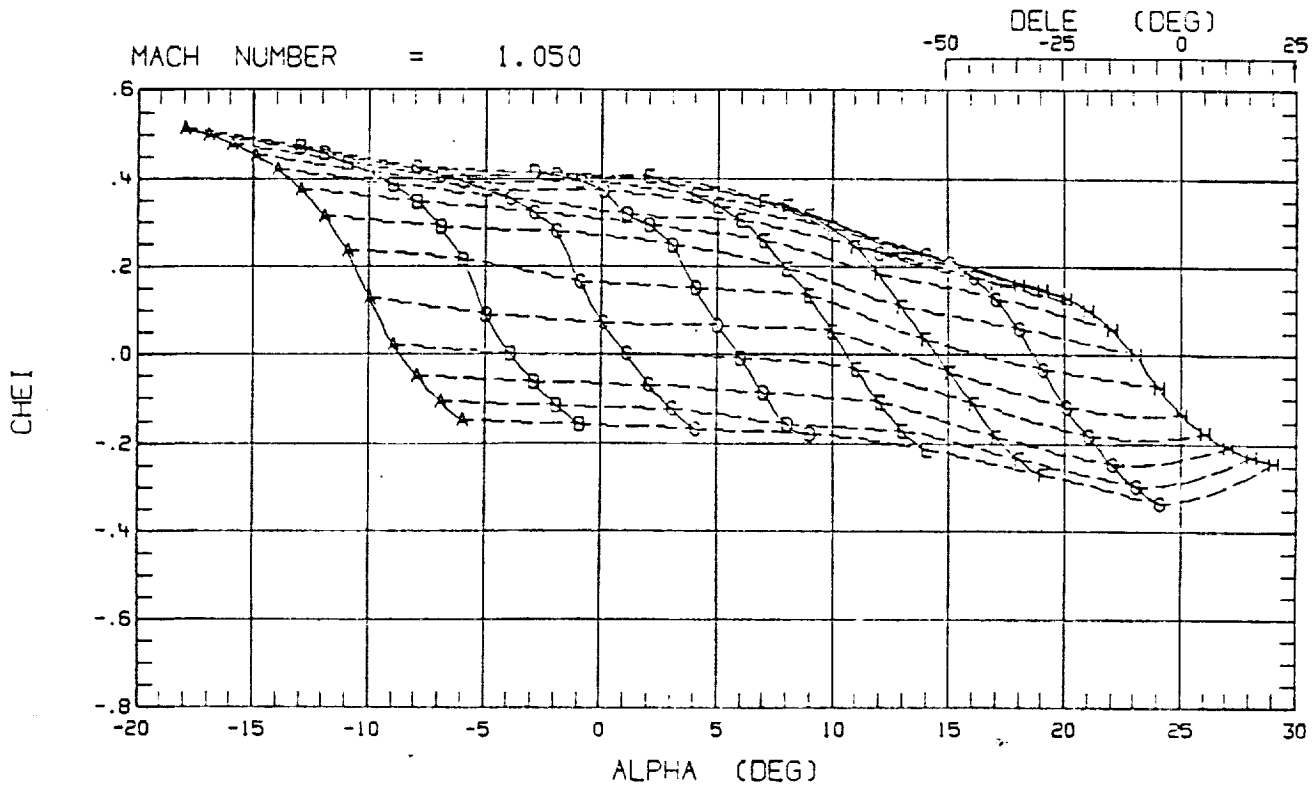
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.44838	0.42922	0.40359	0.39222	0.37247	0.31544	0.22369	0.16098
-35.000	0.43957	0.41792	0.38947	0.38090	0.35729	0.30044	0.22239	0.15918
-30.000	0.42344	0.40012	0.37290	0.36452	0.33662	0.28181	0.21314	0.15235
-25.000	0.40144	0.37676	0.35390	0.34484	0.31152	0.26057	0.19673	0.14100
-20.000	0.36934	0.34480	0.33036	0.31719	0.27856	0.23523	0.17141	0.12057
-15.000	0.31545	0.29832	0.28515	0.26672	0.23104	0.18891	0.13514	0.08230
-10.000	0.25093	0.24400	0.23600	0.21000	0.18500	0.09700	0.07000	0.03310
-5.000	0.17736	0.16000	0.16300	0.15000	0.13900	0.03000	-0.03800	-0.02846
0.0	0.11303	0.07000	0.06500	0.07900	0.06300	-0.03800	-0.11500	-0.08557
5.000	0.05648	0.0	0.0	0.00200	-0.01500	-0.11000	-0.18500	-0.12008
10.000	0.00244	-0.04200	-0.02300	-0.03300	-0.06000	-0.17000	-0.21500	-0.15059
15.000	-0.05009	-0.06662	-0.08213	-0.10471	-0.13932	-0.22029	-0.24500	-0.17865
20.000	-0.10358	-0.11479	-0.12920	-0.14546	-0.18995	-0.26775	-0.26190	-0.20701

ENGINEER HD
DATE 6/27/72

FIGURE 5.1-8
ELEVON HINGE MOMENT COEFFICIENT



CONFIGURATION

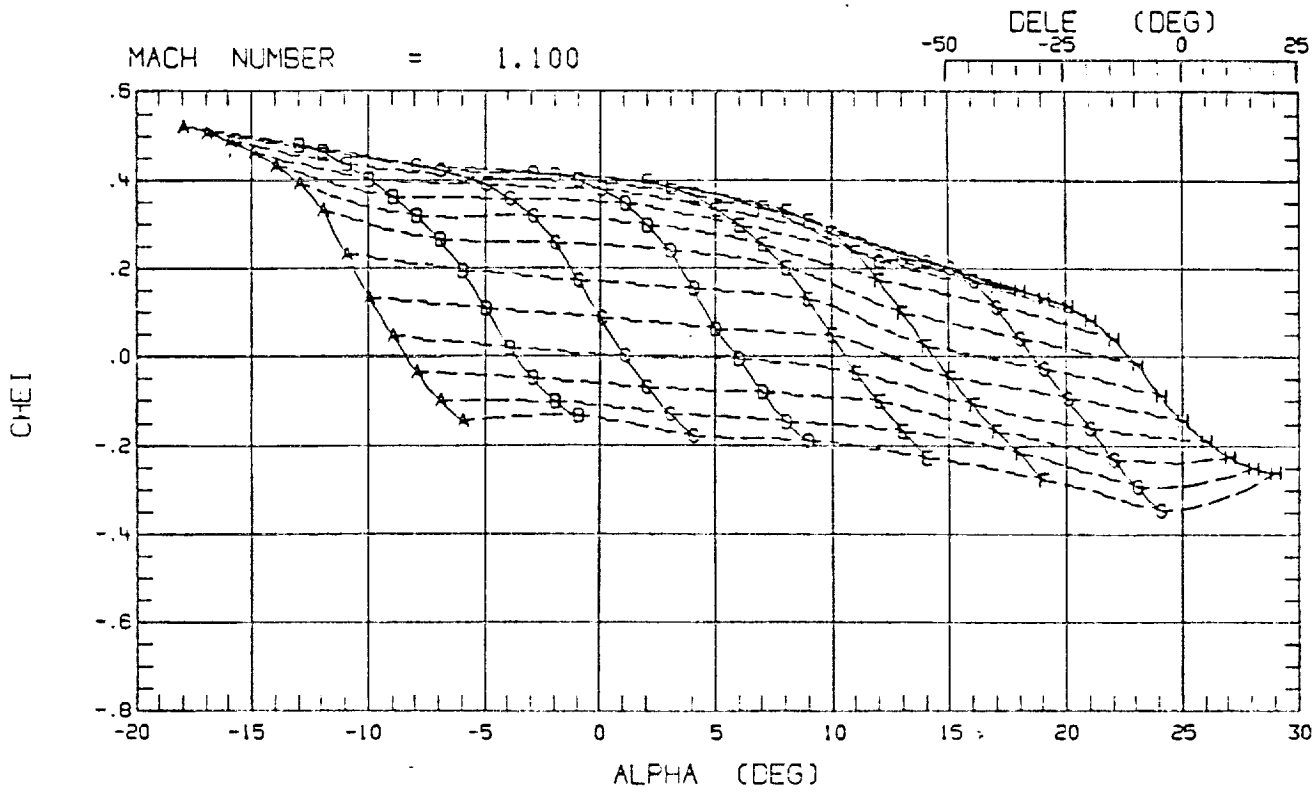
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.
ELEVON AREA	SE =	210.0 SQ.FT.	ELEVON CHORD	CE =	90.7 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.51100	0.46910	0.42080	0.41060	0.40040	0.34580	0.22750	0.16020
-35.000	0.49626	0.45259	0.40615	0.40456	0.38197	0.33242	0.23185	0.15672
-30.000	0.47610	0.43280	0.38960	0.39090	0.35910	0.31080	0.22440	0.14560
-25.000	0.45157	0.41029	0.37177	0.37027	0.33278	0.28234	0.20618	0.12798
-20.000	0.41950	0.38260	0.35080	0.31500	0.30000	0.24280	0.17410	0.10040
-15.000	0.37353	0.34419	0.31972	0.29000	0.25338	0.18227	0.12544	0.05648
-10.000	0.31330	0.28800	0.27500	0.24500	0.19300	0.10500	0.05500	-0.00190
-5.000	0.23500	0.21200	0.16200	0.15000	0.13200	0.03000	-0.03500	-0.07500
0.0	0.12580	0.09000	0.07000	0.06400	0.04800	-0.04200	-0.12300	-0.13600
5.000	0.02100	0.00100	0.0	-0.01000	-0.03500	-0.11400	-0.18700	-0.17800
10.000	-0.05020	-0.06300	-0.07310	-0.09000	-0.11000	-0.19000	-0.25000	-0.20910
15.000	-0.10763	-0.11793	-0.12653	-0.16000	-0.17463	-0.23983	-0.29940	-0.23113
20.000	-0.15130	-0.16020	-0.17030	-0.18180	-0.21860	-0.27460	-0.33690	-0.24410

ENGINEER HP
DATE 12/9/75

FIGURE 5.1-9
ELEVON HINGE MOMENT COEFFICIENT

SD72-SH-0060 IM



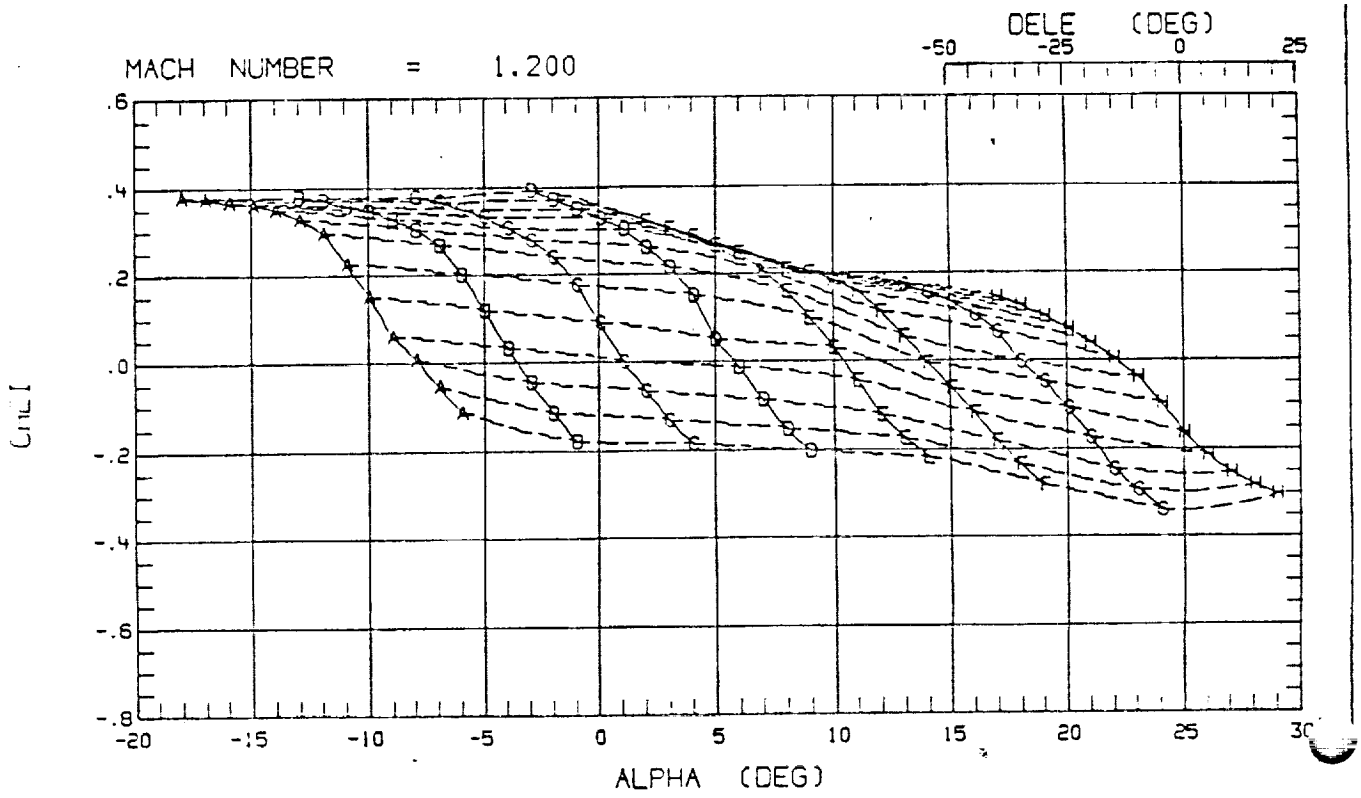
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.51970	0.47560	0.43020	0.41340	0.39270	0.33300	0.21380	0.15680
-35.000	0.50575	0.46181	0.41829	0.40895	0.38102	0.32512	0.21871	0.14789
-30.000	0.48630	0.43200	0.40330	0.39600	0.36060	0.30620	0.21290	0.13250
-25.000	0.46227	0.39900	0.36601	0.37535	0.33117	0.27737	0.19820	0.11172
-20.000	0.43090	0.35900	0.35500	0.34540	0.29350	0.23520	0.16910	0.08230
-15.000	0.38948	0.31400	0.31700	0.29500	0.25026	0.17139	0.11113	0.03772
-10.000	0.33140	0.26200	0.25500	0.23700	0.20030	0.09690	0.03780	-0.01980
-5.000	0.23050	0.19300	0.17000	0.15080	0.12900	0.02000	-0.03000	-0.09020
0.0	0.13200	0.10600	0.08500	0.06000	0.04400	-0.04900	-0.09500	-0.14770
5.000	0.04420	0.01760	0.0	-0.00800	-0.03900	-0.11200	-0.16500	-0.19230
10.000	-0.03600	-0.05100	-0.07100	-0.08400	-0.10500	-0.17000	-0.23500	-0.22780
15.000	-0.10000	-0.10500	-0.13100	-0.14800	-0.17000	-0.22200	-0.29500	-0.25203
20.000	-0.14780	-0.13600	-0.18000	-0.19370	-0.23000	-0.29060	-0.34800	-0.26500

ENGINEER HP
DATE 10/23/85

FIGURE 5.1-10
ELEVON HINGE MOMENT COEFFICIENT



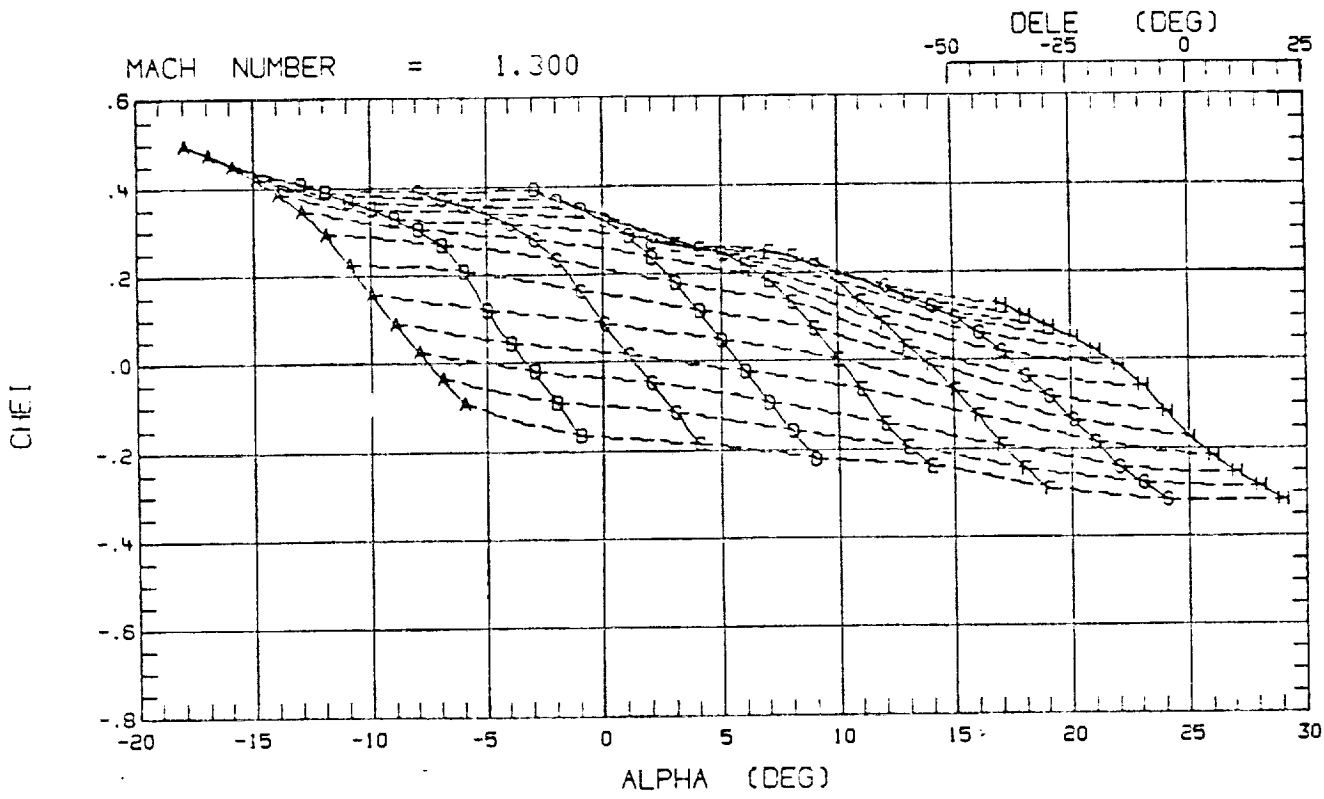
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
CR YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.37500	0.37500	0.37500	0.39000	0.32000	0.21000	0.18010	0.14290
-35.000	0.37200	0.36900	0.36600	0.37000	0.30200	0.20600	0.16837	0.12246
-30.000	0.36400	0.35600	0.34800	0.34800	0.28400	0.19700	0.15160	0.09850
-25.000	0.36000	0.34500	0.33000	0.32700	0.26400	0.18100	0.13073	0.07143
-20.000	0.34800	0.32600	0.30400	0.30000	0.24400	0.15600	0.10290	0.04000
-15.000	0.32500	0.30200	0.27800	0.26000	0.20300	0.11100	0.06211	0.00322
-10.000	0.29500	0.26500	0.23600	0.21400	0.15600	0.05300	-0.00540	-0.04130
-5.000	0.22500	0.20000	0.17400	0.15000	0.09700	-0.00700	-0.05200	-0.10000
0.0	0.15030	0.11800	0.08900	0.05000	0.02900	-0.06500	-0.11200	-0.16700
5.000	0.06100	0.03100	0.00100	-0.01500	-0.04800	-0.12300	-0.17700	-0.21900
10.000	0.00800	-0.04700	-0.06800	-0.09100	-0.12500	-0.18700	-0.25000	-0.25500
15.000	-0.05550	-0.11600	-0.13400	-0.15667	-0.17800	-0.24000	-0.29533	-0.28433
20.000	-0.11300	-0.18300	-0.18900	-0.20800	-0.22000	-0.29300	-0.34000	-0.30700

ENGINEER HP
DATE 10/9/72X

FIGURE 5.1-11
ELEVON HINGE MOMENT COEFFICIENT



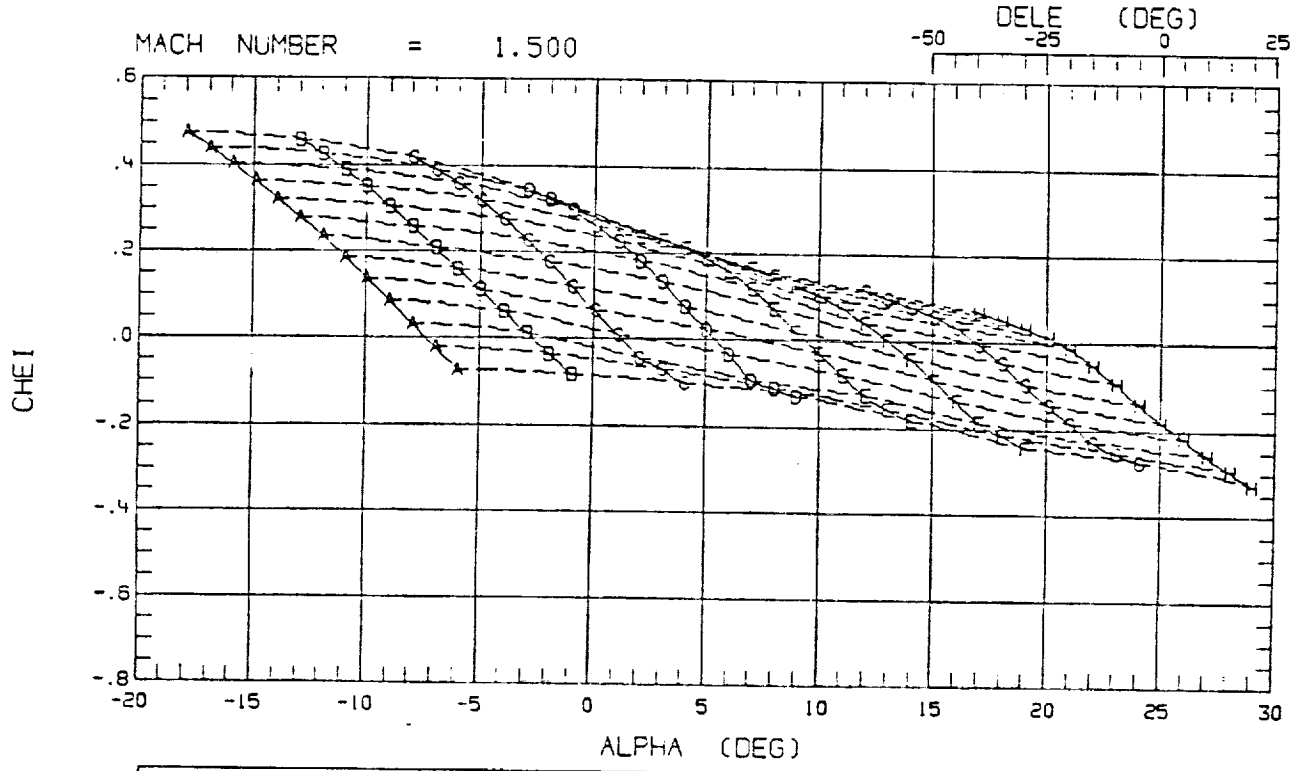
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.49510	0.40500	0.38700	0.39000	0.27000	0.24580	0.16520	0.12530
-35.000	0.47249	0.38800	0.37000	0.36600	0.26200	0.23500	0.14327	0.10027
-30.000	0.44640	0.36700	0.35400	0.34500	0.25300	0.21100	0.11980	0.07440
-25.000	0.41745	0.34900	0.33700	0.32000	0.24100	0.17600	0.09529	0.04801
-20.000	0.38380	0.32600	0.31100	0.29200	0.21600	0.13000	0.06000	0.02010
-15.000	0.34294	0.30000	0.27600	0.23500	0.18000	0.08200	0.01600	-0.01630
-10.000	0.29200	0.26700	0.23100	0.17600	0.13200	0.02900	-0.03800	-0.06140
-5.000	0.22320	0.20600	0.16100	0.11200	0.07000	-0.01500	-0.08500	-0.12030
0.0	0.15480	0.11700	0.08600	0.04400	0.00100	-0.07300	-0.13800	-0.17790
5.000	0.08910	0.04300	0.01380	-0.02700	-0.06900	-0.12900	-0.18900	-0.22130
10.000	0.02500	-0.02300	-0.05200	-0.09500	-0.14600	-0.19600	-0.24500	-0.25680
15.000	-0.03523	-0.09400	-0.11617	-0.16200	-0.20000	-0.24900	-0.29160	-0.29930
20.000	-0.09160	-0.16900	-0.19000	-0.22300	-0.24100	-0.29500	-0.31680	-0.31680

ENGINEER R.
DATE 10/23/25

FIGURE 5.1-12
ELEVON HINGE MOMENT COEFFICIENT



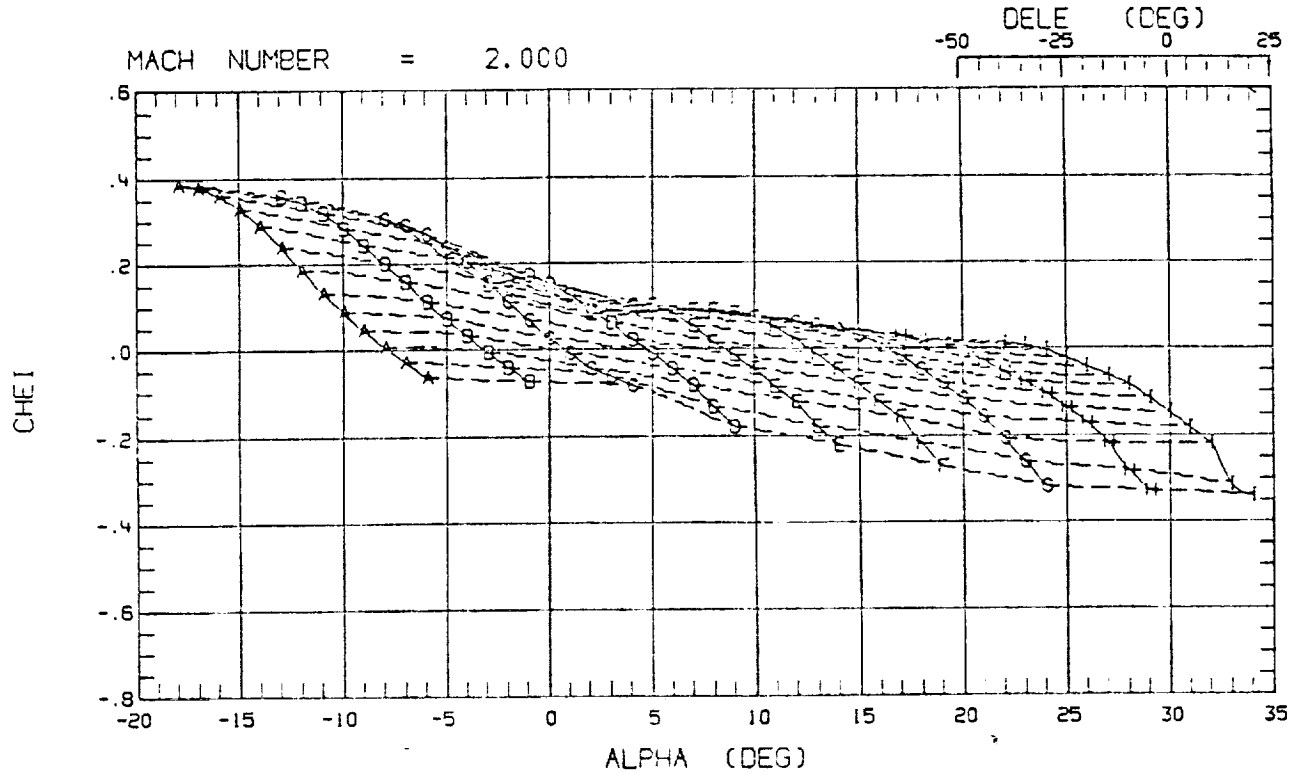
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.47360	0.45390	0.41380	0.34070	0.23480	0.16350	0.11320	0.06600
-35.000	0.43724	0.42275	0.38765	0.31977	0.22590	0.14559	0.09672	0.05009
-30.000	0.39960	0.38700	0.35550	0.29300	0.20950	0.12470	0.07770	0.03120
-25.000	0.36086	0.34609	0.31698	0.26022	0.18540	0.10131	0.05686	0.01006
-20.000	0.32050	0.30170	0.27320	0.22190	0.15420	0.07400	0.03200	-0.01550
-15.000	0.27745	0.25397	0.22431	0.17869	0.11687	0.03961	-0.00641	-0.05299
-10.000	0.23250	0.20520	0.17220	0.12970	0.07200	0.00030	-0.05150	-0.09640
-5.000	0.18600	0.15600	0.11800	0.07400	0.01800	-0.04300	-0.10100	-0.14400
0.0	0.13510	0.10800	0.06190	0.02080	-0.03220	-0.09140	-0.14700	-0.18470
5.000	0.08500	0.06000	0.00800	-0.03700	-0.08100	-0.14000	-0.19000	-0.22200
10.000	0.03000	0.01000	-0.04500	-0.09500	-0.13000	-0.19000	-0.23200	-0.26000
15.000	-0.02333	-0.03833	-0.07300	-0.11500	-0.16000	-0.21900	-0.25700	-0.29600
20.000	-0.07500	-0.08500	-0.10300	-0.13100	-0.16500	-0.24400	-0.27600	-0.33000

ENGINEER HO
DATE 10/3/78

FIGURE 5.1-13
ELEVON HINGE MOMENT COEFFICIENT



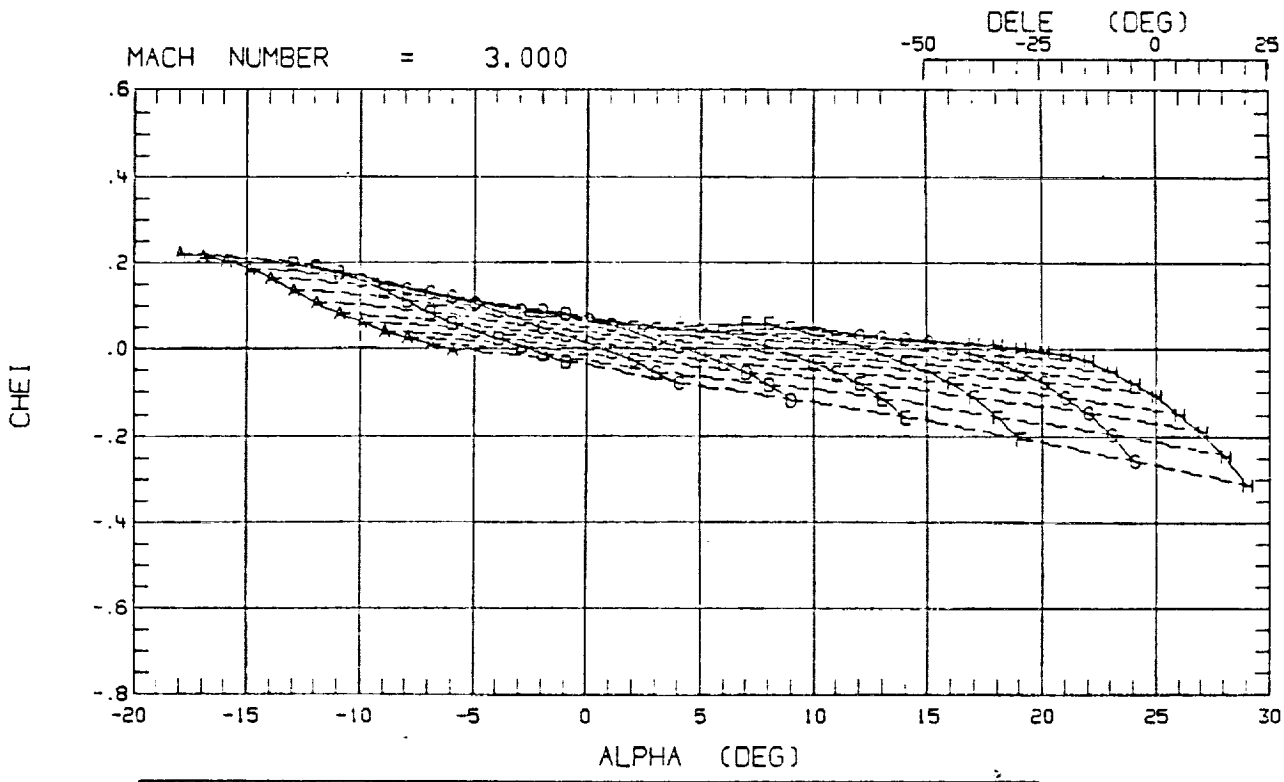
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	INBOARD ELEVON HINGE MOMENT								
-40.000	0.38370	0.35370	0.30200	0.15000	0.08000	0.08720	0.06040	0.02700	0.01110
-35.000	0.37612	0.33999	0.28785	0.16000	0.09000	0.08677	0.05424	0.01752	0.00589
-30.000	0.35770	0.31680	0.26630	0.17000	0.10000	0.08050	0.04360	0.00500	-0.00510
-25.000	0.32775	0.28171	0.23538	0.15000	0.10000	0.06891	0.02882	-0.01003	-0.02229
-20.000	0.28830	0.24200	0.20100	0.12400	0.08000	0.05040	0.00690	-0.02920	-0.04440
-15.000	0.23759	0.19958	0.15700	0.09000	0.05300	0.02058	-0.01844	-0.05697	-0.08300
-10.000	0.18510	0.15500	0.11000	0.06000	0.01500	-0.01360	-0.04990	-0.08000	-0.08500
-5.000	0.13200	0.10900	0.06700	0.02000	-0.01500	-0.05000	-0.08400	-0.10600	-0.11800
0.0	0.08680	0.06940	0.02500	-0.01000	-0.04770	-0.08380	-0.11910	-0.13900	-0.15000
5.000	0.04400	0.03100	-0.01000	-0.04800	-0.09000	-0.12500	-0.16200	-0.17500	-0.18600
10.000	0.00600	-0.00700	-0.04500	-0.08500	-0.12600	-0.16200	-0.21000	-0.22000	-0.22200
15.000	-0.03033	-0.04233	-0.06500	-0.13500	-0.18000	-0.22000	-0.26500	-0.29400	-0.31800
20.000	-0.06500	-0.07500	-0.08500	-0.18000	-0.22500	-0.27500	-0.32000	-0.33000	-0.34000

ENGINEER HP
DATE 01/3/75

FIGURE 5.1- 14
ELEVON HINGE MOMENT COEFFICIENT



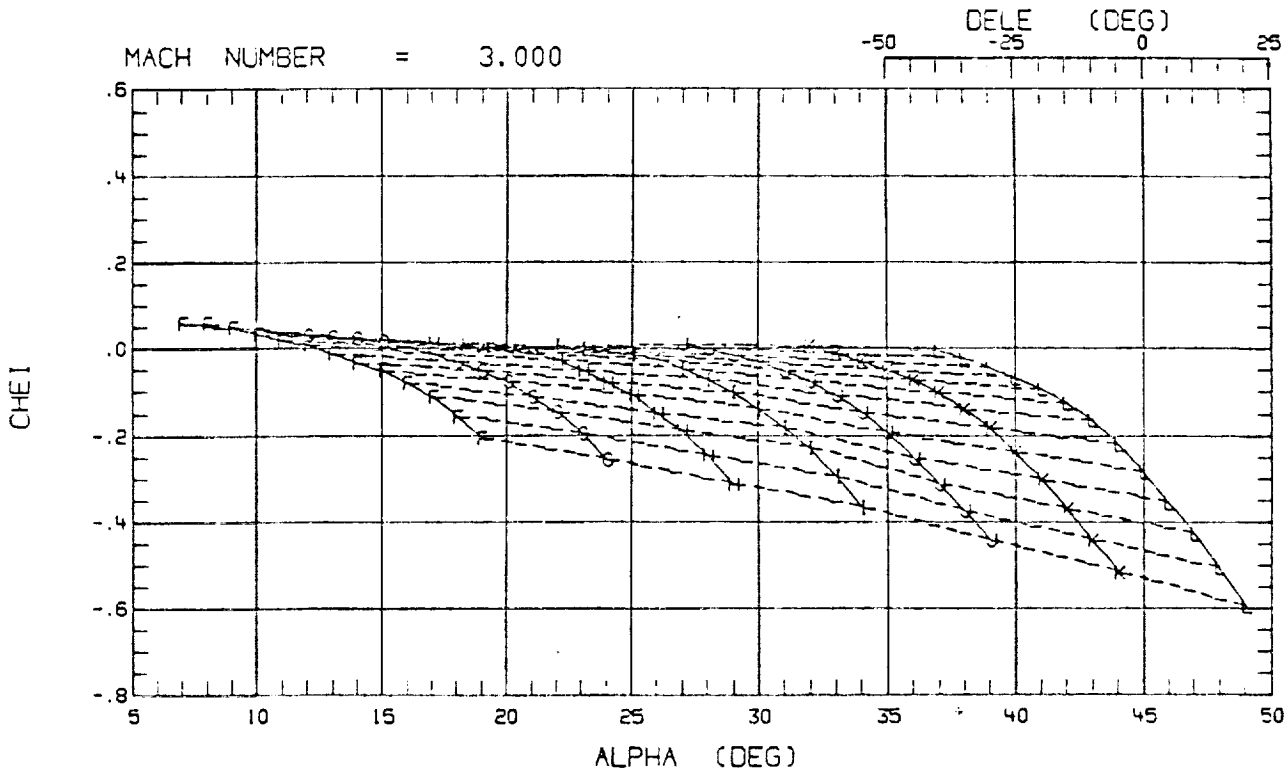
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.21880	0.19350	0.13500	0.08600	0.04700	0.05600	0.02700	0.01180
-35.000	0.21314	0.18701	0.12600	0.08300	0.04200	0.05602	0.02500	0.00800
-30.000	0.20210	0.17500	0.11600	0.07600	0.04300	0.04400	0.02000	0.00010
-25.000	0.18554	0.15868	0.10200	0.06300	0.03800	0.03200	0.01200	-0.00695
-20.000	0.16390	0.13440	0.08500	0.05200	0.03390	0.01800	0.0	-0.01570
-15.000	0.13515	0.10795	0.06600	0.03700	0.02137	0.00500	-0.01517	-0.03029
-10.000	0.10640	0.08150	0.04500	0.01900	0.00200	-0.01500	-0.03400	-0.05400
-5.000	0.08100	0.05700	0.02900	0.00300	-0.01400	-0.03500	-0.05500	-0.08100
0.0	0.06060	0.04030	0.01000	-0.01500	-0.03400	-0.05530	-0.07920	-0.11000
5.000	0.04000	0.02100	-0.01000	-0.03500	-0.05600	-0.08300	-0.11500	-0.15300
10.000	0.02500	0.00350	-0.03000	-0.05600	-0.08200	-0.11500	-0.15000	-0.19300
15.000	0.01000	-0.01450	-0.05700	-0.08500	-0.11600	-0.15900	-0.20000	-0.25000
20.000	-0.00500	-0.03300	-0.08300	-0.12000	-0.16000	-0.21000	-0.26000	-0.31500

ENGINEER HP
DATE 10/25/78

FIGURE 5.1-15
ELEVON HINGE MOMENT COEFFICIENT



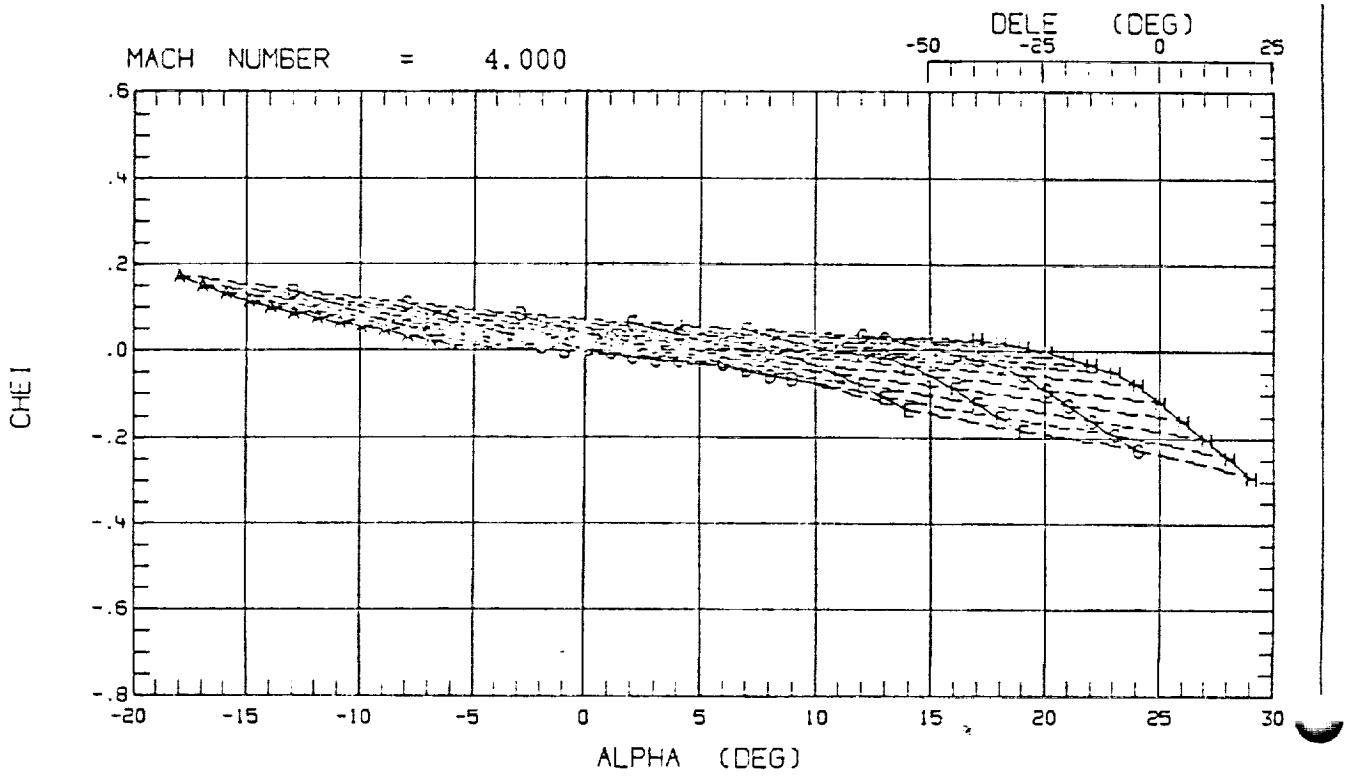
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	INBOARD ELEVON HINGE MOMENT						
-40.000	0.05600	0.02700	0.01180	0.00130	0.00810	0.00170	-0.00600
-35.000	0.05602	0.02500	0.00800	-0.00341	-0.00324	-0.01396	-0.02534
-30.000	0.04400	0.02000	0.00010	-0.00990	-0.01740	-0.03210	-0.04690
-25.000	0.03200	0.01200	-0.00695	-0.01763	-0.03400	-0.05226	-0.07020
-20.000	0.01800	0.0	-0.01570	-0.02920	-0.05420	-0.07580	-0.09670
-15.000	0.00500	-0.01517	-0.03029	-0.04914	-0.07961	-0.10504	-0.12995
-10.000	-0.01500	-0.03400	-0.05400	-0.07530	-0.11090	-0.14100	-0.16910
-5.000	-0.03500	-0.05500	-0.08100	-0.10500	-0.15000	-0.18700	-0.22500
0.0	-0.05530	-0.07920	-0.11000	-0.14160	-0.19750	-0.24240	-0.28750
5.000	-0.08300	-0.11500	-0.15300	-0.18600	-0.25500	-0.30600	-0.35800
10.000	-0.11500	-0.15000	-0.19300	-0.23200	-0.31500	-0.37300	-0.42900
15.000	-0.15900	-0.20000	-0.25000	-0.30000	-0.37933	-0.44367	-0.50933
20.000	-0.21000	-0.26000	-0.31500	-0.37000	-0.44500	-0.51800	-0.59900

ENGINEER HP
DATE 10/12/78

FIGURE 5.1-16
ELEVON HINGE MOMENT COEFFICIENT



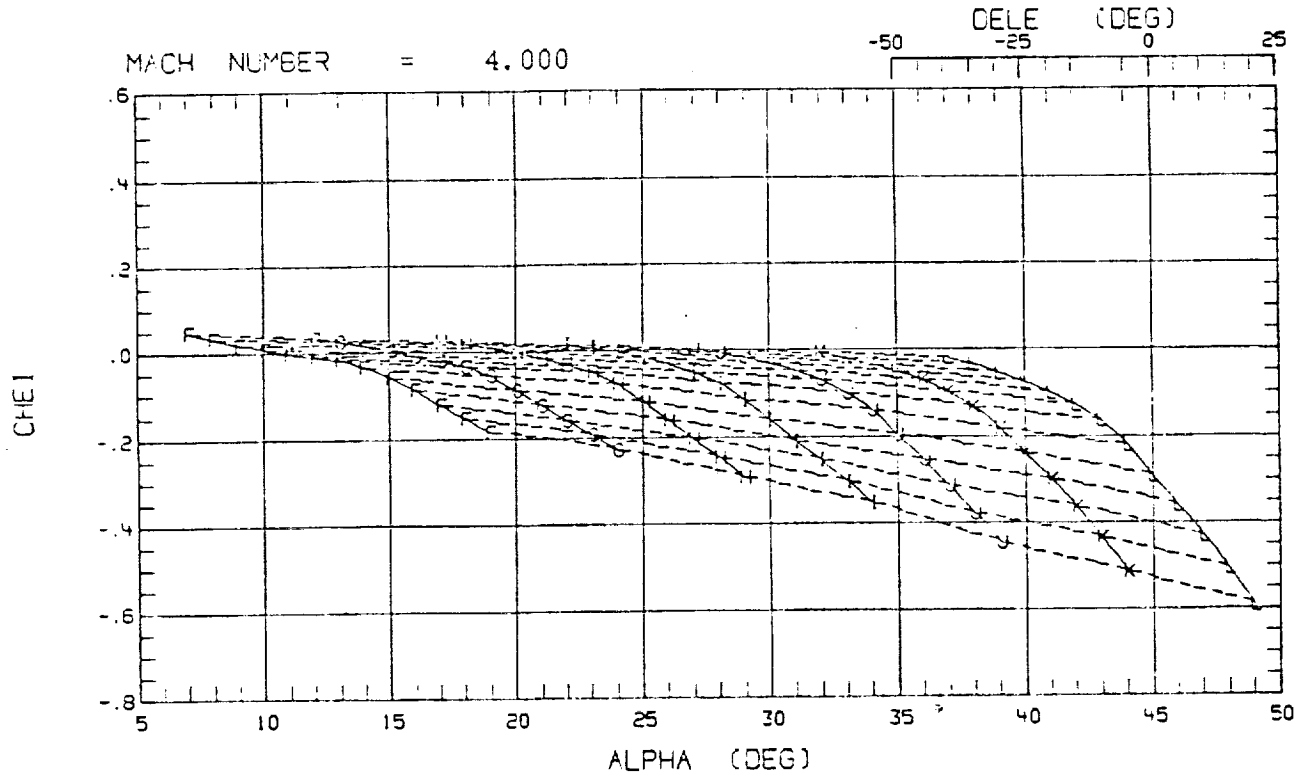
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.17150	0.13580	0.10590	0.08020	0.06050	0.04590	0.03100	0.02390
-35.000	0.15029	0.11840	0.08944	0.06377	0.04710	0.03209	0.02425	0.01651
-30.000	0.13100	0.10100	0.07300	0.04900	0.03400	0.01900	0.01500	0.00700
-25.000	0.11358	0.08360	0.05658	0.03590	0.02108	0.00645	0.00200	-0.00456
-20.000	0.09820	0.06620	0.04020	0.02440	0.00870	-0.00500	-0.01100	-0.01840
-15.000	0.08604	0.05419	0.03160	0.01520	0.00085	-0.01250	-0.02350	-0.03359
-10.000	0.07400	0.04500	0.02300	0.00600	-0.00700	-0.02000	-0.03600	-0.05200
-5.000	0.06200	0.03800	0.01000	-0.00500	-0.01900	-0.03600	-0.05900	-0.08000
0.0	0.05450	0.03160	-0.00100	-0.01700	-0.03650	-0.05990	-0.09320	-0.12230
5.000	0.04500	0.02300	-0.00900	-0.03100	-0.05900	-0.09000	-0.12750	-0.16400
10.000	0.03300	0.01600	-0.01900	-0.04700	-0.08300	-0.12500	-0.16300	-0.20600
15.000	0.02143	0.00667	-0.02423	-0.05943	-0.10967	-0.15770	-0.19710	-0.24970
20.000	0.01030	-0.00500	-0.02470	-0.06830	-0.13900	-0.18810	-0.22980	-0.29510

ENGINEER
DATE 10-23-78

FIGURE 5.1-17
ELEVON HINGE MOMENT COEFFICIENT



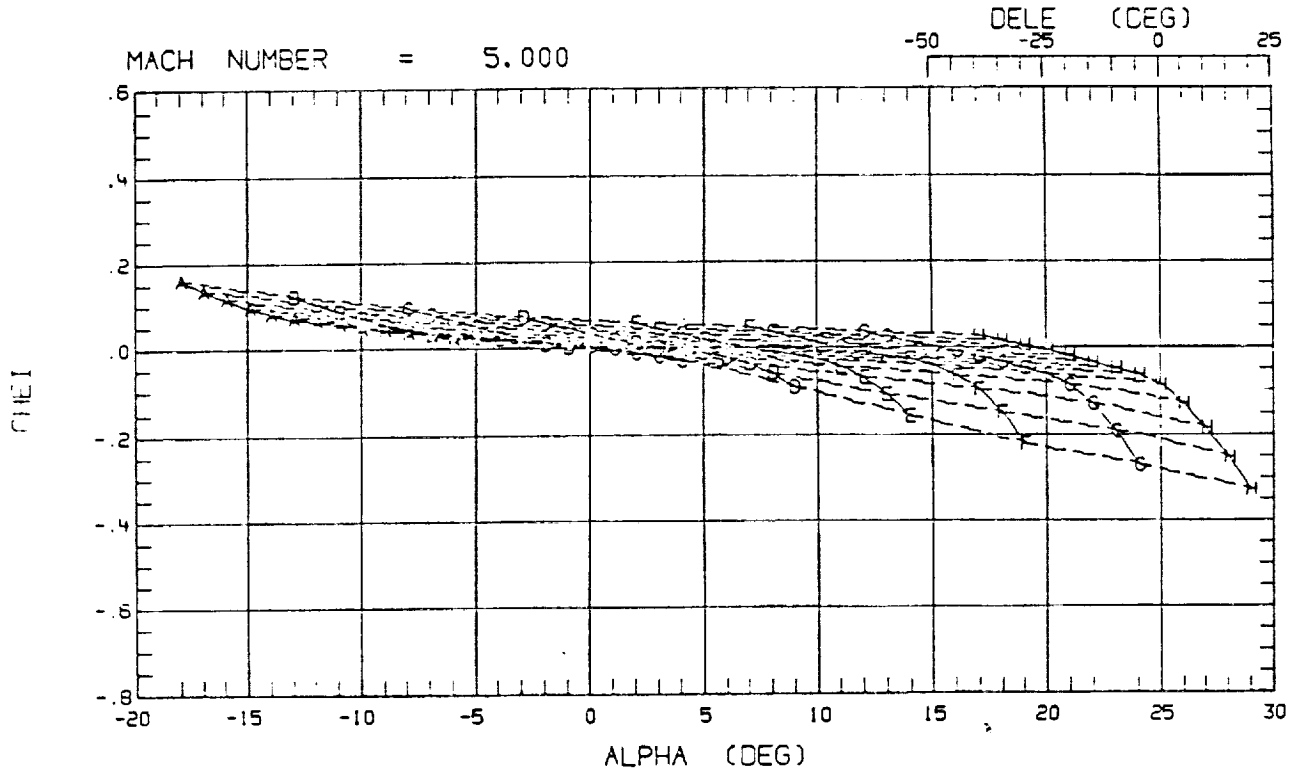
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	INBOARD ELEVON HINGE MOMENT						
-40.000	0.04590	0.03100	0.02390	0.01230	0.00030	-0.00240	-0.02030
-35.000	0.03209	0.02425	0.01651	0.00507	-0.00796	-0.02099	-0.03678
-30.000	0.01900	0.01500	0.00700	-0.00500	-0.01900	-0.03600	-0.05600
-25.000	0.00645	0.00200	-0.00486	-0.01775	-0.03235	-0.05291	-0.07759
-20.000	-0.00500	-0.01100	-0.01940	-0.03370	-0.04940	-0.07330	-0.10270
-15.000	-0.01250	-0.02350	-0.03359	-0.05258	-0.07235	-0.10009	-0.13210
-10.000	-0.02000	-0.03600	-0.05200	-0.07700	-0.10200	-0.13500	-0.16900
-5.000	-0.03600	-0.05900	-0.08000	-0.11600	-0.14100	-0.18400	-0.22600
0.0	-0.05990	-0.09320	-0.12230	-0.16340	-0.19810	-0.24230	-0.29470
5.000	-0.09000	-0.12750	-0.16400	-0.21200	-0.25750	-0.30200	-0.36300
10.000	-0.12500	-0.16300	-0.20600	-0.25700	-0.31700	-0.36700	-0.43300
15.000	-0.15770	-0.19710	-0.24970	-0.30553	-0.38027	-0.43383	-0.50967
20.000	-0.18910	-0.22980	-0.29510	-0.35750	-0.44730	-0.51750	-0.59300

ENGINEER _____
DATE _____

FIGURE 5.1-18
ELEVON HINGE MOMENT COEFFICIENT



CONFIGURATION

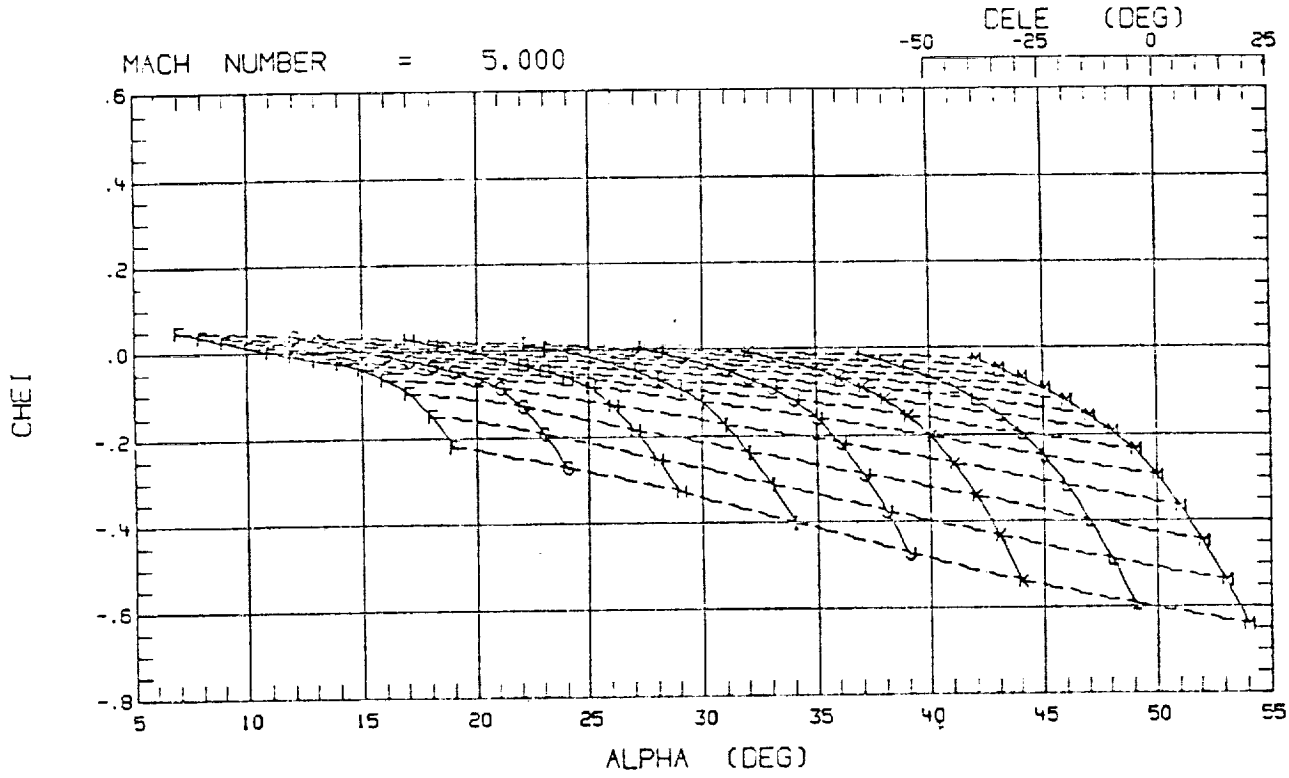
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.15960	0.12170	0.09160	0.07080	0.05650	0.04720	0.03590	0.02540
-35.000	0.13612	0.10334	0.07876	0.05725	0.04286	0.03521	0.02325	0.01441
-30.000	0.11500	0.08600	0.06500	0.04400	0.03000	0.02300	0.01100	0.00300
-25.000	0.09587	0.06945	0.04985	0.03094	0.01777	0.01045	-0.00065	-0.00872
-20.000	0.07980	0.05440	0.03470	0.01840	0.00660	-0.00210	-0.01230	-0.02110
-15.000	0.06992	0.04168	0.02284	0.00839	-0.00188	-0.01270	-0.02406	-0.03602
-10.000	0.06200	0.03200	0.01300	0.0	-0.01000	-0.02200	-0.03600	-0.05100
-5.000	0.05500	0.02750	0.00500	-0.00700	-0.01900	-0.03000	-0.05000	-0.06600
0.0	0.04730	0.02460	0.00200	-0.01400	-0.02810	-0.04400	-0.06520	-0.08860
5.000	0.04200	0.02100	-0.00500	-0.02400	-0.04200	-0.06700	-0.09000	-0.13200
10.000	0.03520	0.01390	-0.01350	-0.03940	-0.07210	-0.09980	-0.13350	-0.18950
15.000	0.02853	0.00637	-0.02253	-0.06263	-0.11030	-0.15280	-0.19447	-0.26633
20.000	0.02200	-0.00160	-0.03210	-0.09370	-0.16060	-0.22600	-0.27290	-0.33250

ENGINEER WD
DATE 12/27/79

FIGURE 5.1-19
ELEVON HINGE MOMENT COEFFICIENT

SL79-SR-0000 1M



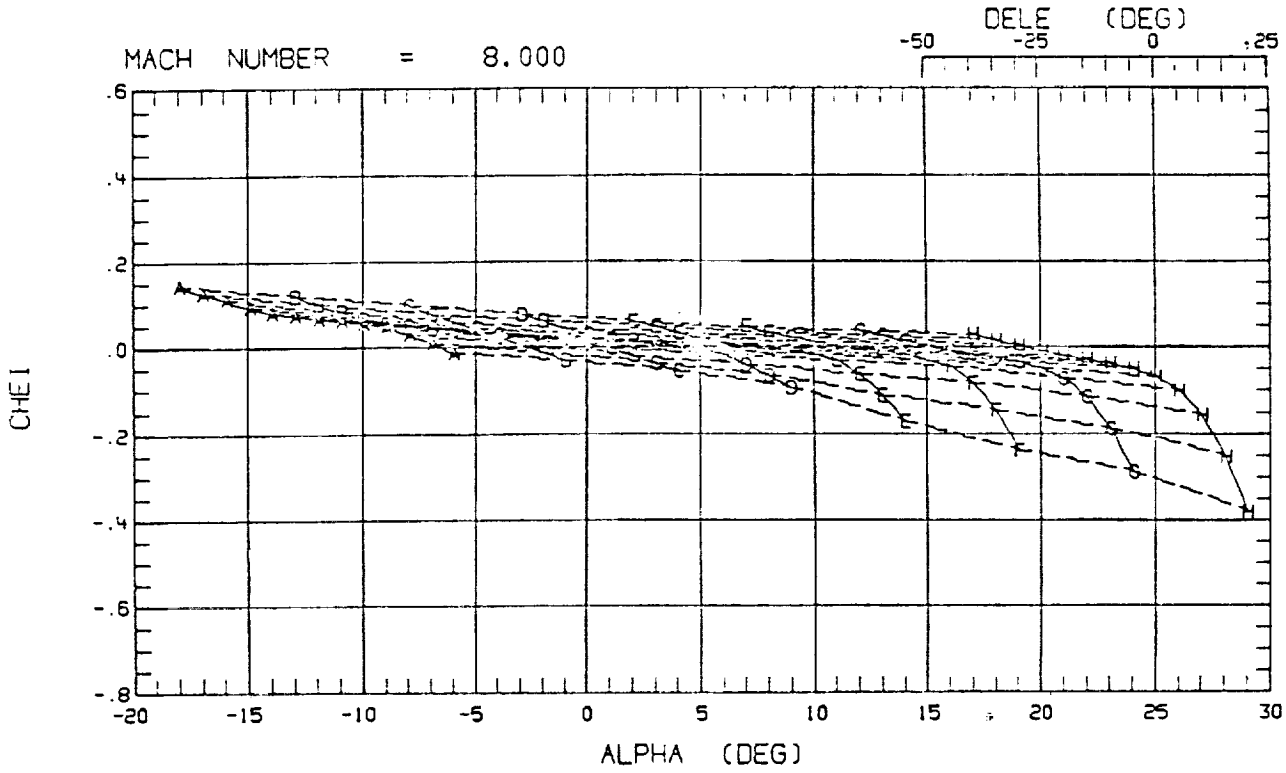
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	-5.000 L	50.000 M
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.04720	0.03590	0.02540	0.01250	0.00150	-0.00940	-0.01690	-0.02900
-35.000	0.03521	0.02325	0.01141	0.00366	-0.00895	-0.02099	-0.03365	-0.04990
-30.000	0.02300	0.01100	0.00300	-0.00700	-0.02100	-0.03500	-0.05200	-0.07300
-25.000	0.01045	-0.00065	-0.00872	-0.01929	-0.03432	-0.05109	-0.07150	-0.09791
-20.000	-0.00210	-0.01230	-0.02110	-0.03380	-0.04990	-0.07030	-0.09350	-0.12580
-15.000	-0.01270	-0.02406	-0.03602	-0.05154	-0.06986	-0.09405	-0.12256	-0.15902
-10.000	-0.02200	-0.03600	-0.05100	-0.07200	-0.09400	-0.12300	-0.15800	-0.19700
-5.000	-0.03000	-0.05000	-0.06600	-0.09500	-0.12300	-0.15900	-0.20100	-0.24000
0.0	-0.04400	-0.06520	-0.08860	-0.12540	-0.16270	-0.20780	-0.25410	-0.29920
5.000	-0.06700	-0.09000	-0.13200	-0.17700	-0.22250	-0.27000	-0.32100	-0.37000
10.000	-0.09980	-0.13350	-0.18950	-0.24060	-0.29460	-0.34640	-0.40080	-0.45100
15.000	-0.15280	-0.19447	-0.25633	-0.31573	-0.37973	-0.43693	-0.49203	-0.54200
20.000	-0.22600	-0.27290	-0.33250	-0.40540	-0.47790	-0.54160	-0.59470	-0.64300

ENGINEER AP
DATE 6-23-78

FIGURE 5.1-20
ELEVON HINGE MOMENT COEFFICIENT



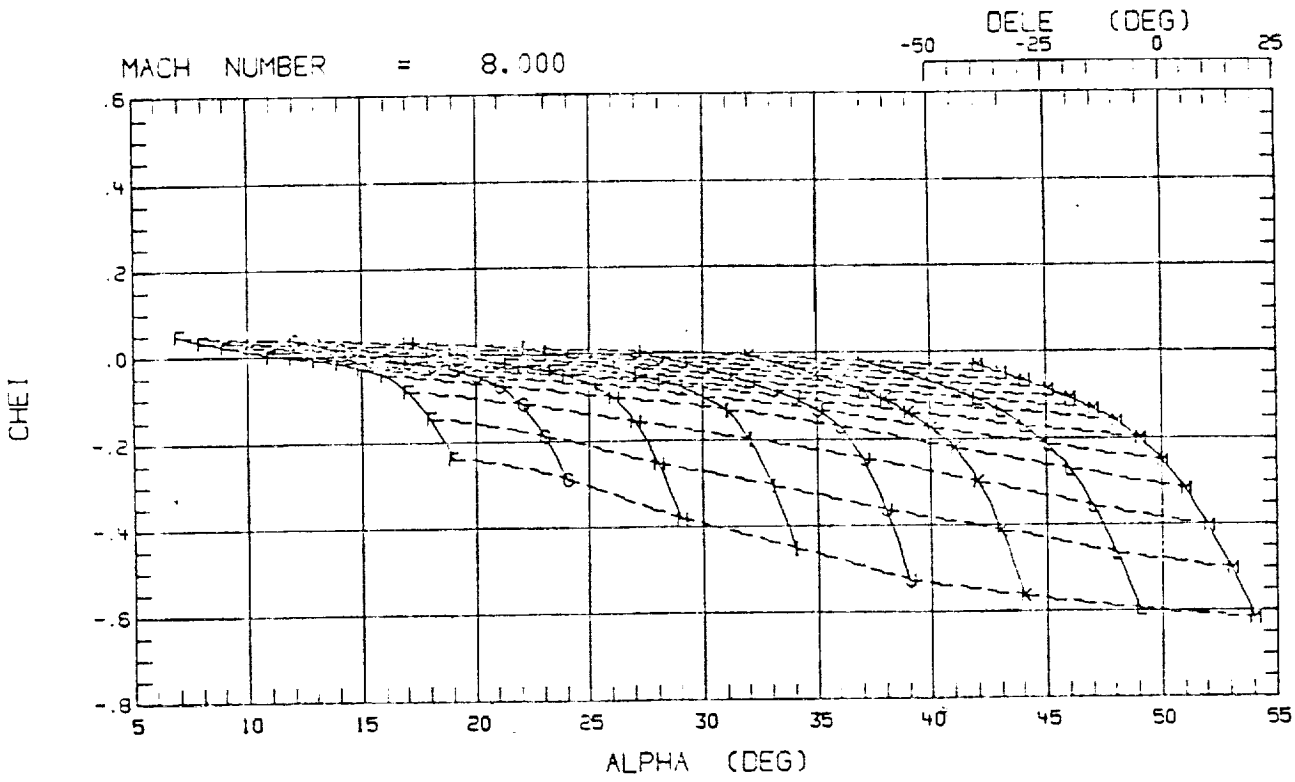
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.14090	0.11740	0.09600	0.07580	0.05790	0.04430	0.03570	0.02630
-35.000	0.12399	0.09734	0.07580	0.05855	0.04484	0.03304	0.02460	0.01399
-30.000	0.10800	0.08000	0.05800	0.04300	0.03200	0.02200	0.01300	0.00200
-25.000	0.09255	0.06513	0.04221	0.02881	0.01929	0.01109	0.00065	-0.00975
-20.000	0.07880	0.05350	0.02960	0.01700	0.00700	0.00060	-0.01170	-0.02100
-15.000	0.07095	0.04716	0.02432	0.01200	0.00200	-0.00470	-0.01935	-0.03050
-10.000	0.06500	0.04300	0.02000	0.00700	-0.00300	-0.01000	-0.02700	-0.04000
-5.000	0.06000	0.04000	0.01600	0.00100	-0.01000	-0.02000	-0.03700	-0.05200
0.0	0.05330	0.03000	0.00630	-0.00690	-0.01960	-0.03190	-0.05170	-0.07210
5.000	0.04500	0.02000	-0.00500	-0.02000	-0.03400	-0.04800	-0.07500	-0.10200
10.000	0.02740	0.00390	-0.02220	-0.04170	-0.06570	-0.08580	-0.11930	-0.16170
15.000	0.00713	-0.01380	-0.04010	-0.06760	-0.11293	-0.14997	-0.19173	-0.25590
20.000	-0.01580	-0.03310	-0.05870	-0.09770	-0.17570	-0.24050	-0.29230	-0.38460

ENGINEER MP
DATE 11/21/75

FIGURE 5.1-21
ELEVON HINGE MOMENT COEFFICIENT



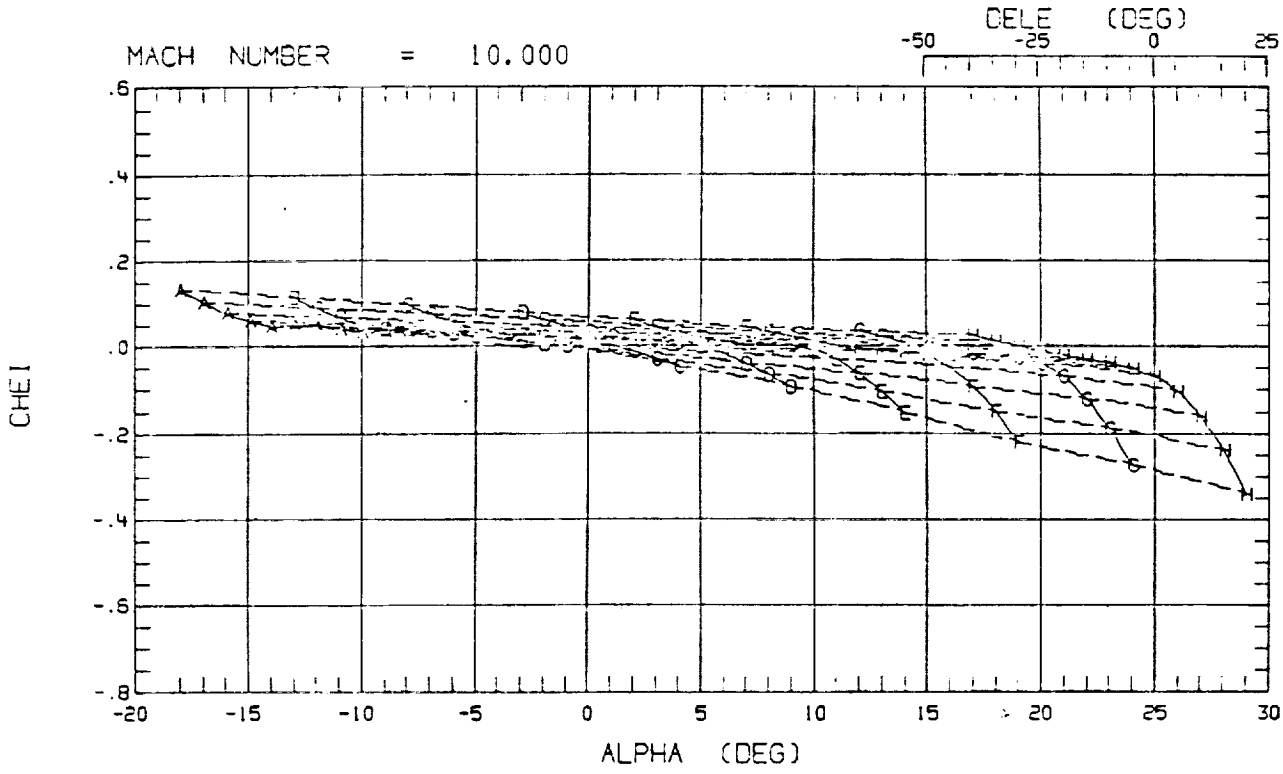
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
OMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.04430	0.03570	0.02630	0.01360	0.00400	-0.00760	-0.02160	-0.03330
-35.000	0.03304	0.02460	0.01399	0.00322	-0.00941	-0.02195	-0.03584	-0.04975
-30.000	0.02200	0.01300	0.00200	-0.00800	-0.02300	-0.03700	-0.05200	-0.06800
-25.000	0.01109	0.00065	-0.00975	-0.01993	-0.03669	-0.05255	-0.06997	-0.08785
-20.000	0.00060	-0.01170	-0.02100	-0.03300	-0.05070	-0.06920	-0.09010	-0.10990
-15.000	-0.00470	-0.01935	-0.03050	-0.04900	-0.06870	-0.08879	-0.11217	-0.13428
-10.000	-0.01000	-0.02700	-0.04000	-0.06500	-0.08800	-0.11200	-0.13800	-0.16300
-5.000	-0.02000	-0.03700	-0.05200	-0.08000	-0.10800	-0.14200	-0.17400	-0.20400
0.0	-0.03190	-0.05170	-0.07210	-0.10260	-0.13460	-0.17780	-0.21810	-0.25580
5.000	-0.04800	-0.07500	-0.10300	-0.13400	-0.17400	-0.22500	-0.27400	-0.32200
10.000	-0.08580	-0.11930	-0.16170	-0.20160	-0.24870	-0.30180	-0.35960	-0.40620
15.000	-0.14997	-0.19173	-0.25390	-0.30820	-0.36693	-0.41540	-0.46783	-0.50467
20.000	-0.24050	-0.29230	-0.36460	-0.45380	-0.52870	-0.56580	-0.59870	-0.61740

ENGINEER 47
DATE 12/21/71

FIGURE 5.1-22
ELEVON HINGE MOMENT COEFFICIENT



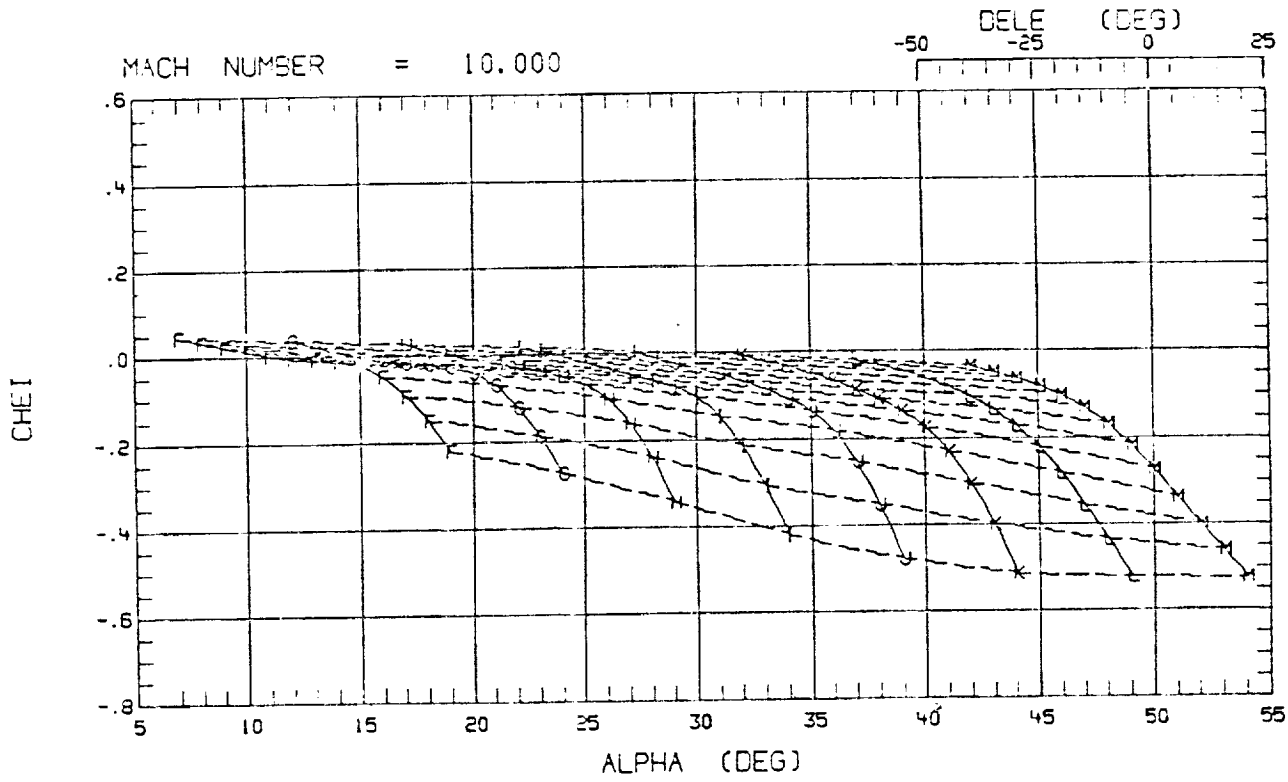
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1075.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.13210	0.11350	0.09490	0.07630	0.05890	0.04390	0.03400	0.02420
-35.000	0.10141	0.08732	0.07324	0.05915	0.04352	0.03209	0.01956	0.01100
-30.000	0.07700	0.06600	0.05500	0.04400	0.03000	0.02100	0.00700	-0.00100
-25.000	0.05855	0.04924	0.03992	0.03060	0.01811	0.01048	-0.00376	-0.01151
-20.000	0.04700	0.03790	0.02880	0.01970	0.00850	0.00100	-0.01250	-0.02140
-15.000	0.04320	0.03705	0.02491	0.01276	0.00207	-0.00644	-0.01790	-0.03075
-10.000	0.04680	0.03410	0.02140	0.00870	-0.00100	-0.01170	-0.02330	-0.04010
-5.000	0.04000	0.02900	0.01800	0.00700	0.0	-0.01400	-0.03000	-0.05500
0.0	0.03290	0.02050	0.00810	-0.00430	-0.01000	-0.02300	-0.04140	-0.07230
5.000	0.03400	0.01600	-0.00200	-0.02000	-0.03100	-0.05000	-0.07300	-0.10700
10.000	0.03540	0.00980	-0.01580	-0.04140	-0.06570	-0.09470	-0.12410	-0.16380
15.000	0.03900	0.00380	-0.03140	-0.06660	-0.10737	-0.15320	-0.19270	-0.24377
20.000	0.04480	-0.00290	-0.04980	-0.09560	-0.15600	-0.22550	-0.27880	-0.34690

ENGINEER _____
DATE 12/2/93

FIGURE 5.1-23
ELEVON HINGE MOMENT COEFFICIENT



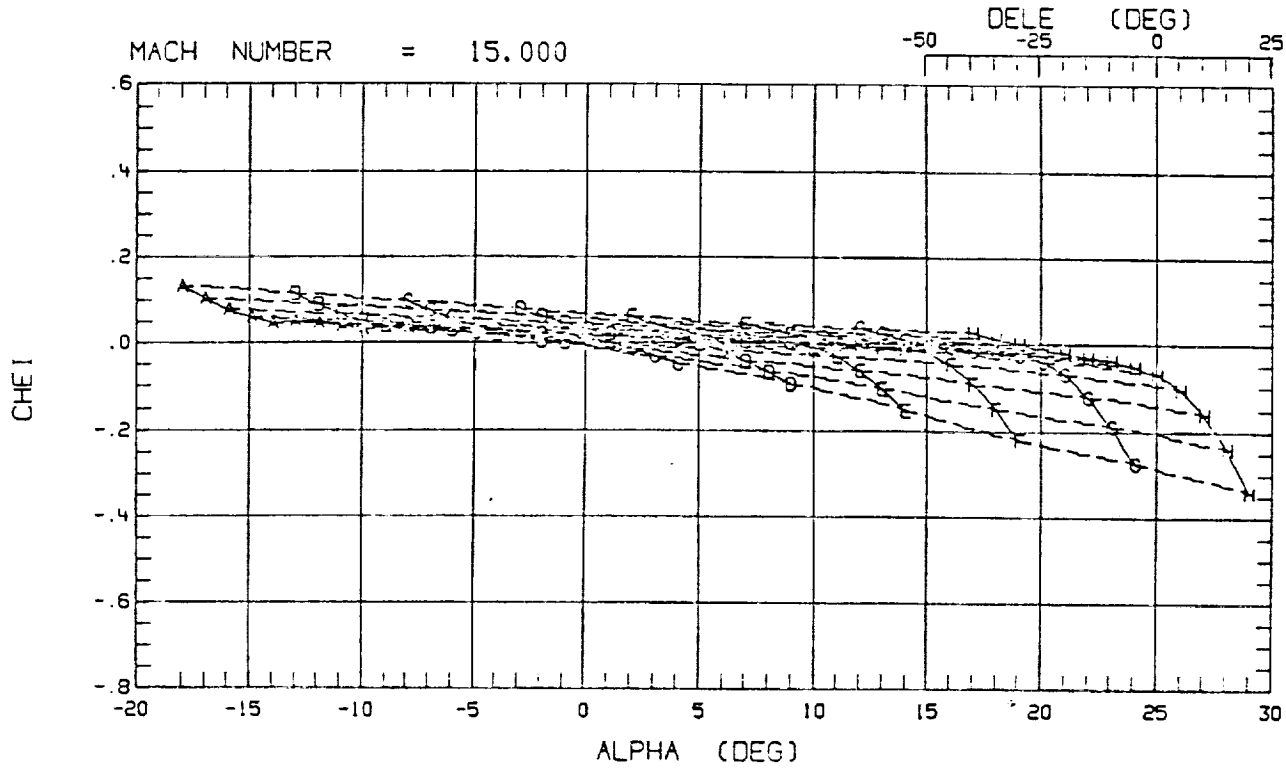
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.04390	0.03400	0.02420	0.01520	0.00410	-0.00920	-0.02290	-0.03650
-35.000	0.03209	0.01956	0.01100	0.00484	-0.01006	-0.02048	-0.03355	-0.04959
-30.000	0.02100	0.00700	-0.00100	-0.00700	-0.02400	-0.03400	-0.04700	-0.06500
-25.000	0.01048	-0.00376	-0.01151	-0.02105	-0.03760	-0.04970	-0.06289	-0.08210
-20.000	0.00100	-0.01250	-0.02140	-0.03510	-0.05120	-0.06780	-0.08230	-0.10260
-15.000	-0.00644	-0.01790	-0.03075	-0.04895	-0.06710	-0.08822	-0.10645	-0.13295
-10.000	-0.01170	-0.02330	-0.04010	-0.06280	-0.08550	-0.11180	-0.13660	-0.17210
-5.000	-0.01400	-0.03000	-0.05500	-0.07800	-0.10900	-0.14000	-0.17600	-0.22250
0.0	-0.02300	-0.04140	-0.07230	-0.10340	-0.13870	-0.17760	-0.22450	-0.27790
5.000	-0.05000	-0.07300	-0.10700	-0.14800	-0.18500	-0.23400	-0.29600	-0.34000
10.000	-0.09470	-0.12410	-0.16380	-0.21650	-0.25780	-0.30280	-0.35780	-0.40240
15.000	-0.15320	-0.19270	-0.24377	-0.31027	-0.35663	-0.40213	-0.43693	-0.46403
20.000	-0.22550	-0.27880	-0.34690	-0.42330	-0.48150	-0.51400	-0.52340	-0.52490

ENGINEER 4P
DATE 12/5/75

FIGURE 5.1-24
ELEVON HINGE MOMENT COEFFICIENT



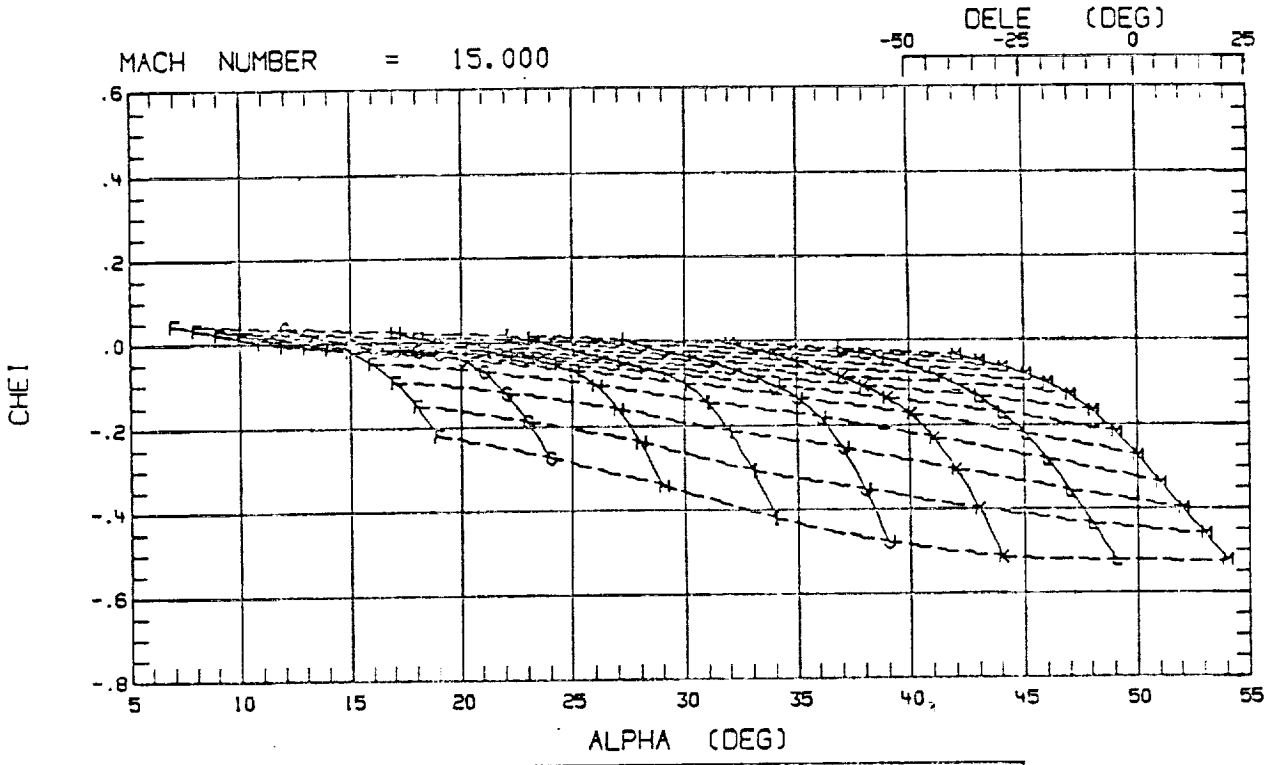
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.13210	0.11350	0.09490	0.07630	0.05690	0.04390	0.03400	0.02420
-35.000	0.10141	0.08732	0.07324	0.05915	0.04352	0.03209	0.01956	0.01100
-30.000	0.07700	0.06600	0.05500	0.04400	0.03000	0.02100	0.00700	-0.00100
-25.000	0.05655	0.04924	0.03992	0.03060	0.01811	0.01048	-0.00376	-0.01151
-20.000	0.04700	0.03790	0.02880	0.01970	0.00850	0.00100	-0.01250	-0.02140
-15.000	0.04920	0.03705	0.02491	0.01276	0.00207	-0.00644	-0.01790	-0.03075
-10.000	0.04680	0.03410	0.02140	0.00870	-0.00100	-0.01170	-0.02330	-0.04010
-5.000	0.04000	0.02900	0.01800	0.00700	0.0	-0.01400	-0.03000	-0.05500
0.0	0.03290	0.02050	0.00810	-0.00430	-0.01000	-0.02300	-0.04140	-0.07230
5.000	0.03400	0.01600	-0.00200	-0.02000	-0.03100	-0.05000	-0.07300	-0.10700
10.000	0.03540	0.00980	-0.01580	-0.04140	-0.06570	-0.09470	-0.12410	-0.16380
15.000	0.03900	0.00380	-0.03140	-0.06660	-0.10737	-0.15320	-0.19270	-0.24377
20.000	0.04480	-0.00200	-0.04880	-0.09560	-0.15600	-0.22550	-0.27880	-0.34690

ENGINEER AP
DATE 12/3/25

FIGURE 5.1-25
ELEVON HINGE MOMENT COEFFICIENT



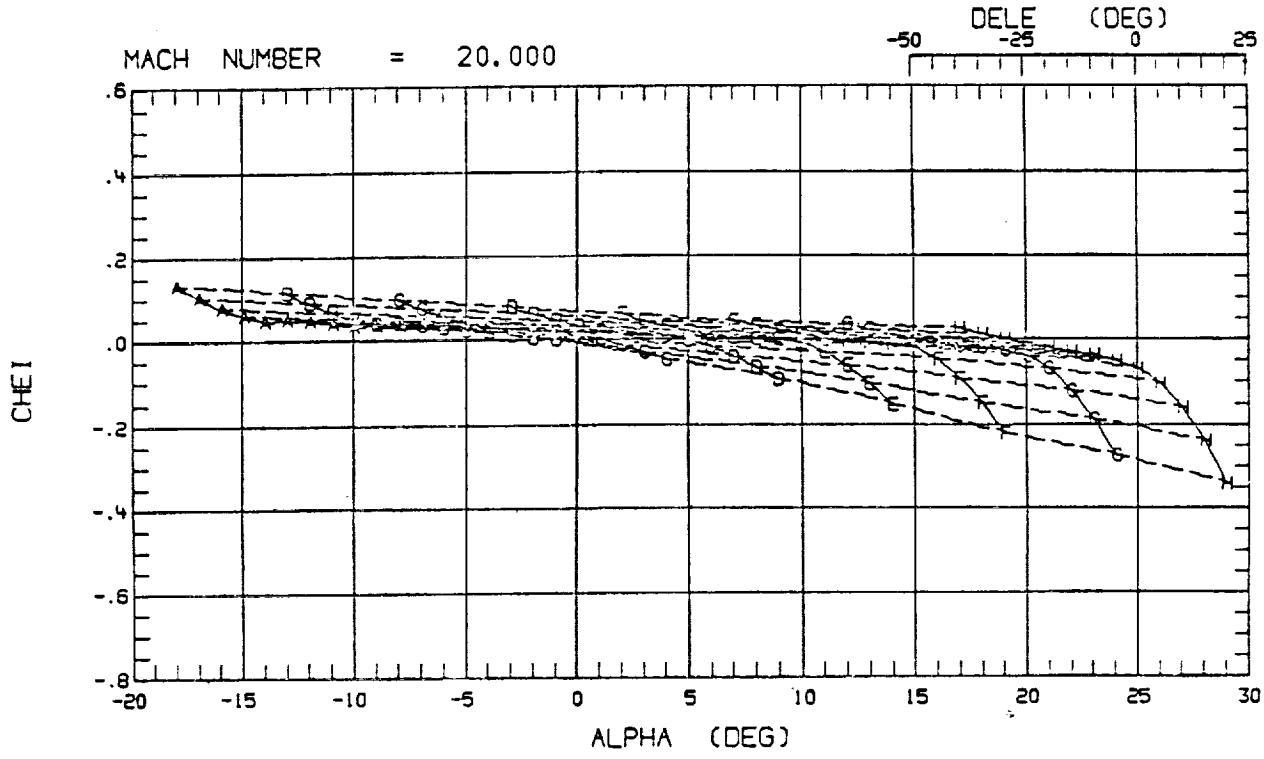
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
CR YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.04390	0.03400	0.02420	0.01520	0.00410	-0.00920	-0.02290	-0.03650
-35.000	0.03209	0.01956	0.01100	0.00484	-0.01006	-0.02048	-0.03355	-0.04959
-30.000	0.02100	0.00700	-0.00100	-0.00700	-0.02400	-0.03400	-0.04700	-0.06500
-25.000	0.01048	-0.00376	-0.01151	-0.02105	-0.03760	-0.04970	-0.06299	-0.08210
-20.000	0.00100	-0.01250	-0.02140	-0.03510	-0.05120	-0.06780	-0.08230	-0.10290
-15.000	-0.00644	-0.01790	-0.03075	-0.04895	-0.06710	-0.08822	-0.10645	-0.13295
-10.000	-0.01170	-0.02330	-0.04010	-0.06280	-0.08550	-0.11180	-0.13660	-0.17210
-5.000	-0.01400	-0.03000	-0.05500	-0.07800	-0.10900	-0.14000	-0.17600	-0.22250
0.0	-0.02300	-0.04140	-0.07230	-0.10340	-0.13870	-0.17760	-0.22450	-0.27790
5.000	-0.05000	-0.07300	-0.10700	-0.14900	-0.18500	-0.23400	-0.29600	-0.34000
10.000	-0.09470	-0.12410	-0.16380	-0.21850	-0.25780	-0.30880	-0.35780	-0.40240
15.000	-0.15320	-0.19270	-0.24377	-0.31027	-0.35663	-0.40213	-0.43693	-0.46403
20.000	-0.22550	-0.27880	-0.34690	-0.42330	-0.48150	-0.51400	-0.52340	-0.52490

ENGINEER HC
DATE 10/21/75

FIGURE 5.1-26
ELEVON HINGE MOMENT COEFFICIENT



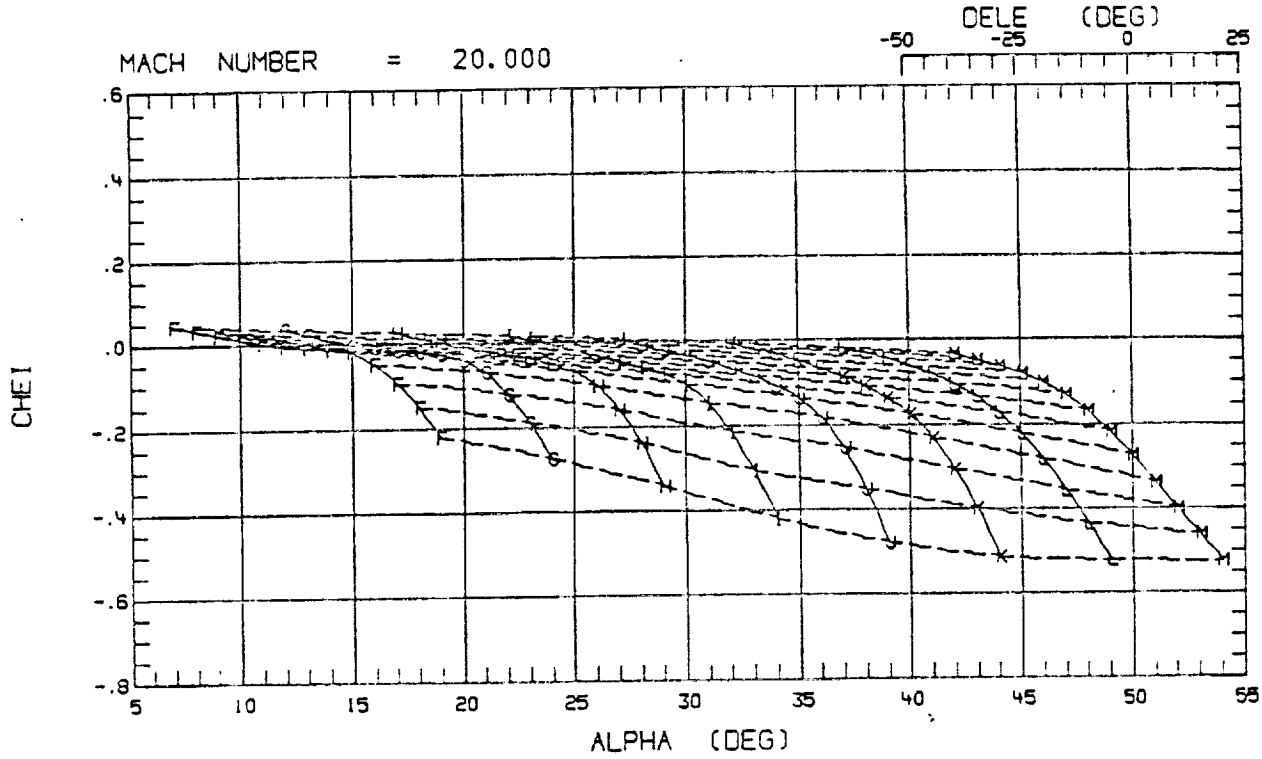
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.13210	0.11350	0.09490	0.07630	0.05890	0.04390	0.03400	0.02420
-35.000	0.10141	0.08732	0.07324	0.05915	0.04352	0.03209	0.01956	0.01100
-30.000	0.07700	0.06600	0.05500	0.04400	0.03000	0.02100	0.00700	-0.00100
-25.000	0.05855	0.04924	0.03992	0.03060	0.01811	0.01048	-0.00376	-0.01151
-20.000	0.04700	0.03790	0.02880	0.01970	0.00850	0.00100	-0.01250	-0.02140
-15.000	0.04920	0.03705	0.02491	0.01276	0.00207	-0.00644	-0.01790	-0.03075
-10.000	0.04680	0.03410	0.02140	0.00870	-0.00100	-0.01170	-0.02330	-0.04010
-5.000	0.04000	0.02900	0.01800	0.00700	0.0	-0.01400	-0.03000	-0.05500
0.0	0.03290	0.02050	0.00810	-0.00430	-0.01000	-0.02300	-0.04140	-0.07230
5.000	0.03400	0.01600	-0.00200	-0.02000	-0.03100	-0.05000	-0.07300	-0.10700
10.000	0.03540	0.00980	-0.01580	-0.04140	-0.06570	-0.09470	-0.12410	-0.16380
15.000	0.03900	0.00380	-0.03140	-0.06660	-0.10737	-0.15320	-0.19270	-0.24377
20.000	0.04480	-0.00200	-0.04880	-0.09560	-0.15600	-0.22550	-0.27890	-0.34690

ENGINEER HD
DATE 10/3/78

FIGURE 5.1-27
ELEVON HINGE MOMENT COEFFICIENT



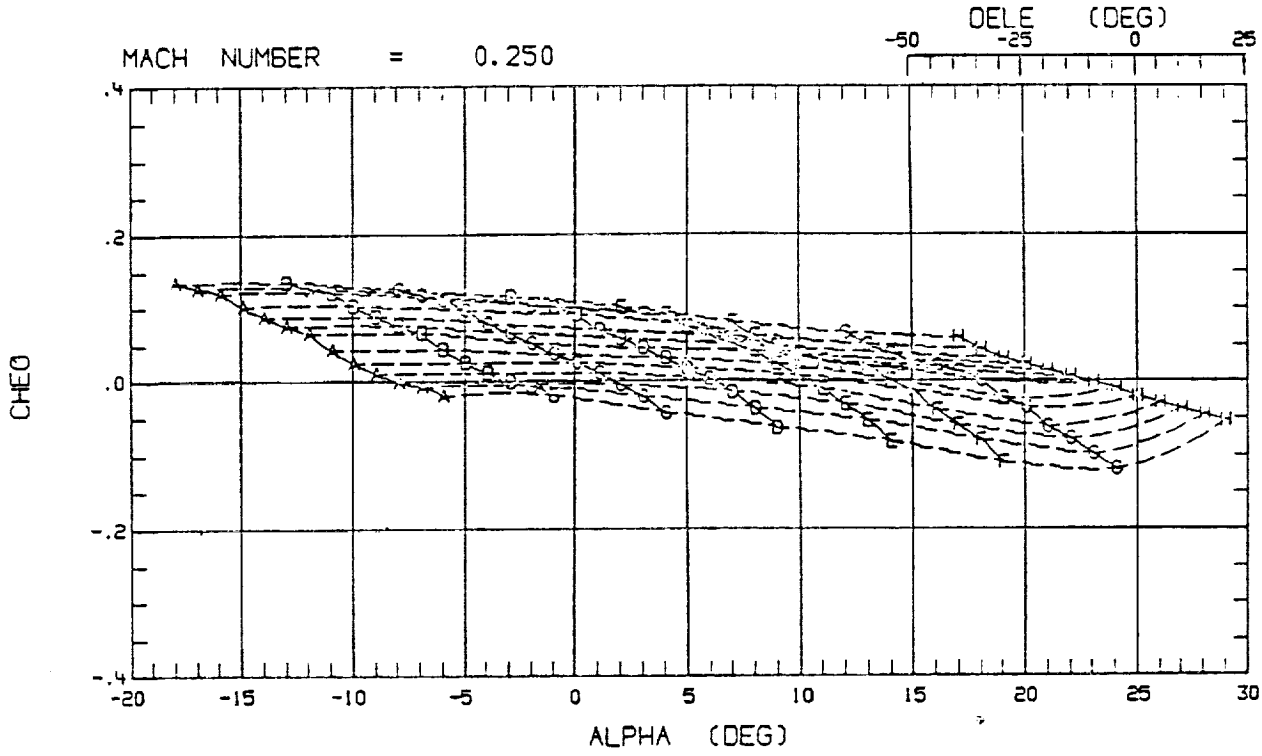
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	INBOARD ELEVON HINGE MOMENT							
-40.000	0.04390	0.03400	0.02420	0.01520	0.00410	-0.00920	-0.02290	-0.03650
-35.000	0.03209	0.01956	0.01100	0.00484	-0.01006	-0.02048	-0.03355	-0.04959
-30.000	0.02100	0.00700	-0.00100	-0.00700	-0.02400	-0.03400	-0.04700	-0.06500
-25.000	0.01048	-0.00376	-0.01151	-0.02105	-0.03780	-0.04970	-0.06289	-0.08210
-20.000	0.00100	-0.01250	-0.02140	-0.03510	-0.05120	-0.06780	-0.08230	-0.10280
-15.000	-0.00644	-0.01790	-0.03075	-0.04895	-0.06710	-0.08822	-0.10645	-0.13295
-10.000	-0.01170	-0.02330	-0.04010	-0.06280	-0.08550	-0.11180	-0.13660	-0.17210
-5.000	-0.01400	-0.03000	-0.05500	-0.07800	-0.10900	-0.14000	-0.17600	-0.22250
0.0	-0.02300	-0.04140	-0.07230	-0.10340	-0.13870	-0.17760	-0.22450	-0.27790
5.000	-0.05000	-0.07300	-0.10700	-0.14800	-0.18500	-0.23400	-0.29600	-0.34000
10.000	-0.09470	-0.12410	-0.16380	-0.21850	-0.26780	-0.30880	-0.35780	-0.40240
15.000	-0.15320	-0.19270	-0.24377	-0.31027	-0.35663	-0.40213	-0.43693	-0.46403
20.000	-0.22550	-0.27860	-0.34690	-0.42330	-0.48150	-0.51400	-0.52340	-0.52490

ENGINEER H?
DATE 10/27/83

FIGURE 5.1-28
ELEVON HINGE MOMENT COEFFICIENT



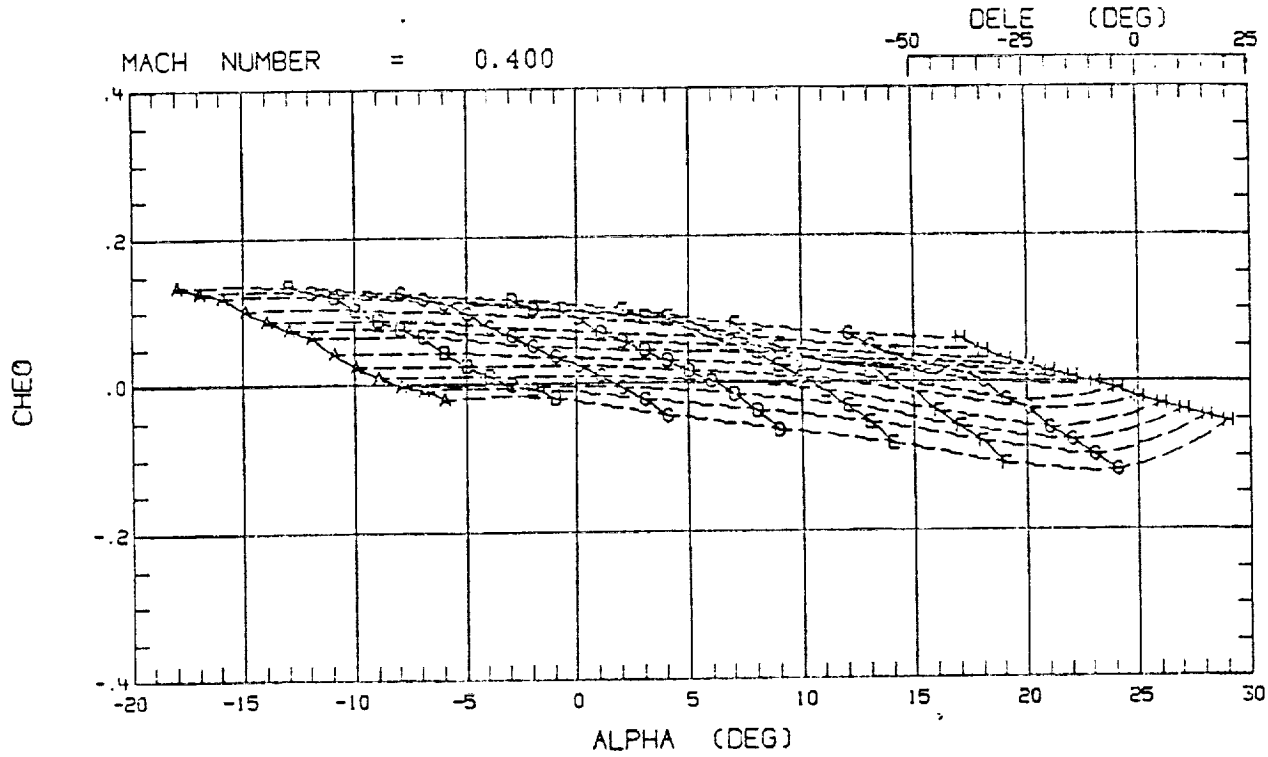
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.13390	0.13390	0.12300	0.11430	0.10010	0.07860	0.06440	0.05790
-35.000	0.12600	0.12600	0.11600	0.10200	0.08900	0.06060	0.04864	0.04317
-30.000	0.12000	0.12000	0.11000	0.10000	0.08900	0.04580	0.03590	0.03090
-25.000	0.10200	0.10200	0.09500	0.08900	0.07400	0.03470	0.02722	0.02207
-20.000	0.08700	0.08700	0.07800	0.06900	0.06000	0.02580	0.01950	0.01370
-15.000	0.07500	0.07500	0.06400	0.05700	0.05000	0.02215	0.01245	0.00560
-10.000	0.06400	0.06400	0.05000	0.04400	0.04000	0.02000	0.0	-0.00250
-5.000	0.04200	0.04200	0.03600	0.03000	0.02200	0.0	-0.02400	-0.01100
0.0	0.02500	0.02500	0.02500	0.01600	0.00600	-0.01500	-0.03700	-0.02300
5.000	0.01000	0.01000	0.01000	0.00200	-0.01200	-0.04000	-0.06200	-0.03100
10.000	-0.00300	-0.00300	-0.00600	-0.01600	-0.03300	-0.06100	-0.07900	-0.03900
15.000	-0.00600	-0.00800	-0.02200	-0.03800	-0.05400	-0.08133	-0.09900	-0.04700
20.000	-0.02000	-0.02000	-0.04400	-0.06400	-0.08400	-0.11100	-0.12000	-0.05500

ENGINEER H.P
DATE 5-14-28

FIGURE 5.1-29
ELEVON HINGE MOMENT COEFFICIENT



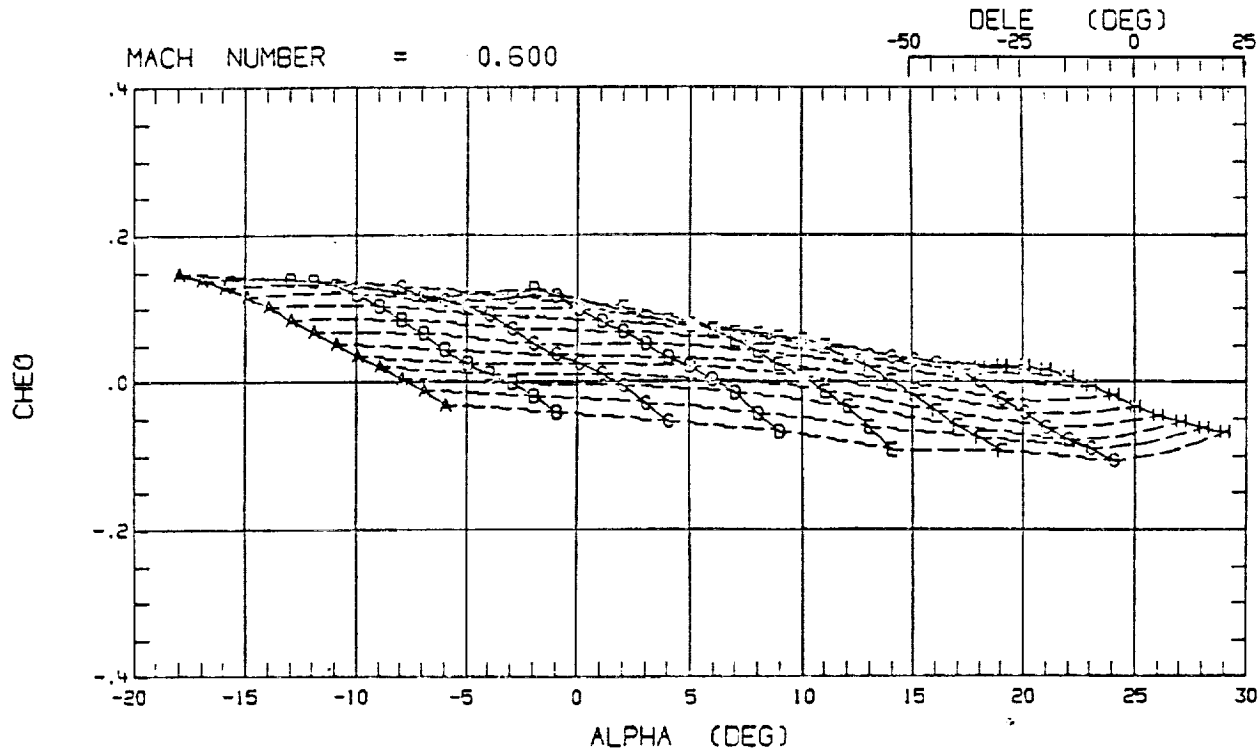
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.13390	0.13390	0.12300	0.11430	0.10010	0.07860	0.06440	0.05790
-35.000	0.12600	0.12600	0.11600	0.10200	0.08980	0.06060	0.04864	0.04317
-30.000	0.12000	0.12000	0.11000	0.10000	0.08900	0.04580	0.03590	0.03090
-25.000	0.10200	0.10200	0.09500	0.08900	0.07400	0.03470	0.02722	0.02207
-20.000	0.08700	0.08700	0.07800	0.06900	0.06000	0.02580	0.01950	0.01370
-15.000	0.07500	0.07500	0.06400	0.05700	0.05000	0.02215	0.01245	0.00560
-10.000	0.06400	0.06400	0.05000	0.04400	0.04000	0.02000	0.0	-0.00250
-5.000	0.04200	0.04200	0.03600	0.03000	0.02200	0.0	-0.02400	-0.01100
0.0	0.02500	0.02500	0.02500	0.01600	0.00600	-0.01500	-0.03700	-0.02300
5.000	0.01000	0.01000	0.01000	0.00200	-0.01200	-0.04000	-0.06200	-0.03100
10.000	-0.00300	-0.00300	-0.00600	-0.01600	-0.03300	-0.06100	-0.07900	-0.03900
15.000	-0.00800	-0.00800	-0.02200	-0.03800	-0.05400	-0.08100	-0.09900	-0.04700
20.000	-0.02000	-0.02000	-0.04400	-0.06400	-0.08400	-0.11100	-0.12000	-0.05500

ENGINEER A.P
DATE 2 AUG 78

FIGURE 5.1-30
ELEVON HINGE MOMENT COEFFICIENT



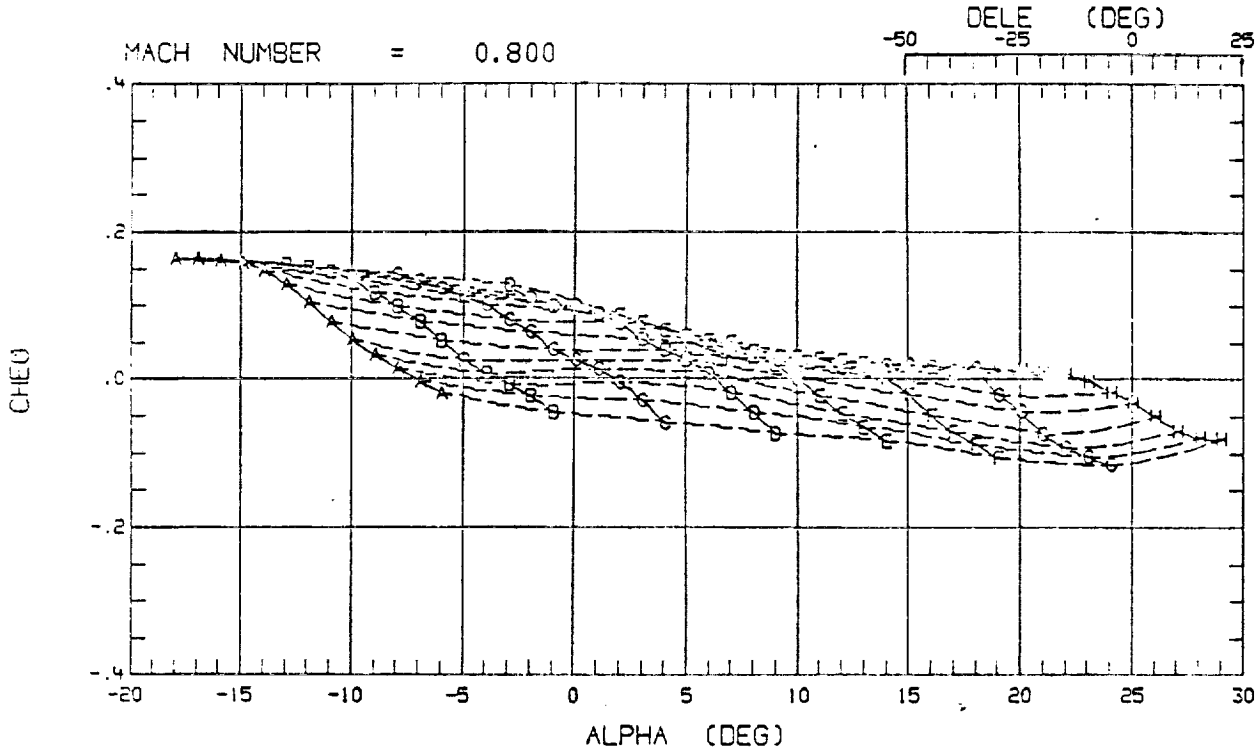
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.14580	0.13790	0.12850	0.11400	0.09950	0.06530	0.03720	0.01490
-35.000	0.13796	0.13600	0.11600	0.12500	0.08600	0.06204	0.03537	0.01873
-30.000	0.12790	0.13000	0.10900	0.11500	0.08100	0.05900	0.03260	0.02030
-25.000	0.11551	0.11800	0.10200	0.09800	0.07600	0.05500	0.02914	0.02001
-20.000	0.10110	0.10200	0.08900	0.08190	0.06880	0.04600	0.02420	0.01670
-15.000	0.08400	0.08300	0.07200	0.06613	0.05561	0.03300	0.01531	0.00689
-10.000	0.06690	0.06400	0.05000	0.05000	0.04000	0.02000	0.0	-0.00540
-5.000	0.05000	0.04200	0.03600	0.03200	0.02200	0.0	-0.02400	-0.01900
0.0	0.03480	0.02500	0.02500	0.02000	0.00600	-0.01800	-0.04200	-0.03370
5.000	0.02000	0.01000	0.01000	0.00200	-0.01400	-0.04000	-0.06200	-0.04600
10.000	0.00500	-0.00300	-0.00600	-0.01600	-0.03500	-0.06100	-0.07900	-0.05500
15.000	-0.01233	-0.02000	-0.03000	-0.04400	-0.06300	-0.07700	-0.09133	-0.06300
20.000	-0.03200	-0.04300	-0.05500	-0.07000	-0.09300	-0.09500	-0.10700	-0.07000

ENGINEER M.P.
DATE 6/21/78

FIGURE 5.1-31
ELEVON HINGE MOMENT COEFFICIENT



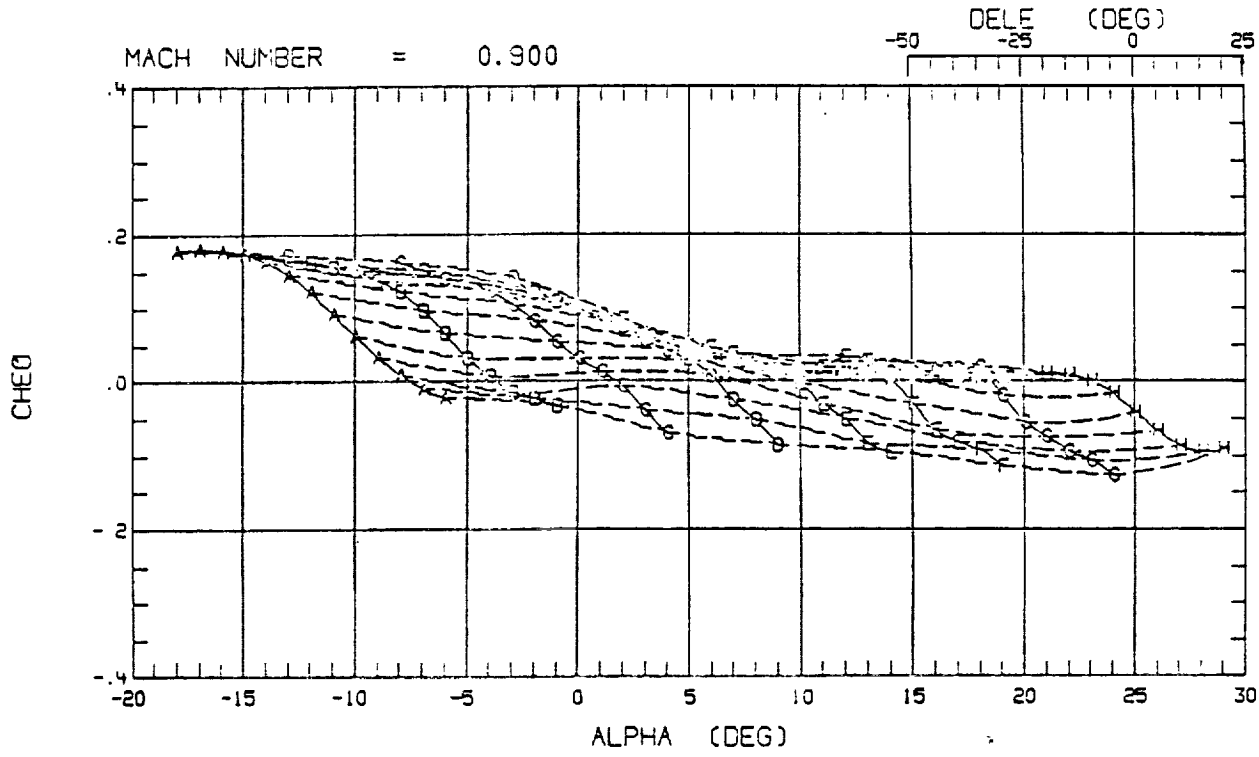
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.16230	0.15330	0.14030	0.12600	0.08440	0.02860	0.01430	0.00650
-35.000	0.16334	0.15100	0.13100	0.10700	0.07500	0.02992	0.01706	0.00894
-30.000	0.16110	0.14500	0.12100	0.09700	0.06500	0.02860	0.01820	0.01040
-25.000	0.15620	0.13300	0.11100	0.09700	0.05700	0.02762	0.01798	0.01117
-20.000	0.14680	0.11600	0.10000	0.08800	0.05100	0.02600	0.01560	0.01040
-15.000	0.12767	0.09700	0.08000	0.07500	0.04800	0.02399	0.00986	0.00520
-10.000	0.10390	0.07700	0.06200	0.05200	0.03600	0.02000	0.01400	-0.00390
-5.000	0.07730	0.05100	0.03800	0.03800	0.01800	0.0	-0.02200	-0.01750
0.0	0.05200	0.02500	0.02500	0.02500	0.0	-0.02300	-0.04500	-0.03250
5.000	0.03180	0.00700	0.01200	0.00600	-0.02500	-0.05000	-0.07500	-0.05130
10.000	0.01430	-0.00900	-0.00600	-0.02000	-0.04800	-0.07400	-0.09300	-0.07010
15.000	-0.00323	-0.02500	-0.03000	-0.04653	-0.06600	-0.09000	-0.10600	-0.07983
20.000	-0.02080	-0.04700	-0.06000	-0.07530	-0.08500	-0.10700	-0.11560	-0.08050

ENGINEER _____
DATE _____

FIGURE 5.1-32
ELEVON HINGE MOMENT COEFFICIENT



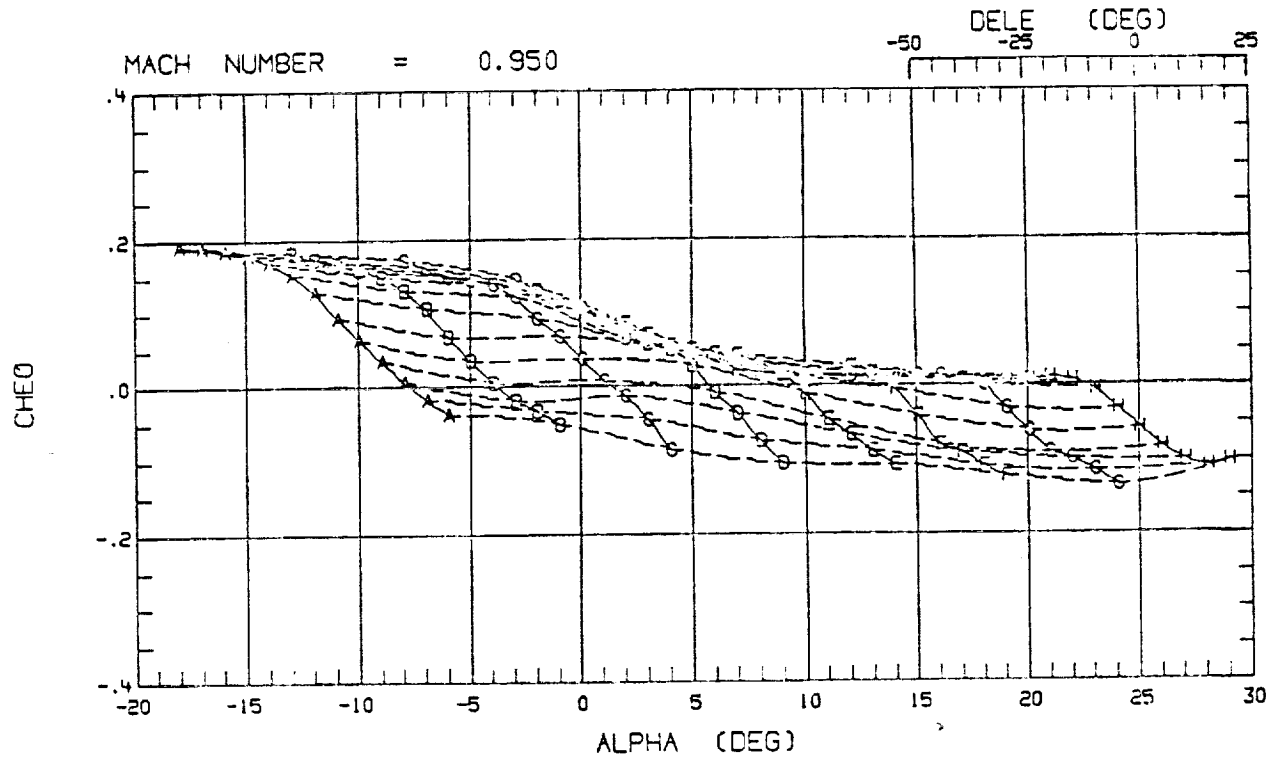
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.17760	0.17030	0.16070	0.13920	0.08380	0.01750	0.00880	0.00480
-35.000	0.17917	0.16000	0.15000	0.12000	0.06000	0.01667	0.00916	0.00339
-30.000	0.17710	0.15500	0.13900	0.10800	0.04800	0.01100	0.00980	8.00380
-25.000	0.17187	0.15000	0.13500	0.10000	0.04700	0.01200	0.01085	0.00695
-20.000	0.16200	0.13700	0.12200	0.09000	0.04500	0.01900	0.01190	0.01010
-15.000	0.14497	0.12111	0.10400	0.07400	0.03600	0.03300	0.01600	0.00776
-10.000	0.12140	0.09620	0.08200	0.05400	0.02200	0.02700	0.01900	0.0
-5.000	0.09100	0.06400	0.05300	0.04100	0.01500	0.00200	-0.02000	-0.01700
0.0	0.06150	0.03000	0.03000	0.02900	-0.00500	-0.03200	-0.05700	-0.04300
5.000	0.03300	0.00600	0.01200	0.00700	-0.03200	-0.06800	-0.07600	-0.06800
10.000	0.00840	-0.01600	-0.00800	-0.02700	-0.05200	-0.08300	-0.09500	-0.08820
15.000	-0.01027	-0.02500	-0.04100	-0.05373	-0.08500	-0.09400	-0.10783	-0.09620
20.000	-0.02300	-0.03500	-0.07200	-0.08700	-0.09700	-0.11600	-0.12700	-0.09200

ENGINEER [illegible]
DATE 9/22/72

FIGURE 5.1-33
ELEVON HINGE MOMENT COEFFICIENT



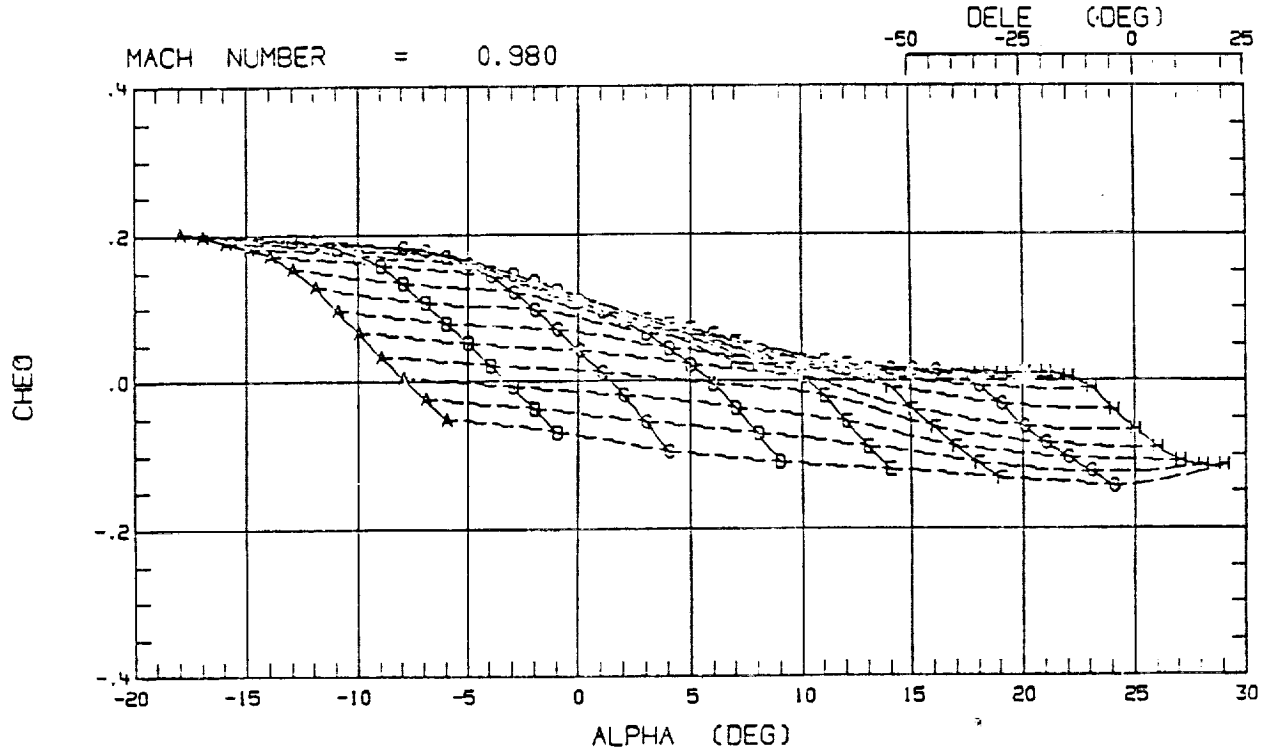
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.19010	0.18100	0.17100	0.14480	0.08500	0.01940	0.01160	0.00520
-35.000	0.18812	0.17200	0.16000	0.13000	0.07000	0.01825	0.01181	0.00389
-30.000	0.18390	0.16600	0.14900	0.11600	0.05500	0.01240	0.01200	0.00420
-25.000	0.17797	0.15900	0.14500	0.10500	0.04900	0.01300	0.01217	0.00695
-20.000	0.16870	0.14800	0.13800	0.08900	0.04200	0.02000	0.01230	0.00970
-15.000	0.15190	0.13000	0.12100	0.06500	0.04000	0.02400	0.00692	0.00577
-10.000	0.12770	0.10500	0.09200	0.05600	0.03000	0.01600	0.00100	-0.00550
-5.000	0.09420	0.06700	0.06800	0.04900	0.01400	-0.00700	-0.03300	-0.03200
0.0	0.06340	0.03500	0.03700	0.02700	-0.01200	-0.04200	-0.06300	-0.05820
5.000	0.03380	0.00500	0.00700	-0.01000	-0.04700	-0.08200	-0.09100	-0.08330
10.000	0.00600	-0.02000	-0.01500	-0.03800	-0.06800	-0.09100	-0.10000	-0.10160
15.000	-0.01797	-0.03400	-0.04600	-0.07600	-0.09000	-0.11000	-0.11613	-0.10873
20.000	-0.03810	-0.05200	-0.06800	-0.10600	-0.10600	-0.12420	-0.13640	-0.10410

ENGINEER HP
DATE 6-24-82

FIGURE 5.1-34
ELEVON HINGE MOMENT COEFFICIENT



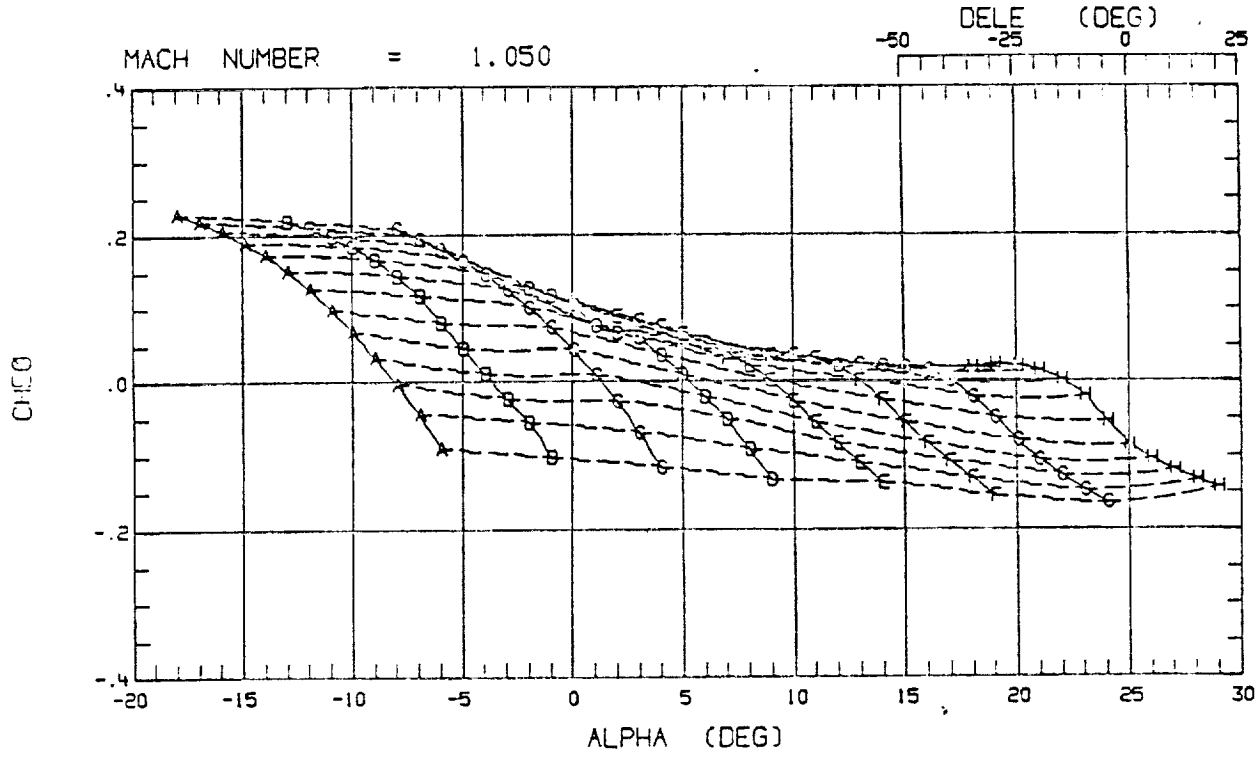
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.20074	0.19130	0.18055	0.14489	0.08564	0.02231	0.01402	0.00646
-35.000	0.19611	0.18705	0.17654	0.13349	0.08033	0.02221	0.01441	0.00744
-30.000	0.18952	0.17982	0.16866	0.12094	0.07450	0.02254	0.01435	0.00849
-25.000	0.18157	0.17013	0.15742	0.10756	0.06845	0.02392	0.01397	0.01032
-20.000	0.17106	0.15660	0.14195	0.09362	0.06115	0.02450	0.01289	0.01079
-15.000	0.15197	0.13123	0.12075	0.07951	0.05090	0.01994	0.00502	0.00449
-10.000	0.12761	0.10503	0.09613	0.06323	0.03894	0.01007	-0.00894	-0.00989
-5.000	0.09521	0.07805	0.06908	0.04278	0.02369	-0.00931	-0.03242	-0.03986
0.0	0.06458	0.05058	0.03973	0.02100	0.00406	-0.03997	-0.06328	-0.06710
5.000	0.03346	0.02120	0.01051	-0.00509	-0.02135	-0.06535	-0.08626	-0.09147
10.000	0.00340	-0.00839	-0.02114	-0.03789	-0.05729	-0.09105	-0.10532	-0.10860
15.000	-0.02529	-0.03689	-0.05740	-0.07373	-0.09075	-0.11363	-0.12466	-0.12623
20.000	-0.05271	-0.07027	-0.09749	-0.11245	-0.12207	-0.13308	-0.14431	-0.14534

ENGINEER [illegible]
DATE 9/20/78

FIGURE 5.1-35
ELEVON HINGE MOMENT COEFFICIENT



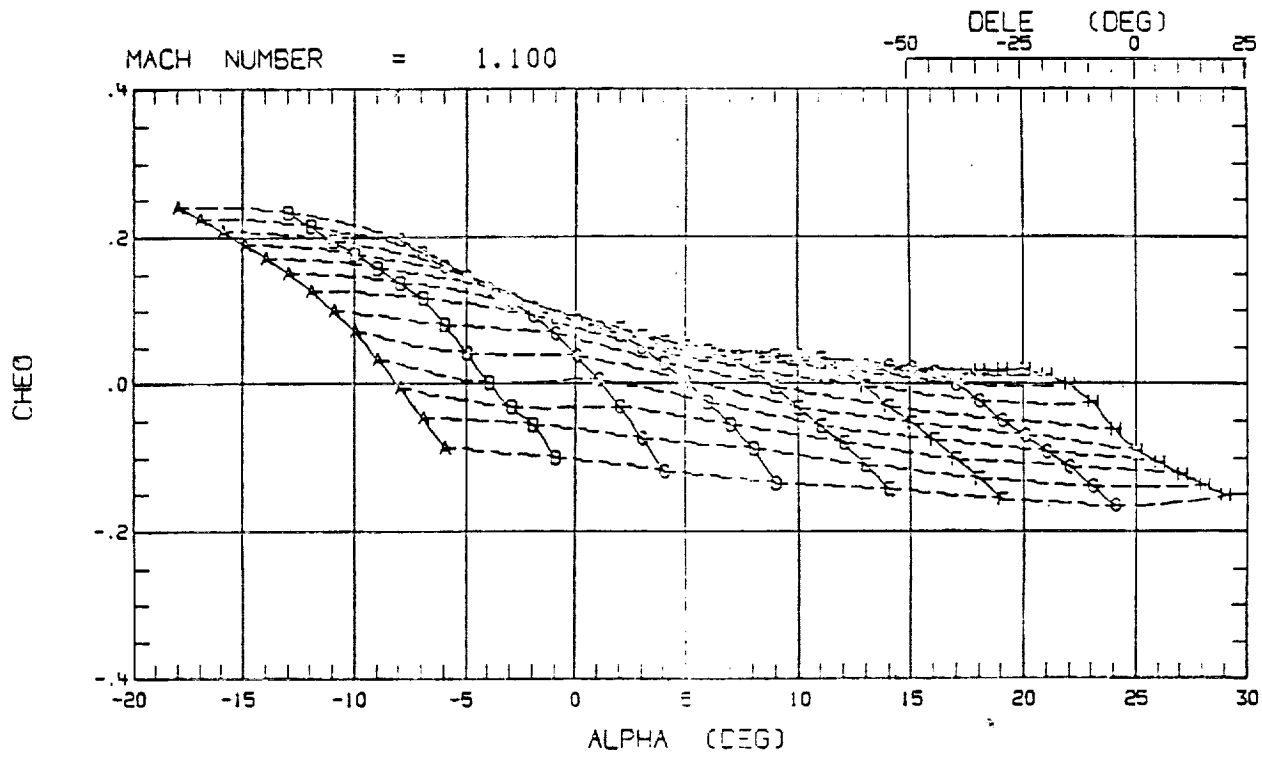
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.22900	0.21780	0.20540	0.13380	0.08660	0.03060	0.02040	0.01020
-35.000	0.21700	0.20842	0.19335	0.12504	0.08070	0.03376	0.02135	0.01650
-30.000	0.20410	0.19650	0.17870	0.11500	0.07290	0.03470	0.02070	0.02200
-25.000	0.18961	0.18237	0.16263	0.10386	0.06328	0.03392	0.01897	0.02116
-20.000	0.17260	0.16500	0.14460	0.07500	0.05160	0.02990	0.01460	0.01460
-15.000	0.15111	0.14219	0.12391	0.06500	0.03790	0.01906	-0.00020	0.00107
-10.000	0.12600	0.11560	0.10030	0.05830	0.02130	0.00100	-0.02200	-0.02100
-5.000	0.09750	0.09000	0.07300	0.03500	0.0	-0.02700	-0.05000	-0.05500
0.0	0.06750	0.04500	0.04200	0.00760	-0.02800	-0.05730	-0.08150	-0.08660
5.000	0.03200	0.01000	0.00800	-0.02250	-0.05700	-0.08500	-0.10700	-0.10600
10.000	-0.00350	-0.02500	-0.02900	-0.05200	-0.08500	-0.10920	-0.12830	-0.12070
15.000	-0.04493	-0.05627	-0.07093	-0.09257	-0.11207	-0.13287	-0.14763	-0.13357
20.000	-0.09230	-0.10380	-0.11780	-0.13310	-0.13620	-0.15600	-0.16500	-0.14460

ENGINEER HP
DATE 9/22/72

FIGURE 5.1-36
ELEVON HINGE MOMENT COEFFICIENT



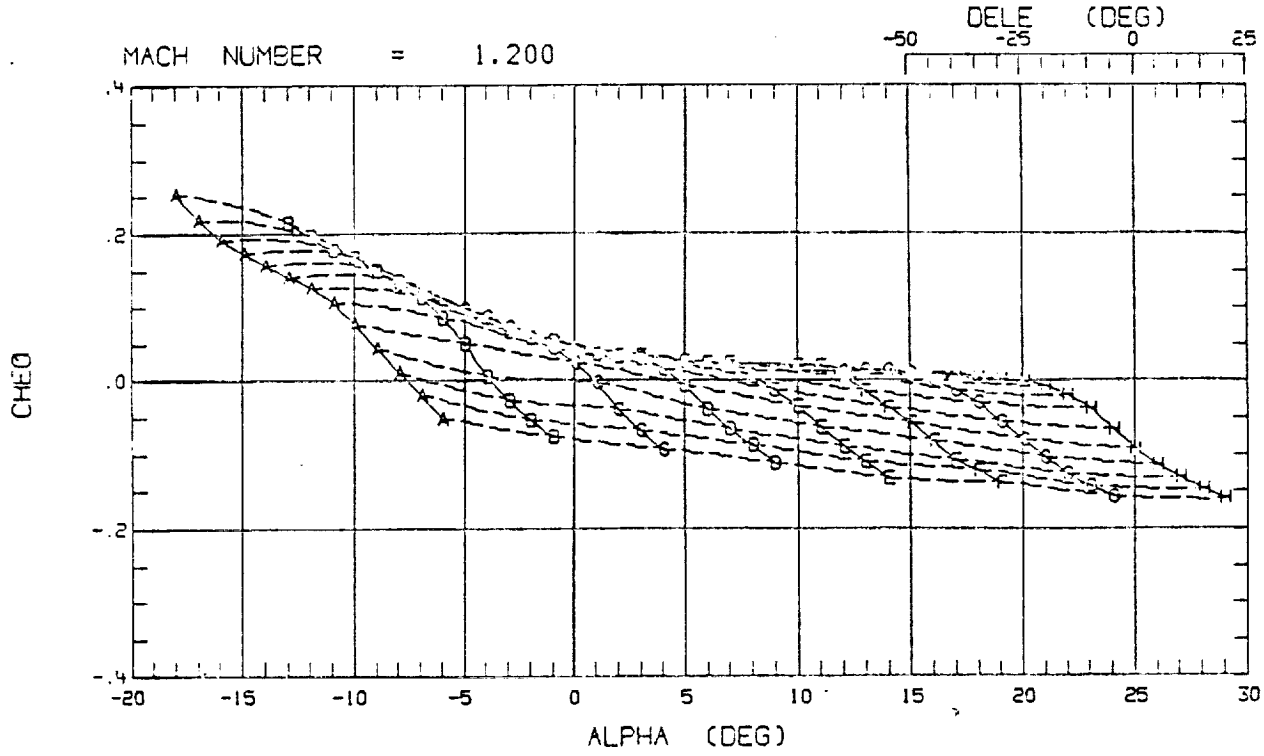
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.24030	0.23120	0.19510	0.11300	0.07400	0.03120	0.02080	0.01040
-35.000	0.22382	0.21245	0.17627	0.10063	0.06349	0.03525	0.02290	0.01640
-30.000	0.20680	0.19380	0.15880	0.09020	0.05490	0.03670	0.02240	0.01650
-25.000	0.18939	0.17530	0.14335	0.08245	0.04920	0.03622	0.01992	0.01731
-20.000	0.17110	0.15680	0.12790	0.07470	0.04350	0.03180	0.01360	0.01100
-15.000	0.15035	0.13692	0.11035	0.06465	0.03242	0.01599	-0.00140	-0.00303
-10.000	0.12690	0.11530	0.09060	0.04800	0.01660	-0.00550	-0.02440	-0.02630
-5.000	0.09920	0.08000	0.06670	0.02600	-0.00600	-0.03300	-0.05000	-0.06320
0.0	0.07010	0.04000	0.03700	0.00260	-0.03390	-0.05400	-0.07100	-0.09220
5.000	0.03330	0.0	0.00470	-0.02700	-0.05900	-0.07700	-0.09300	-0.10700
10.000	-0.00620	-0.03300	-0.03350	-0.05600	-0.08200	-0.10300	-0.11300	-0.12310
15.000	-0.04653	-0.05607	-0.07467	-0.09000	-0.11200	-0.12900	-0.14000	-0.13830
20.000	-0.08770	-0.10200	-0.11880	-0.13570	-0.14480	-0.15790	-0.16690	-0.15360

ENGINEER [illegible]
DATE 2/24/78

FIGURE 5.1-37
ELEVON HINGE MOMENT COEFFICIENT



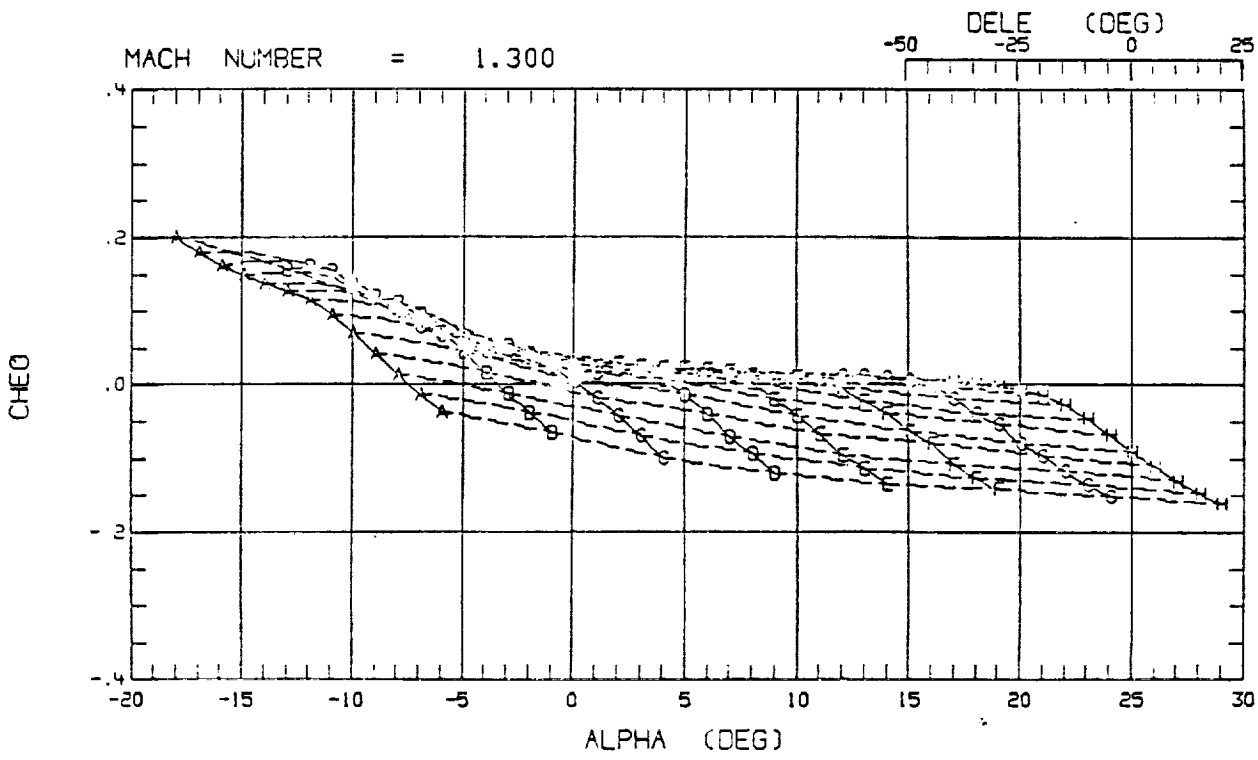
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.25090	0.21360	0.12970	0.06420	0.03230	0.02170	0.01000	0.00250
-35.000	0.21825	0.19400	0.11300	0.05600	0.03190	0.01200	0.01246	0.00267
-30.000	0.19150	0.17700	0.10200	0.05300	0.02200	0.01300	0.01150	0.00090
-25.000	0.17234	0.16600	0.09500	0.03811	0.02400	0.01900	0.00749	-0.00239
-20.000	0.15570	0.14900	0.08500	0.03390	0.02200	0.01800	-0.00070	-0.00950
-15.000	0.14100	0.13300	0.07200	0.03135	0.01600	0.00500	-0.01492	-0.02043
-10.000	0.12630	0.11200	0.05700	0.02680	0.00400	-0.01600	-0.03100	-0.03870
-5.000	0.10500	0.08400	0.04200	0.01500	-0.01500	-0.03800	-0.05700	-0.06500
0.0	0.07470	0.04800	0.02300	-0.00900	-0.03700	-0.05900	-0.08140	-0.09320
5.000	0.04300	0.00500	-0.00500	-0.04000	-0.06400	-0.08400	-0.10500	-0.11500
10.000	0.01100	-0.02800	-0.04100	-0.06800	-0.09100	-0.11000	-0.12900	-0.13200
15.000	-0.02067	-0.05500	-0.07000	-0.09000	-0.11200	-0.12400	-0.14367	-0.14733
20.000	-0.05200	-0.07800	-0.09500	-0.11400	-0.13400	-0.14100	-0.15900	-0.16100

ENGINEER KP
DATE 8-24-78

FIGURE 5.1-38
ELEVON HINGE MOMENT COEFFICIENT



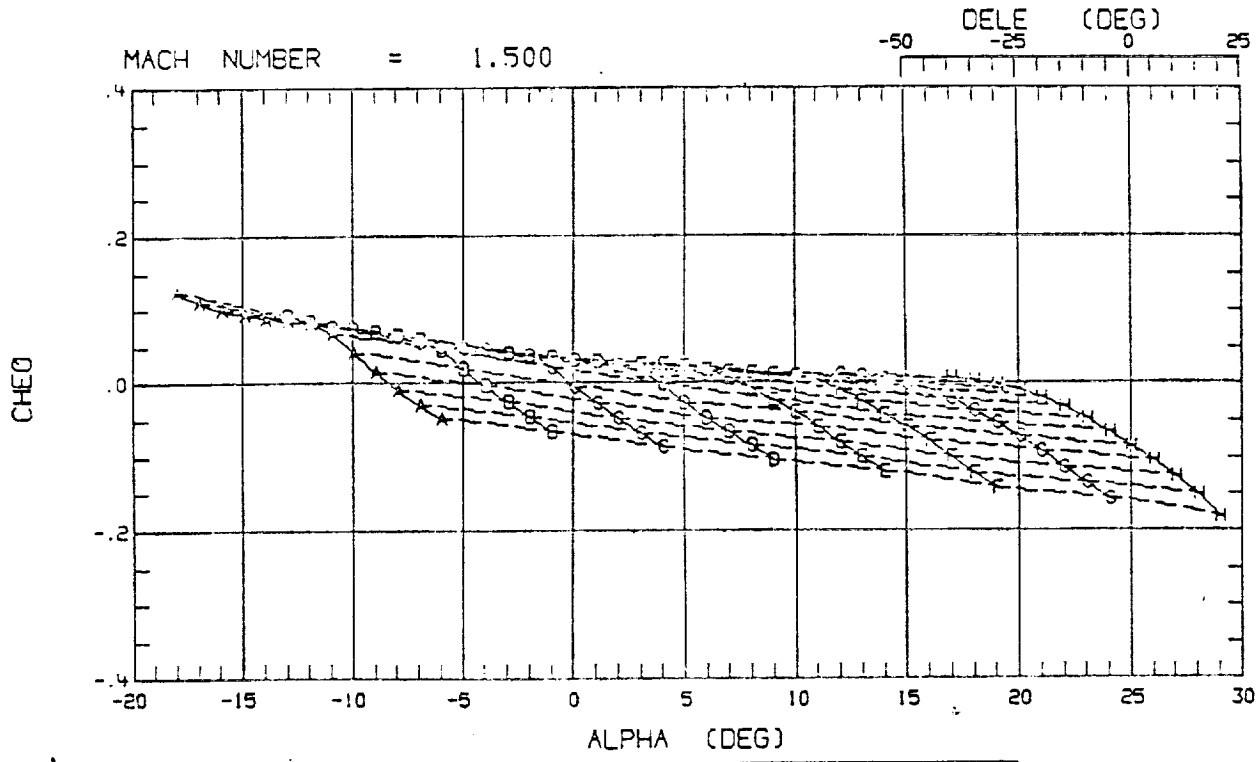
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.19810	0.15410	0.09840	0.05050	0.02720	0.01680	0.01040	0.00300
-35.000	0.17820	0.15800	0.07720	0.03800	0.02200	0.01100	0.01069	0.00067
-30.000	0.16120	0.15300	0.06410	0.02600	0.02000	0.00700	0.00840	-0.00320
-25.000	0.14781	0.13400	0.05000	0.01600	0.02000	0.00800	0.00397	-0.00823
-20.000	0.13590	0.11700	0.04300	0.01400	0.01900	0.00500	-0.00390	-0.01560
-15.000	0.12525	0.10900	0.04500	0.01800	0.01100	-0.00700	-0.01939	-0.02918
-10.000	0.11460	0.09300	0.04000	0.02000	-0.00100	-0.02400	-0.04100	-0.04730
-5.000	0.09350	0.07000	0.02200	0.00420	-0.02200	-0.04100	-0.05530	-0.06960
0.0	0.06890	0.04300	0.00300	-0.01600	-0.04500	-0.06500	-0.08100	-0.09190
5.000	0.04110	0.01500	-0.01980	-0.04200	-0.07000	-0.08060	-0.09740	-0.11160
10.000	0.01230	-0.01490	-0.04470	-0.07310	-0.09700	-0.10900	-0.11840	-0.13140
15.000	-0.01437	-0.03983	-0.07200	-0.09543	-0.11500	-0.12783	-0.13687	-0.14857
20.000	-0.03990	-0.06800	-0.10200	-0.12200	-0.13600	-0.14300	-0.15280	-0.16310

ENGINEER [illegible]
DATE 9/30/72

FIGURE 5.1-39
ELEVON HINGE MOMENT COEFFICIENT



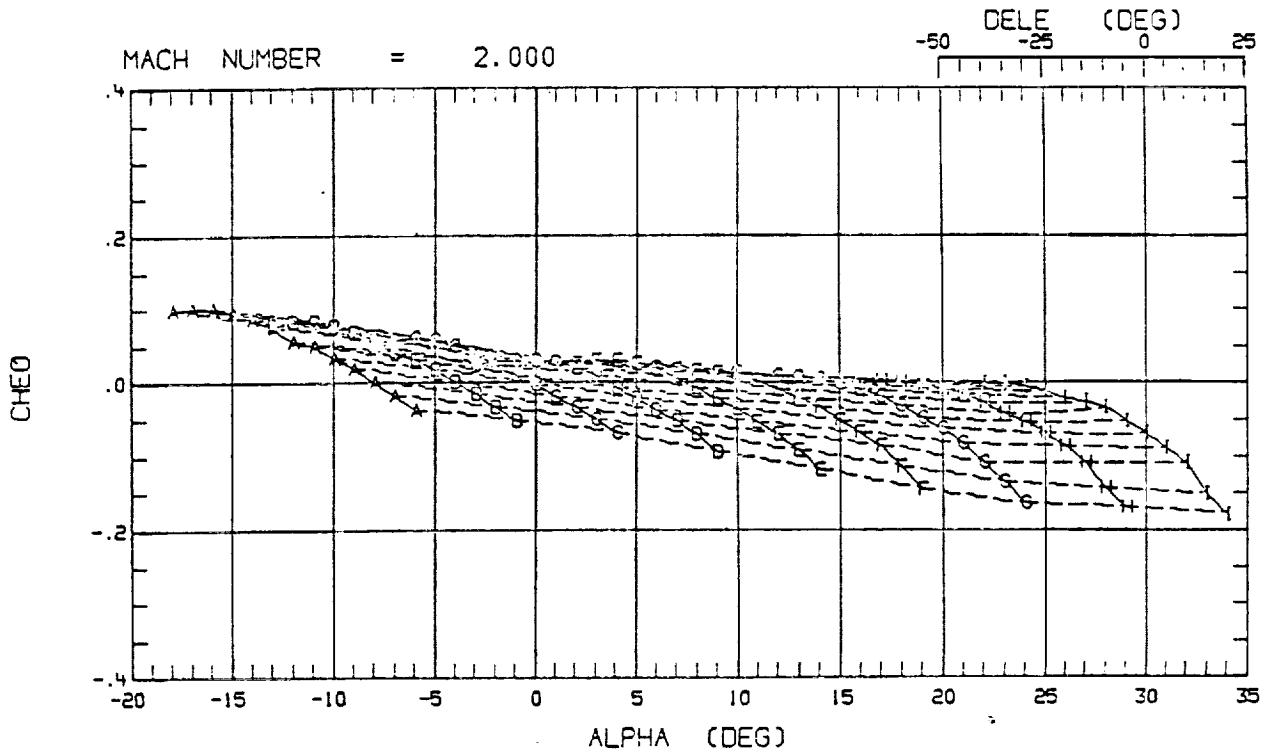
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.12420	0.09050	0.06250	0.03850	0.02150	0.01330	0.01010	0.00590
-35.000	0.10994	0.08246	0.05391	0.03634	0.02451	0.01285	0.00791	0.00219
-30.000	0.09920	0.07610	0.04800	0.03390	0.02480	0.01080	0.00390	-0.00340
-25.000	0.09311	0.07225	0.04610	0.03129	0.02270	0.00754	-0.00161	-0.01064
-20.000	0.08830	0.06840	0.04420	0.02820	0.01720	0.00190	-0.00960	-0.02020
-15.000	0.08440	0.06421	0.04132	0.02279	0.00572	-0.00983	-0.02315	-0.03342
-10.000	0.08050	0.05940	0.03680	0.01420	-0.00840	-0.02540	-0.03860	-0.04920
-5.000	0.06600	0.04500	0.02000	-0.00300	-0.02400	-0.04400	-0.06500	-0.06700
0.0	0.04130	0.01830	-0.00520	-0.02770	-0.04000	-0.06000	-0.07390	-0.08650
5.000	0.01400	-0.00500	-0.02800	-0.04900	-0.06000	-0.07900	-0.09300	-0.10600
10.000	-0.01000	-0.02700	-0.04900	-0.06700	-0.08200	-0.10200	-0.11500	-0.12700
15.000	-0.03067	-0.04767	-0.06900	-0.08567	-0.10233	-0.12367	-0.13667	-0.15233
20.000	-0.04800	-0.06700	-0.08800	-0.10500	-0.12100	-0.14400	-0.15800	-0.18200

ENGINEER MP
DATE 5/22/28

FIGURE 5.1-40
ELEVON HINGE MOMENT COEFFICIENT



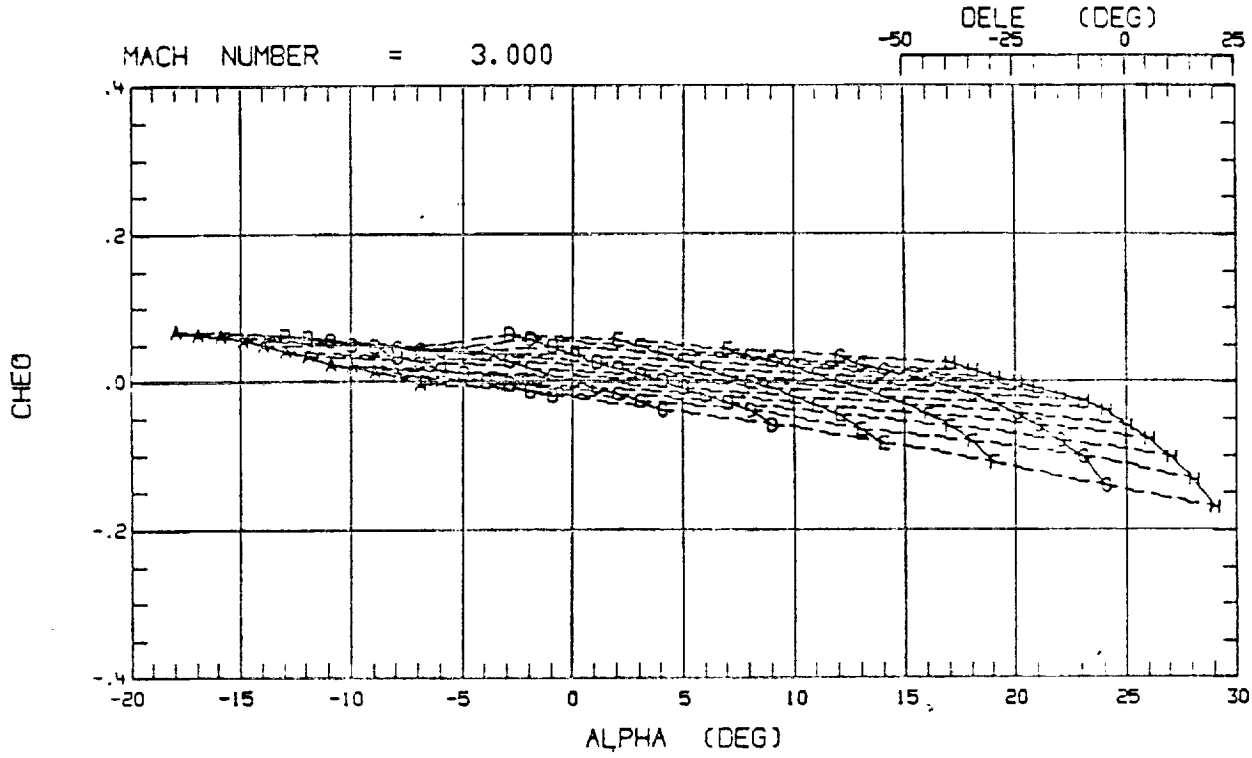
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT								
-40.000	0.09730	0.07750	0.05280	0.02200	0.02470	0.01600	0.00770	0.00300	-0.00110
-35.000	0.10050	0.08101	0.05761	0.02800	0.02796	0.01400	0.00705	0.00035	-0.00219
-30.000	0.09940	0.08060	0.05870	0.02900	0.02800	0.01200	0.00400	-0.00380	-0.00600
-25.000	0.09324	0.07586	0.05591	0.02900	0.02507	0.01194	-0.00140	-0.00916	-0.01280
-20.000	0.08430	0.06800	0.04970	0.02700	0.01840	0.0	-0.00930	-0.01660	-0.02180
-15.000	0.07328	0.05773	0.03700	0.01900	0.00489	-0.01000	-0.01981	-0.02959	-0.02700
-10.000	0.05400	0.03800	0.02200	0.00900	-0.00900	-0.02200	-0.03300	-0.04300	-0.03500
-5.000	0.04800	0.03000	0.00800	-0.00800	-0.02300	-0.03500	-0.04900	-0.05400	-0.05200
0.0	0.03250	0.01600	-0.00350	-0.02250	-0.03700	-0.05180	-0.06380	-0.07000	-0.07000
5.000	0.01900	-0.00100	-0.02000	-0.03800	-0.05400	-0.07000	-0.08400	-0.08700	-0.09000
10.000	0.0	-0.01700	-0.03500	-0.05350	-0.07200	-0.08700	-0.11000	-0.11000	-0 11000
15.000	-0.01900	-0.03433	-0.05167	-0.07200	-0.09400	-0.11600	-0.13600	-0.14433	-0 15133
20.000	-0.03800	-0.05300	-0.07000	-0.09600	-0.12000	-0.14700	-0.16500	-0.17000	-0.18000

ENGINEER KP
DATE 6/12/78

FIGURE 5.1-41
ELEVON HINGE MOMENT COEFFICIENT



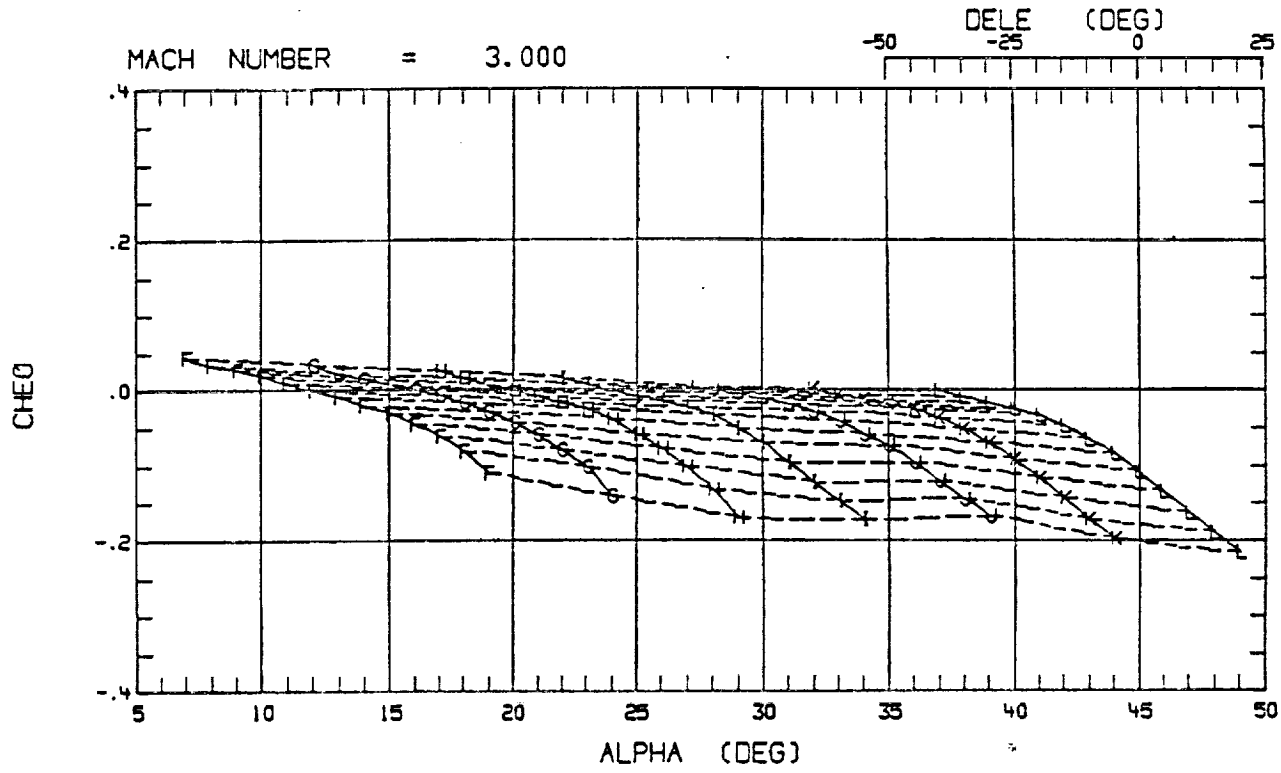
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 3690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.06630	0.06130	0.04500	0.06200	0.05500	0.04200	0.03350	0.02480
-35.000	0.06360	0.05899	0.04200	0.05600	0.04600	0.03300	0.02100	0.01430
-30.000	0.06000	0.05500	0.04100	0.04600	0.03700	0.02600	0.01400	0.00500
-25.000	0.05572	0.04936	0.03700	0.03500	0.02600	0.01800	0.00665	-0.00250
-20.000	0.04800	0.04700	0.03600	0.02400	0.01600	0.00800	0.0	-0.01000
-15.000	0.04005	0.03200	0.02700	0.01600	0.00600	-0.00200	-0.00695	-0.01807
-10.000	0.03500	0.02700	0.01700	0.00800	-0.00200	-0.01000	-0.01900	-0.02700
-5.000	0.02300	0.01500	0.00700	0.0	-0.01000	-0.02200	-0.03000	-0.04000
0.0	0.01950	0.01000	0.0	-0.01100	-0.02150	-0.03160	-0.04500	-0.06000
5.000	0.01200	-0.00200	-0.01000	-0.02000	-0.03400	-0.04600	-0.06100	-0.08000
10.000	0.00700	-0.00500	-0.01800	-0.03000	-0.04600	-0.06200	-0.08200	-0.10300
15.000	-0.00367	-0.01450	-0.02800	-0.04067	-0.06700	-0.08300	-0.10400	-0.13300
20.000	-0.00100	-0.02000	-0.04000	-0.06000	-0.08500	-0.11200	-0.14300	-0.17000

ENGINEER HP
DATE 10/23/78

FIGURE 5.1-42
ELEVON HINGE MOMENT COEFFICIENT



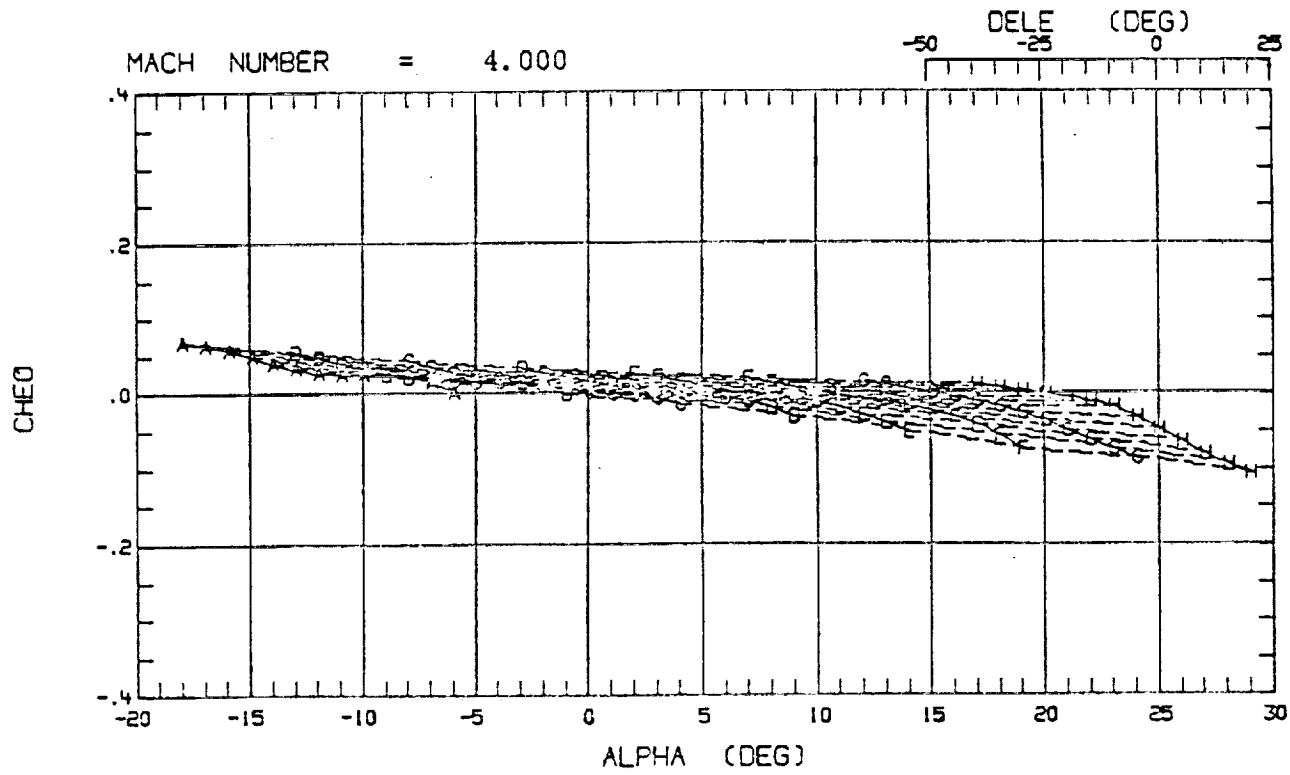
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT						
-40.000	0.04200	0.03350	0.02480	0.01520	0.00300	0.0	-0.00300
-35.000	0.03300	0.02100	0.01430	0.00545	-0.00162	-0.00717	-0.01019
-30.000	0.02600	0.01400	0.00500	-0.00300	-0.00700	-0.01400	-0.01800
-25.000	0.01800	0.00665	-0.00250	-0.00950	-0.01294	-0.02030	-0.02623
-20.000	0.00800	0.0	-0.01000	-0.01600	-0.02000	-0.02560	-0.03550
-15.000	-0.00200	-0.00885	-0.01807	-0.02435	-0.02948	-0.03798	-0.04915
-10.000	-0.01000	-0.01800	-0.02700	-0.03500	-0.04200	-0.05300	-0.06600
-5.000	-0.02200	-0.03000	-0.04000	-0.05200	-0.06000	-0.07200	-0.08600
0.0	-0.03160	-0.04500	-0.06000	-0.07200	-0.07590	-0.09270	-0.11060
5.000	-0.04600	-0.06100	-0.08000	-0.09700	-0.09750	-0.11750	-0.13700
10.000	-0.06200	-0.08200	-0.10300	-0.12300	-0.12200	-0.14500	-0.16400
15.000	-0.08300	-0.10400	-0.13300	-0.14833	-0.14550	-0.17250	-0.19100
20.000	-0.11200	-0.14300	-0.17000	-0.17300	-0.16800	-0.20000	-0.21800

ENGINEER HP
DATE 10/27/73

FIGURE 5.1-43
ELEVON HINGE MOMENT COEFFICIENT



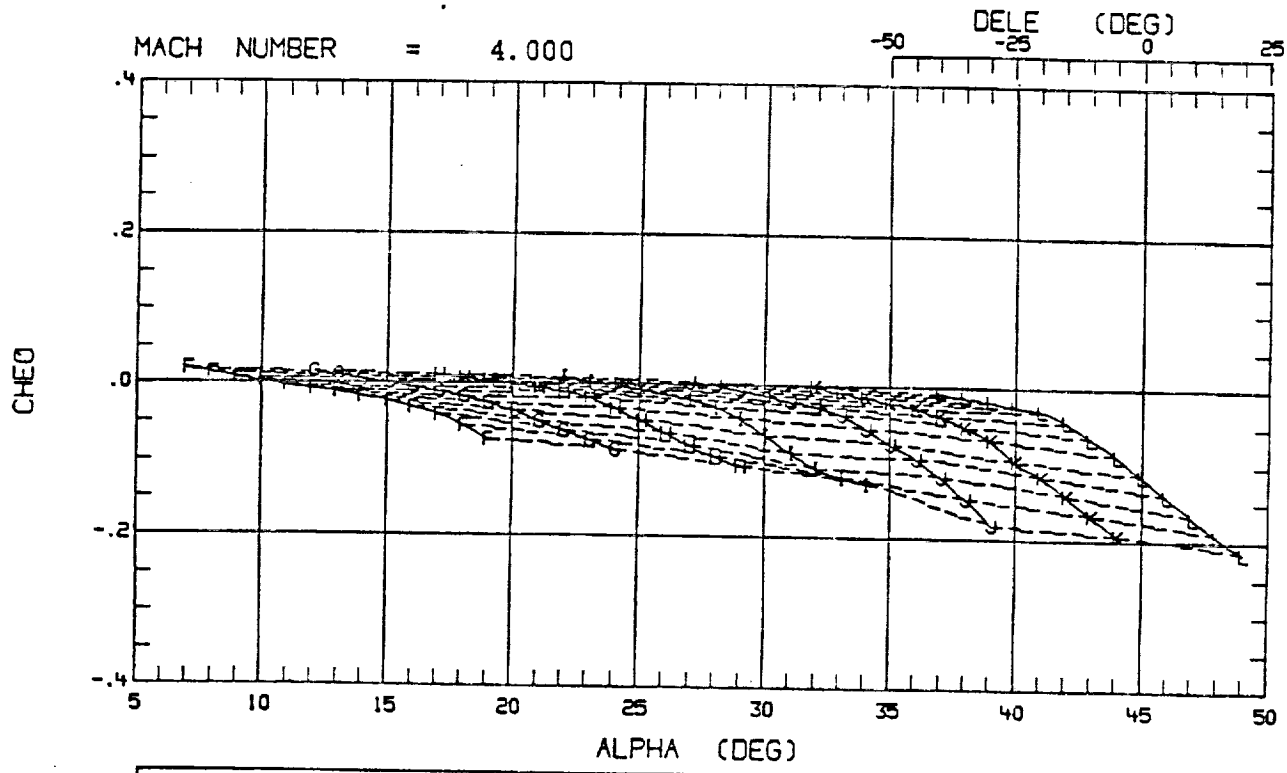
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.06700	0.05300	0.04200	0.03200	0.02500	0.01800	0.01400	0.01100
-35.000	0.06299	0.04596	0.03362	0.02575	0.02042	0.01256	0.00969	0.00709
-30.000	0.05700	0.03900	0.02700	0.02000	0.01500	0.00700	0.00500	0.00300
-25.000	0.04805	0.03208	0.02300	0.01470	0.00830	0.00125	-0.00004	-0.00120
-20.000	0.03910	0.02530	0.01900	0.01000	0.00160	-0.00450	-0.00550	-0.00570
-15.000	0.03164	0.02131	0.01464	0.00650	-0.00070	-0.00825	-0.01136	-0.01142
-10.000	0.02600	0.01800	0.01000	0.00300	-0.00300	-0.01200	-0.01800	-0.01900
-5.000	0.02500	0.01500	0.00500	-0.00050	-0.00700	-0.01800	-0.02700	-0.03300
0.0	0.02350	0.01400	0.0	-0.00400	-0.01290	-0.02450	-0.03700	-0.04850
5.000	0.02500	0.01400	-0.00200	-0.00750	-0.02000	-0.03200	-0.05000	-0.06500
10.000	0.02200	0.01200	-0.00400	-0.01200	-0.03000	-0.04200	-0.06200	-0.08100
15.000	0.01367	0.00663	-0.00877	-0.02027	-0.04060	-0.05640	-0.07463	-0.09547
20.000	0.0	-0.00210	-0.01630	-0.03230	-0.05180	-0.07520	-0.08790	-0.10840

ENGINEER [signature]
DATE 10/31/75

FIGURE 5.1-44
ELEVCN HINGE MCMENT COEFFICIENT

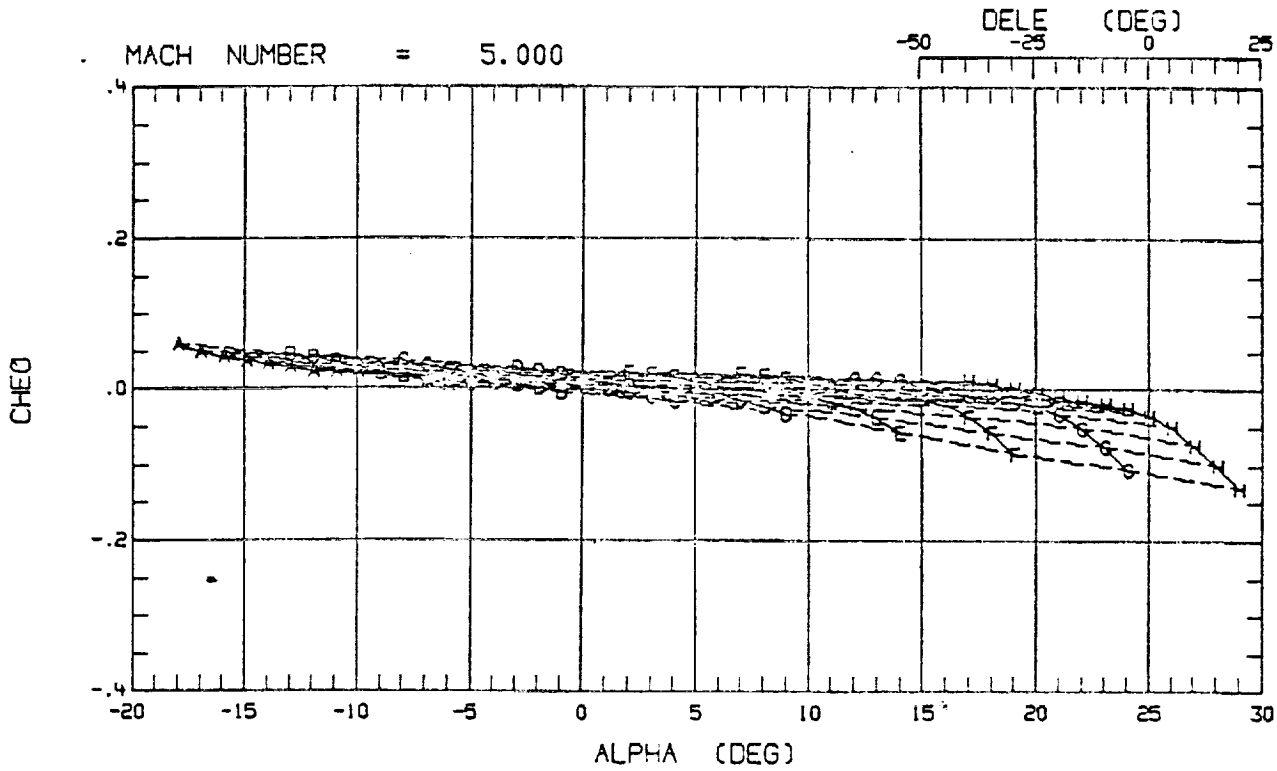


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT						
-40.000	0.01800	0.01400	0.01100	0.00750	0.00300	-0.00300	-0.00900
-35.000	0.01256	0.00969	0.00709	0.00296	-0.00220	-0.00875	-0.01391
-30.000	0.00700	0.00500	0.00300	-0.00200	-0.00800	-0.01500	-0.01900
-25.000	0.00125	-0.00004	-0.00120	-0.00727	-0.01436	-0.02159	-0.02418
-20.000	-0.00450	-0.00550	-0.00570	-0.01320	-0.02140	-0.02900	-0.02970
-15.000	-0.00825	-0.01136	-0.01142	-0.02054	-0.02899	-0.03902	-0.04543
-10.000	-0.01200	-0.01800	-0.01900	-0.03000	-0.03800	-0.05200	-0.06600
-5.000	-0.01800	-0.02700	-0.03300	-0.04500	-0.05600	-0.07000	-0.09000
0.0	-0.02450	-0.03700	-0.04850	-0.06660	-0.07680	-0.09760	-0.11610
5.000	-0.03200	-0.05000	-0.06500	-0.09000	-0.09500	-0.11800	-0.14300
10.000	-0.04200	-0.06200	-0.08100	-0.10900	-0.12000	-0.14300	-0.17000
15.000	-0.05640	-0.07463	-0.09547	-0.12200	-0.14903	-0.16897	-0.19467
20.000	-0.07520	-0.08790	-0.10840	-0.12900	-0.18210	-0.19590	-0.21700

ENGINEER AP
DATE 6/21/73

FIGURE 5.1-45
ELEVON HINGE MOMENT COEFFICIENT



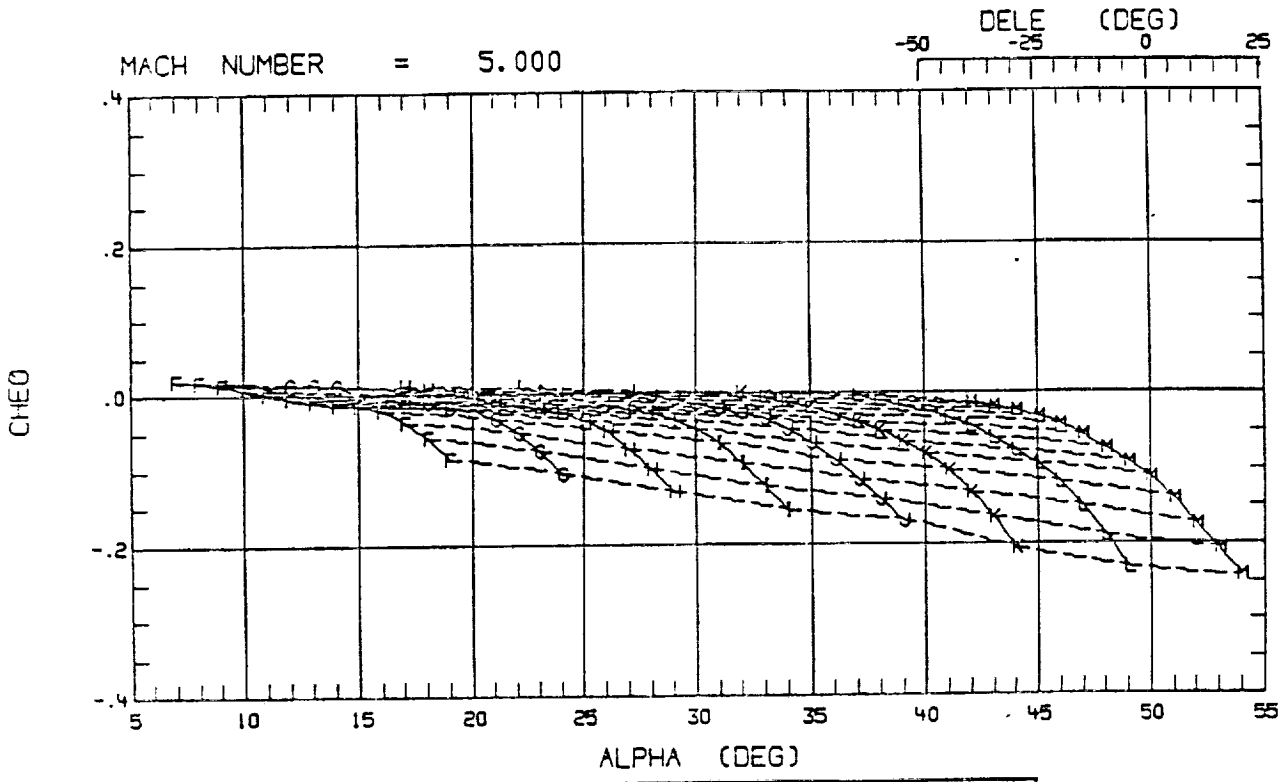
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.05800	0.04400	0.03600	0.02600	0.02100	0.01800	0.01160	0.01000
-35.000	0.04921	0.04026	0.03062	0.02250	0.01882	0.01650	0.01260	0.00511
-30.000	0.04200	0.03500	0.02500	0.01800	0.01500	0.01300	0.01000	0.0
-25.000	0.03706	0.02745	0.01900	0.01200	0.00870	0.00650	0.00200	-0.00545
-20.000	0.03230	0.01990	0.01300	0.00600	0.00240	0.0	-0.00600	-0.01090
-15.000	0.02755	0.01645	0.00879	0.00229	-0.00080	-0.00588	-0.00950	-0.01595
-10.000	0.02300	0.01300	0.00600	0.0	-0.00400	-0.01100	-0.01300	-0.02100
-5.000	0.02200	0.00800	0.00500	-0.00100	-0.00900	-0.01400	-0.01800	-0.02700
0.0	0.02200	0.00590	0.0	-0.00660	-0.01200	-0.01540	-0.02290	-0.03640
5.000	0.02000	0.00600	-0.00300	-0.00900	-0.01600	-0.02200	-0.03400	-0.05100
10.000	0.01600	0.00400	-0.00700	-0.01600	-0.02600	-0.03800	-0.05300	-0.07500
15.000	0.01050	0.00007	-0.01220	-0.02433	-0.03963	-0.05953	-0.07767	-0.10193
20.000	0.00350	-0.00580	-0.01860	-0.03400	-0.05660	-0.08660	-0.10800	-0.13180

ENGINEER AP
DATE 10/2/78

FIGURE 5.1-46
ELEVON HINGE MOMENT COEFFICIENT



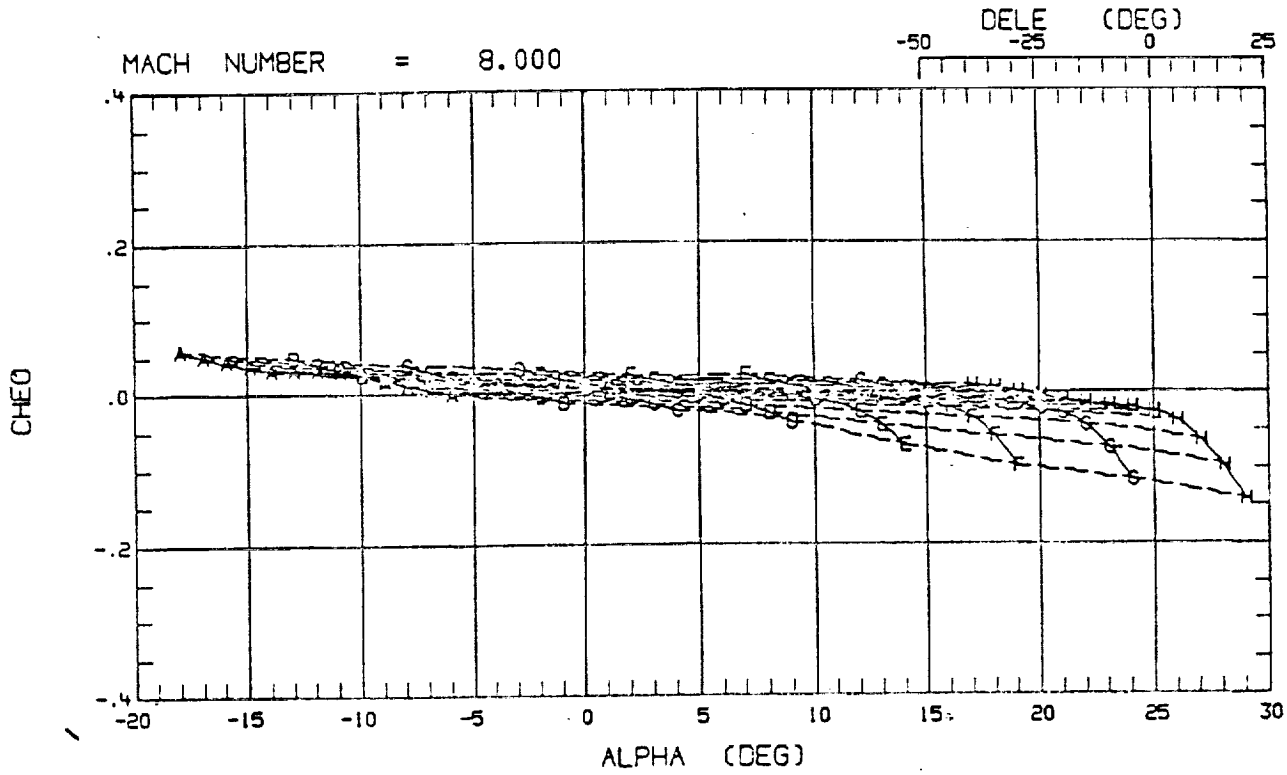
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.01800	0.01160	0.01000	0.00800	0.00200	-0.00100	-0.00500	-0.01410
-35.000	0.01650	0.01260	0.00511	0.00283	-0.00340	-0.00647	-0.01116	-0.01876
-30.000	0.01300	0.01000	0.0	-0.00300	-0.00900	-0.01300	-0.01800	-0.02500
-25.000	0.00650	0.00200	-0.00545	-0.00980	-0.01475	-0.02055	-0.02531	-0.03248
-20.000	0.0	-0.00600	-0.01090	-0.01660	-0.02080	-0.02920	-0.03370	-0.04220
-15.000	-0.00588	-0.00950	-0.01595	-0.02180	-0.02737	-0.03876	-0.04539	-0.05776
-10.000	-0.01100	-0.01300	-0.02100	-0.02700	-0.03500	-0.05000	-0.06000	-0.07500
-5.000	-0.01400	-0.01800	-0.02700	-0.03600	-0.04900	-0.06500	-0.07800	-0.09300
0.0	-0.01540	-0.02290	-0.03640	-0.04900	-0.06750	-0.08160	-0.09650	-0.11340
5.000	-0.02200	-0.03400	-0.05100	-0.06600	-0.09000	-0.10400	-0.12000	-0.14300
10.000	-0.03800	-0.05300	-0.07500	-0.09400	-0.11500	-0.13300	-0.15300	-0.17600
15.000	-0.05963	-0.07767	-0.10193	-0.12433	-0.14207	-0.16740	-0.19083	-0.20977
20.000	-0.08660	-0.10800	-0.13180	-0.15700	-0.17120	-0.20720	-0.23350	-0.24430

ENGINEER AP
DATE 6/27/73

FIGURE 5.1-47
ELEVON HINGE MOMENT COEFFICIENT



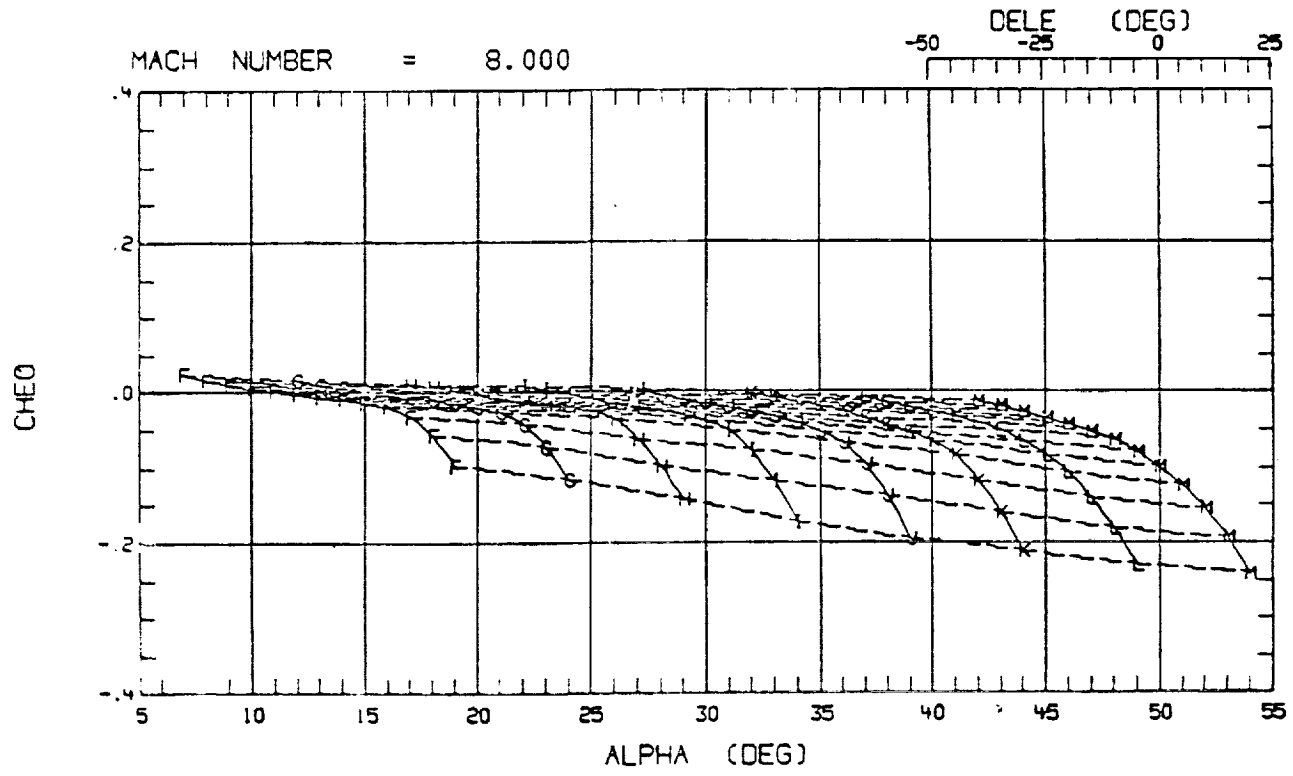
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.05600	0.04600	0.03750	0.03100	0.02200	0.02200	0.01400	0.00910
-35.000	0.04859	0.03900	0.02781	0.02394	0.01617	0.01512	0.00899	0.00545
-30.000	0.04200	0.03200	0.02000	0.01700	0.01100	0.00900	0.00400	0.00100
-25.000	0.03604	0.02500	0.01393	0.01013	0.00638	0.00362	-0.00097	-0.00465
-20.000	0.03130	0.01800	0.01000	0.00350	0.00260	-0.00100	-0.00590	-0.01030
-15.000	0.03065	0.01750	0.01000	0.00325	0.00080	-0.00473	-0.00895	-0.01450
-10.000	0.03000	0.01700	0.01000	0.00300	-0.00100	-0.00800	-0.01200	-0.01800
-5.000	0.02800	0.01600	0.00700	0.00100	-0.00500	-0.01100	-0.01700	-0.02100
0.0	0.02400	0.01200	0.00390	-0.00320	-0.01040	-0.01560	-0.02250	-0.02670
5.000	0.01700	0.00700	-0.00200	-0.01000	-0.01600	-0.02100	-0.02900	-0.03800
10.000	0.01090	0.0	-0.00950	-0.01780	-0.02610	-0.03370	-0.04450	-0.06400
15.000	0.00453	-0.00693	-0.01677	-0.02777	-0.04470	-0.05967	-0.07423	-0.09960
20.000	-0.00210	-0.01380	-0.02380	-0.03990	-0.07180	-0.09890	-0.11820	-0.14480

ENGINEER JP
DATE 10/27/71

FIGURE 5.1-48
ELEVON HINGE MOMENT COEFFICIENT



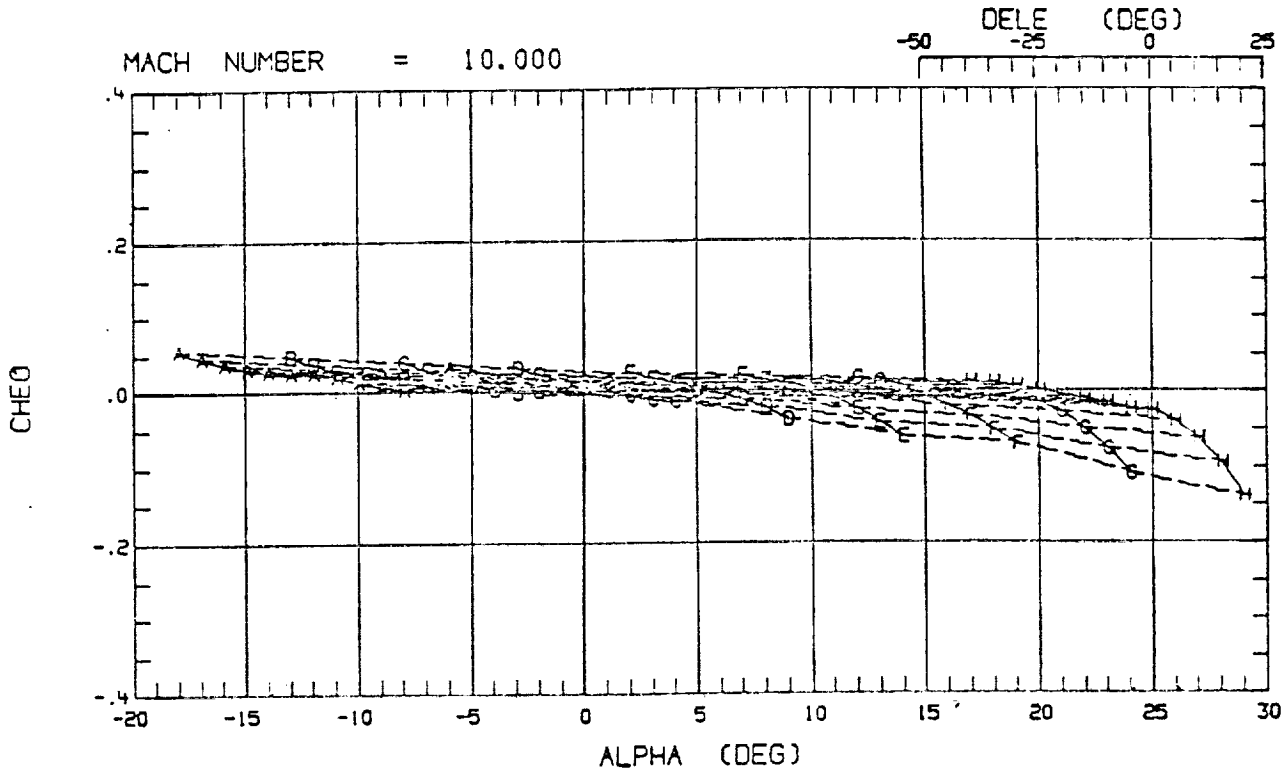
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.02200	0.01400	0.00910	0.00700	0.00300	-0.00500	-0.00900	-0.01400
-35.000	0.01512	0.00899	0.00545	0.00174	-0.00511	-0.00900	-0.01563	-0.02062
-30.000	0.00900	0.00400	0.00100	-0.00400	-0.01200	-0.01400	-0.02200	-0.02800
-25.000	0.00362	-0.00097	-0.00465	-0.01045	-0.01705	-0.01990	-0.02800	-0.03620
-20.000	-0.00100	-0.00590	-0.01030	-0.01690	-0.02210	-0.02700	-0.03400	-0.04500
-15.000	-0.00473	-0.00895	-0.01450	-0.02145	-0.02813	-0.03650	-0.04191	-0.05405
-10.000	-0.00800	-0.01200	-0.01800	-0.02600	-0.03500	-0.04600	-0.05200	-0.06400
-5.000	-0.01100	-0.01700	-0.02100	-0.03200	-0.04300	-0.05500	-0.06700	-0.08100
0.0	-0.01560	-0.02250	-0.02670	-0.03990	-0.05440	-0.06700	-0.08500	-0.10200
5.000	-0.02100	-0.02900	-0.03800	-0.05200	-0.07000	-0.08600	-0.10800	-0.12500
10.000	-0.03370	-0.04450	-0.05400	-0.07980	-0.09790	-0.11980	-0.14250	-0.15660
15.000	-0.05967	-0.07423	-0.09960	-0.12050	-0.14030	-0.16253	-0.18343	-0.19593
20.000	-0.09890	-0.11820	-0.14480	-0.17410	-0.19720	-0.21420	-0.23080	-0.24300

ENGINEER AP
DATE 10/3/72

FIGURE 5.1-49
ELEVON HINGE MOMENT COEFFICIENT



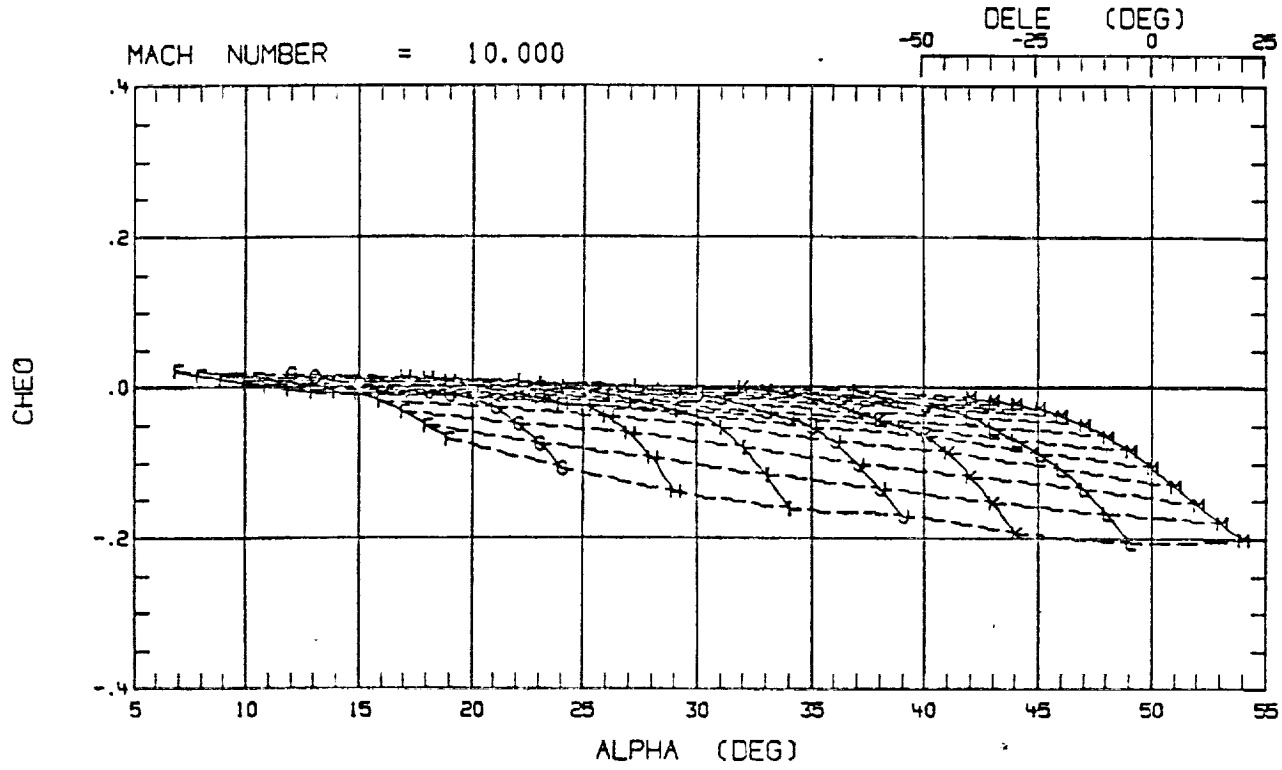
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.05510	0.04690	0.03870	0.03050	0.02350	0.01980	0.01530	0.01140
-35.000	0.04445	0.03680	0.02915	0.02150	0.01706	0.01417	0.01129	0.00942
-30.000	0.03600	0.02900	0.02200	0.01500	0.01100	0.00900	0.00700	0.00600
-25.000	0.03070	0.02455	0.01840	0.01225	0.00517	0.00434	0.00230	0.00040
-20.000	0.02570	0.02030	0.01490	0.00950	0.0	0.0	-0.00240	-0.00520
-15.000	0.02470	0.01805	0.01140	0.00475	0.0	-0.00422	-0.00586	-0.01060
-10.000	0.02400	0.01600	0.00800	0.0	0.0	-0.00800	-0.00900	-0.01600
-5.000	0.02100	0.01400	0.00700	0.0	-0.00100	-0.00900	-0.01200	-0.02400
0.0	0.01200	0.00800	0.00400	0.0	-0.00620	-0.01110	-0.01620	-0.02640
5.000	0.00700	0.00300	-0.00100	-0.00500	-0.01000	-0.02000	-0.02900	-0.04100
10.000	0.00300	-0.00200	-0.00700	-0.01200	-0.02500	-0.03500	-0.05000	-0.06300
15.000	0.01110	-0.00027	-0.01163	-0.02300	-0.04193	-0.05187	-0.07660	-0.09637
20.000	0.03130	0.00820	-0.01490	-0.03800	-0.06080	-0.07060	-0.10980	-0.14110

ENGINEER EP
DATE 10/31/78

FIGURE 5.1-50
ELEVON HINGE MOMENT COEFFICIENT



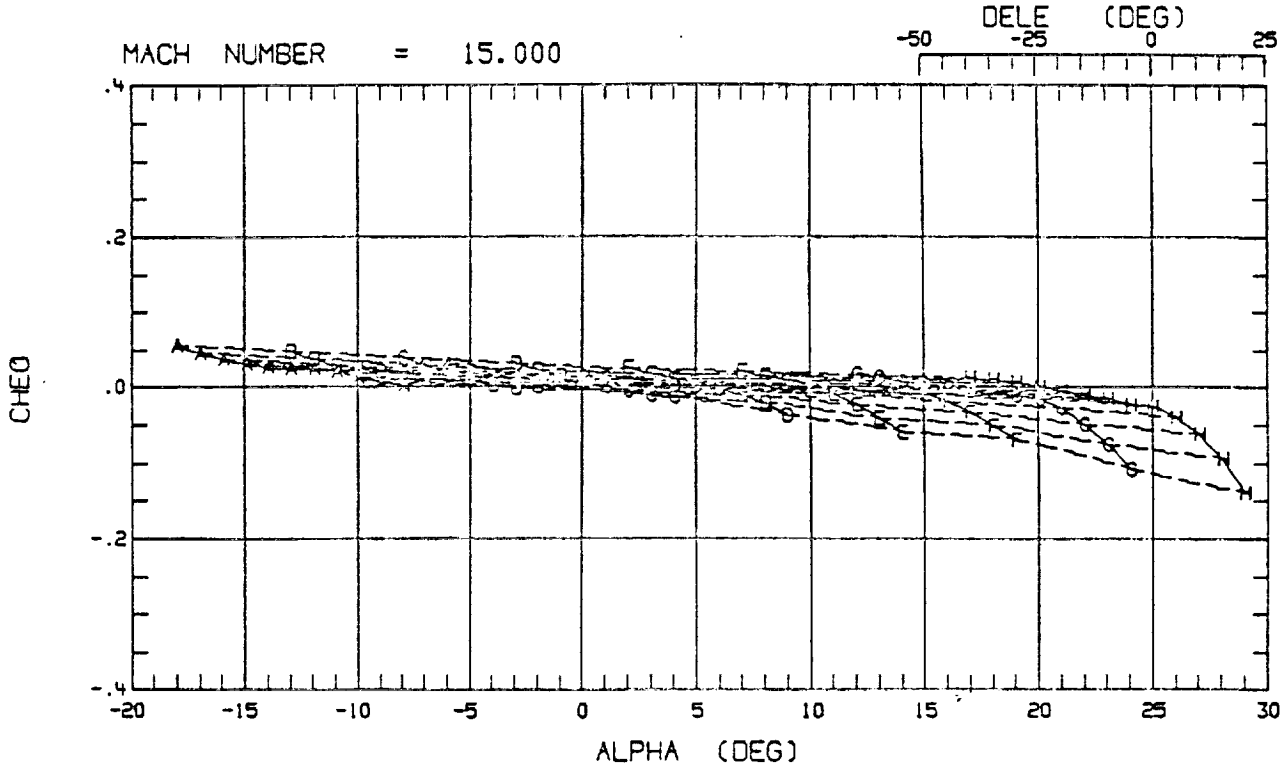
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.01980	0.01530	0.01140	0.00650	0.0	-0.00220	-0.00580	-0.01500
-35.000	0.01417	0.01129	0.00942	0.00237	-0.00407	-0.00541	-0.01345	-0.01814
-30.000	0.00900	0.00700	0.00600	-0.00200	-0.00800	-0.01000	-0.02000	-0.02300
-25.000	0.00434	0.00230	0.00040	-0.00655	-0.01170	-0.01586	-0.02490	-0.02932
-20.000	0.0	-0.00240	-0.00520	-0.01150	-0.01540	-0.02330	-0.02980	-0.03790
-15.000	-0.00422	-0.00586	-0.01060	-0.01780	-0.02470	-0.03365	-0.04019	-0.05030
-10.000	-0.00800	-0.00900	-0.01600	-0.02500	-0.03400	-0.04400	-0.05400	-0.06600
-5.000	-0.00900	-0.01200	-0.02400	-0.03300	-0.04200	-0.05300	-0.07100	-0.08500
0.0	-0.01110	-0.01620	-0.02640	-0.03960	-0.05400	-0.06520	-0.08840	-0.10720
5.000	-0.02000	-0.02900	-0.04100	-0.05400	-0.07400	-0.08700	-0.11000	-0.13250
10.000	-0.03500	-0.05000	-0.06300	-0.08200	-0.10300	-0.11900	-0.13700	-0.15700
15.000	-0.05187	-0.07660	-0.09637	-0.11820	-0.13567	-0.15497	-0.16923	-0.18063
20.000	-0.07060	-0.10880	-0.14110	-0.16260	-0.17200	-0.19490	-0.20670	-0.20340

ENGINEER AP
DATE 10/3/75

FIGURE 5.1-51
ELEVON HINGE MOMENT COEFFICIENT



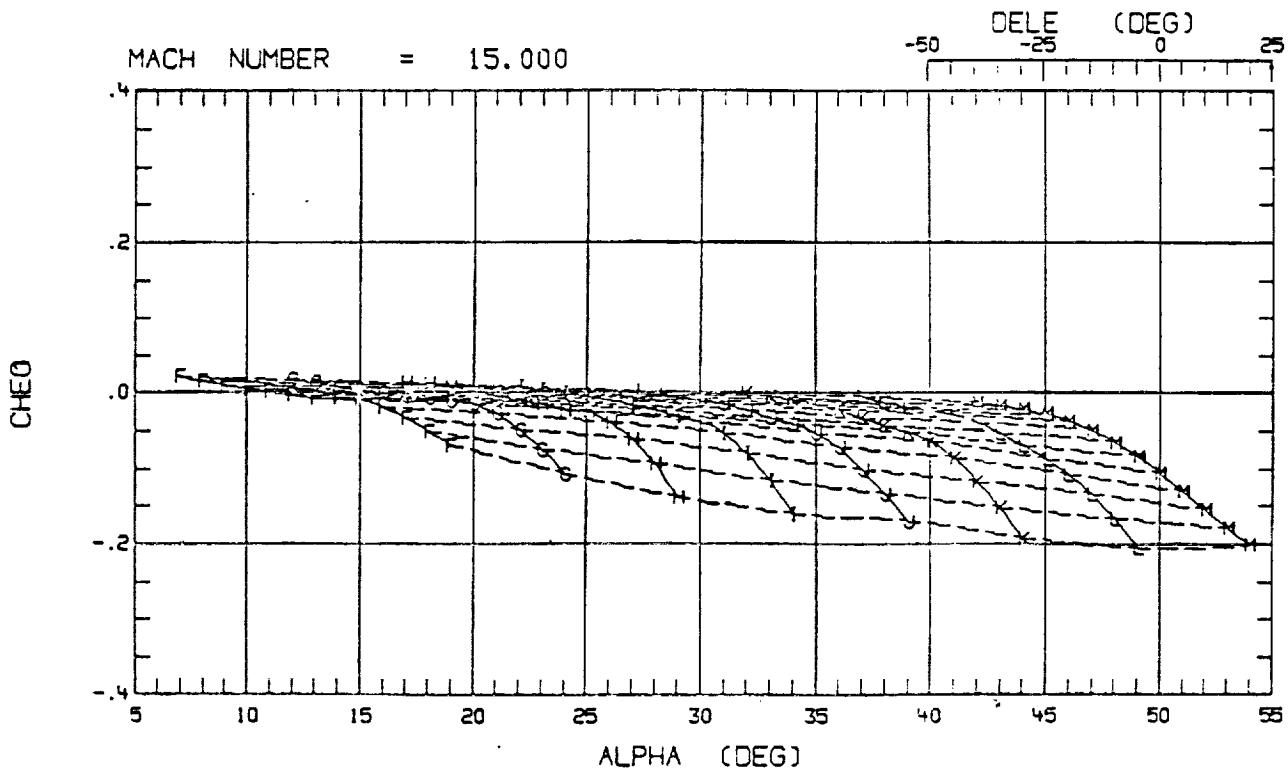
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.05510	0.04690	0.03870	0.03050	0.02350	0.01960	0.01530	0.01140
-35.000	0.04445	0.03680	0.02915	0.02150	0.01706	0.01417	0.01129	0.00942
-30.000	0.03600	0.02900	0.02200	0.01500	0.01100	0.00900	0.00700	0.00600
-25.000	0.03070	0.02455	0.01840	0.01225	0.00517	0.00434	0.00230	0.00040
-20.000	0.02570	0.02030	0.01490	0.00950	0.0	0.0	-0.00240	-0.00520
-15.000	0.02470	0.01805	0.01140	0.00475	0.0	-0.00422	-0.00586	-0.01060
-10.000	0.02400	0.01600	0.00800	0.0	0.0	-0.00800	-0.00900	-0.01600
-5.000	0.02100	0.01400	0.00700	0.0	-0.00100	-0.00900	-0.01200	-0.02400
0.0	0.01200	0.00800	0.00400	0.0	-0.00620	-0.01110	-0.01620	-0.02640
5.000	0.00700	0.00300	-0.00100	-0.00500	-0.01000	-0.02000	-0.02900	-0.04100
10.000	0.00300	-0.00200	-0.00700	-0.01200	-0.02500	-0.03500	-0.05000	-0.06300
15.000	0.01110	-0.00027	-0.01163	-0.02300	-0.04193	-0.05187	-0.07660	-0.09637
20.000	0.03130	0.00820	-0.01490	-0.03800	-0.06080	-0.07060	-0.10880	-0.14110

ENGINEER HD
DATE 10/27/78

FIGURE 5.1-52
ELEVON HINGE MOMENT COEFFICIENT



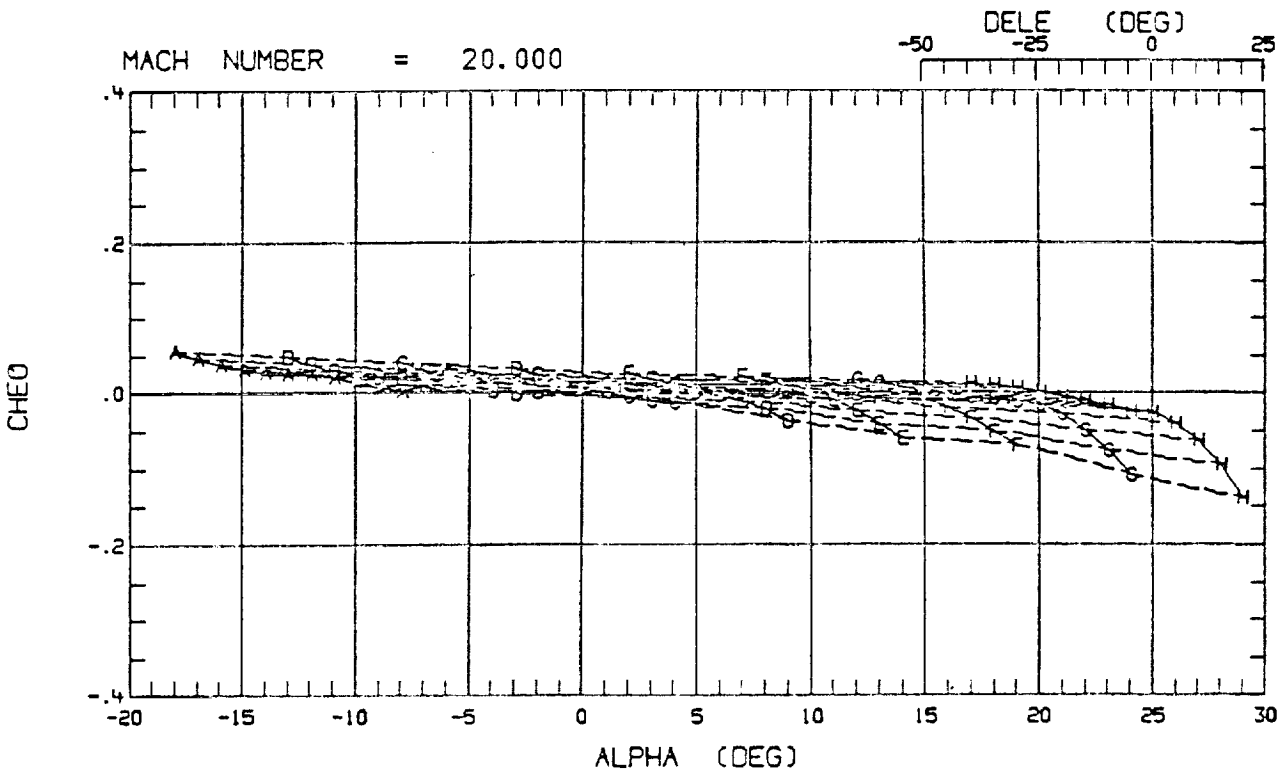
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.01980	0.01530	0.01140	0.00650	0.0	-0.00220	-0.00580	-0.01500
-35.000	0.01417	0.01129	0.00942	0.00237	-0.00407	-0.00541	-0.01345	-0.01814
-30.000	0.00900	0.00700	0.00600	-0.00200	-0.00800	-0.01000	-0.02000	-0.02300
-25.000	0.00434	0.00230	0.00040	-0.00655	-0.01170	-0.01595	-0.02490	-0.02932
-20.000	0.0	-0.00240	-0.00520	-0.01150	-0.01540	-0.02330	-0.02980	-0.03790
-15.000	-0.00422	-0.00586	-0.01060	-0.01780	-0.02470	-0.03385	-0.04019	-0.05030
-10.000	-0.00800	-0.00900	-0.01600	-0.02500	-0.03400	-0.04400	-0.05400	-0.06600
-5.000	-0.00900	-0.01200	-0.02400	-0.03300	-0.04200	-0.05300	-0.07100	-0.08500
0.0	-0.01110	-0.01620	-0.02640	-0.03960	-0.05400	-0.06520	-0.08840	-0.10720
5.000	-0.02000	-0.02900	-0.04100	-0.05400	-0.07400	-0.08700	-0.11000	-0.13250
10.000	-0.03500	-0.05000	-0.06300	-0.08200	-0.10300	-0.11900	-0.13700	-0.15700
15.000	-0.05187	-0.07660	-0.09637	-0.11820	-0.13567	-0.15497	-0.16923	-0.18063
20.000	-0.07060	-0.10880	-0.14110	-0.16260	-0.17200	-0.18490	-0.20670	-0.20340

ENGINEER HP
DATE 10/3/78

FIGURE 5.1-53
ELEVON HINGE MOMENT COEFFICIENT



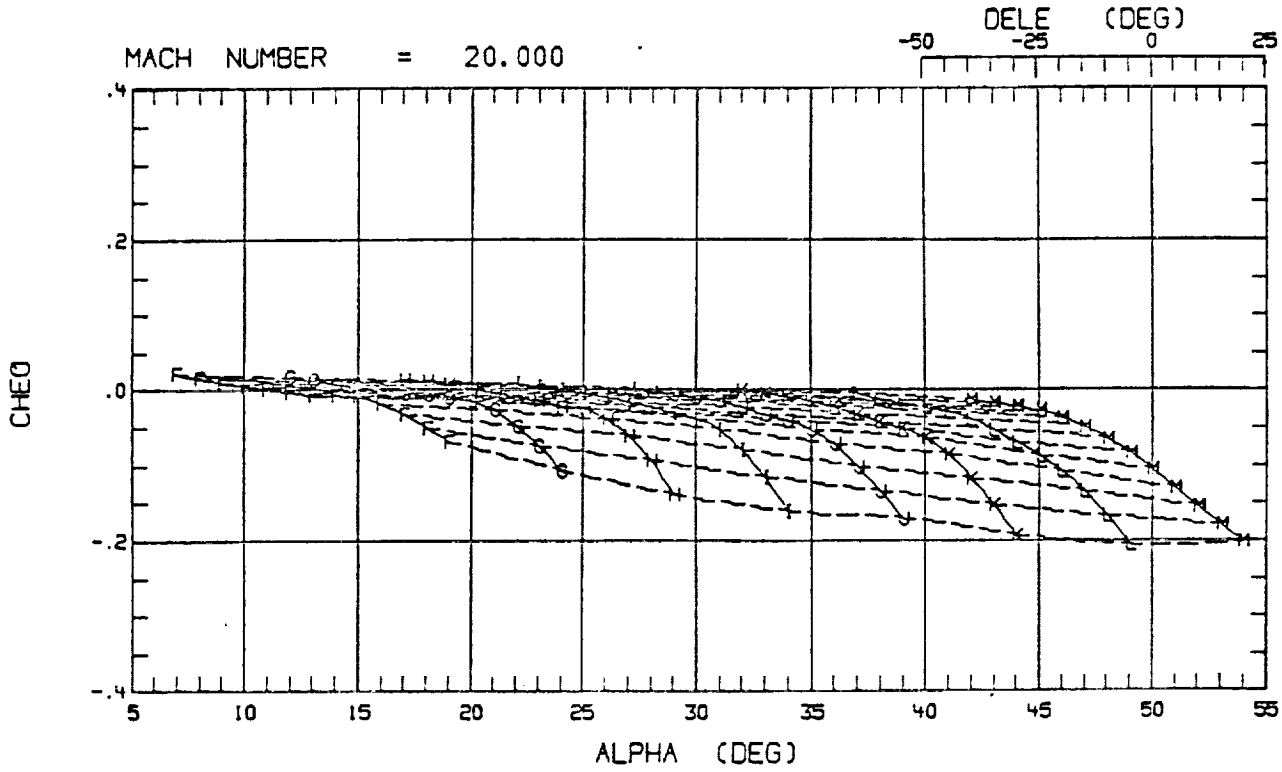
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.05510	0.04690	0.03870	0.03050	0.02350	0.01960	0.01530	0.01140
-35.000	0.04445	0.03680	0.02915	0.02150	0.01706	0.01417	0.01129	0.00942
-30.000	0.03600	0.02900	0.02200	0.01500	0.01100	0.00900	0.00700	0.00600
-25.000	0.03070	0.02455	0.01940	0.01225	0.00517	0.00434	0.00230	0.00040
-20.000	0.02570	0.02030	0.01490	0.00950	0.0	0.0	-0.00240	-0.00520
-15.000	0.02470	0.01805	0.01140	0.00475	0.0	-0.00422	-0.00586	-0.01060
-10.000	0.02400	0.01600	0.00800	0.0	0.0	-0.00800	-0.00900	-0.01600
-5.000	0.02100	0.01400	0.00700	0.0	-0.00100	-0.00900	-0.01200	-0.02400
0.0	0.01200	0.00800	0.00400	0.0	-0.00620	-0.01110	-0.01620	-0.02640
5.000	0.00700	0.00300	-0.00100	-0.00500	-0.01000	-0.02000	-0.02900	-0.04100
10.000	0.00300	-0.00200	-0.00700	-0.01200	-0.02500	-0.03500	-0.05000	-0.06300
15.000	0.01110	-0.00027	-0.01163	-0.02300	-0.04193	-0.05187	-0.07660	-0.09637
20.000	0.03130	0.00820	-0.01490	-0.03800	-0.06080	-0.07060	-0.10980	-0.14110

ENGINEER HP
DATE 10/27/72

FIGURE 5.1-54
ELEVON HINGE MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.
ELEVON AREA	SE = 210.0 SQ.FT.	ELEVON CHORD	CE = 90.7 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	OUTBOARD ELEVON HINGE MOMENT							
-40.000	0.01980	0.01530	0.01140	0.00650	0.0	-0.00220	-0.00580	-0.01500
-35.000	0.01417	0.01129	0.00942	0.00237	-0.00407	-0.00541	-0.01345	-0.01814
-30.000	0.00900	0.00700	0.00600	-0.00200	-0.00800	-0.01000	-0.02000	-0.02300
-25.000	0.00434	0.00230	0.00040	-0.00655	-0.01170	-0.01586	-0.02490	-0.02932
-20.000	0.0	-0.00240	-0.00520	-0.01150	-0.01540	-0.02330	-0.02980	-0.03790
-15.000	-0.00422	-0.00586	-0.01060	-0.01780	-0.02470	-0.03365	-0.04019	-0.05030
-10.000	-0.00800	-0.00900	-0.01600	-0.02500	-0.03400	-0.04400	-0.05400	-0.06600
-5.000	-0.00900	-0.01200	-0.02400	-0.03300	-0.04200	-0.05300	-0.07100	-0.08500
0.0	-0.01110	-0.01620	-0.02640	-0.03960	-0.05400	-0.06520	-0.08840	-0.10720
5.000	-0.02000	-0.02900	-0.04100	-0.05400	-0.07400	-0.08700	-0.11000	-0.13250
10.000	-0.03500	-0.05000	-0.06300	-0.08200	-0.10300	-0.11900	-0.13700	-0.15700
15.000	-0.05187	-0.07660	-0.09637	-0.11820	-0.13567	-0.15497	-0.16923	-0.18063
20.000	-0.07060	-0.10980	-0.14110	-0.16260	-0.17200	-0.19490	-0.20670	-0.20340

ENGINEER HP
DATE 10/3/78

FIGURE 5.1-55
ELEVON HINGE MOMENT COEFFICIENT

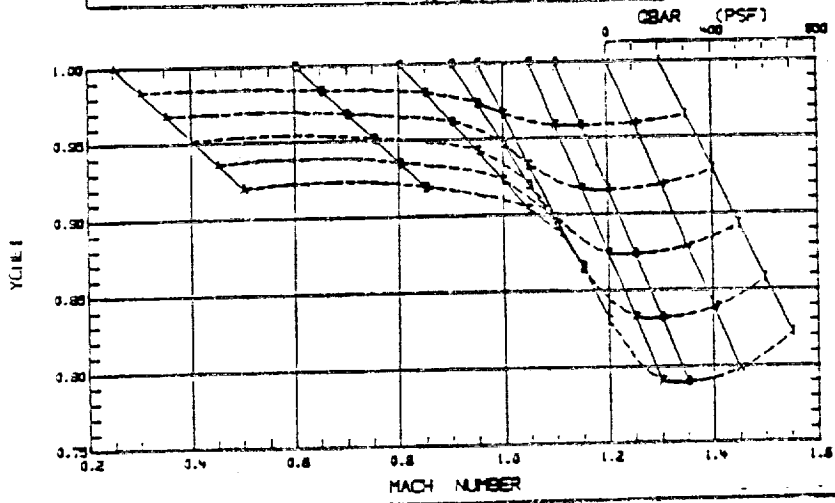
CONFIGURATION

BASELINE ORBITER VEHICLE

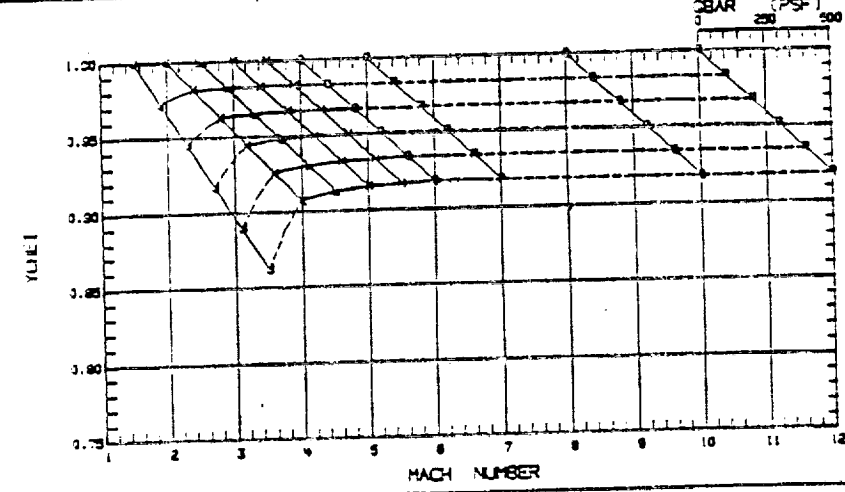
CENTER OF GRAVITY XB = FS 1078.7 IN.
OR YB = BL 0.0 IN.
MOMENT REFERENCE ZB = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.280 FT.
BODY LENGTH LB = 1290.3 IN.



QBAR (PSF)	0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	F/R INBD ELEVON HINGE MOMENT								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98400	0.98373	0.98067	0.97323	0.96800	0.95800	0.25787	0.95857	0.98433
200.000	0.95800	0.95747	0.95133	0.94647	0.23200	0.91600	0.91533	0.91533	0.92567
300.000	0.93200	0.93120	0.92200	0.91970	0.89800	0.87400	0.87280	0.87800	0.89300
400.000	0.93800	0.93493	0.92267	0.92283	0.89400	0.83200	0.83187	0.83867	0.85733
500.000	0.92000	0.91867	0.90333	0.88817	0.83000	0.79000	0.78933	0.79933	0.82167



QBAR (PSF)	1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
	F/R INBD ELEVON HINGE MOMENT								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97233	0.98133	0.98280	0.98310	0.98340	0.98283	0.98287	0.98287	0.98287
200.000	0.94467	0.95267	0.95520	0.95520	0.95680	0.95787	0.95733	0.95733	0.95733
300.000	0.91700	0.94400	0.94760	0.94830	0.95020	0.95080	0.95100	0.95100	0.95100
400.000	0.88933	0.92533	0.93040	0.93240	0.93360	0.93453	0.93467	0.93467	0.93467
500.000	0.86167	0.90667	0.91320	0.91650	0.91700	0.91817	0.91833	0.91833	0.91833

ENGINEER [signature]
DATE 11-2-79

FIGURE 5.1-56
FLEXIBLE/RIGID INBOARD ELEVON HINGE MOMENT

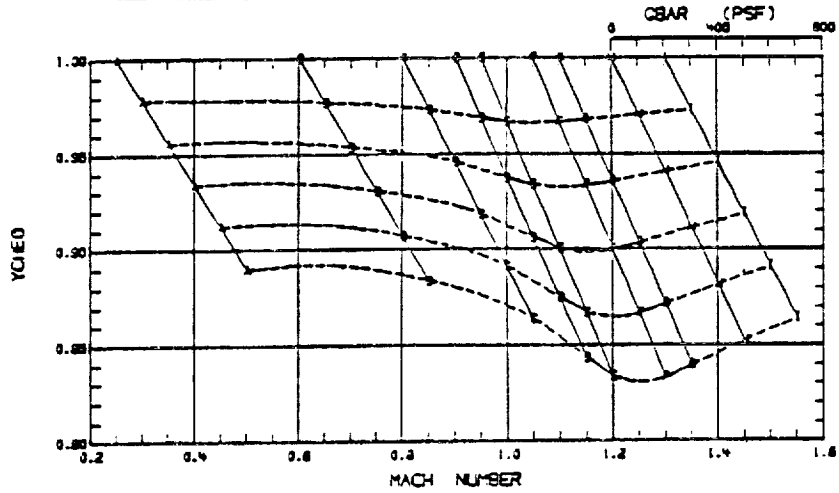
CONFIGURATION

BASELINE ORBITER VEHICLE

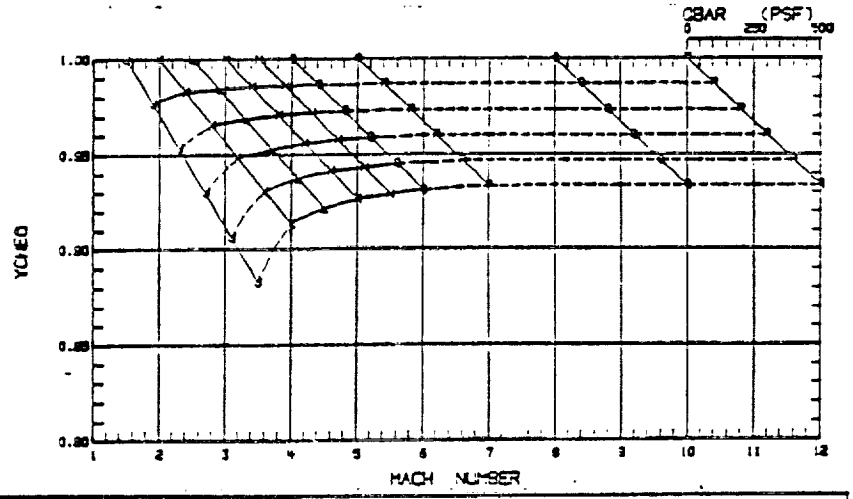
CENTER OF GRAVITY XB = FS 1078.7 IN.
OR YB = BL 0.0 IN.
MOMENT REFERENCE ZB = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2888.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CM = 39.580 FT.
BODY LENGTH LB = (280.3 IN.



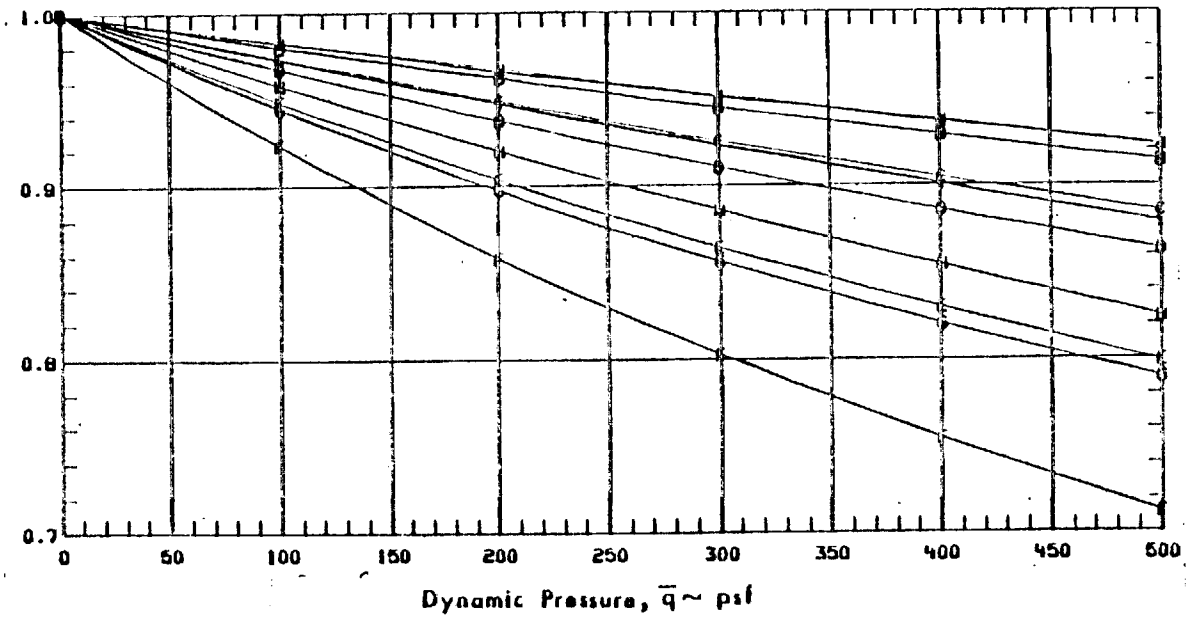
QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	F/R OUTBD ELEVON HINGE MOMENT								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97800	0.97587	0.97287	0.96860	0.96887	0.96883	0.98780	0.97047	0.97877
200.000	0.95600	0.95333	0.94533	0.93720	0.93333	0.93327	0.93580	0.94093	0.94953
300.000	0.93400	0.93000	0.91800	0.90580	0.90000	0.89980	0.90370	0.91140	0.91830
400.000	0.91200	0.90587	0.89087	0.87440	0.86887	0.86853	0.87160	0.88187	0.88107
500.000	0.89000	0.88333	0.86333	0.84300	0.83333	0.83317	0.83750	0.85233	0.85083



QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	8.000 Q	10.000 R
	F/R OUTBD ELEVON HINGE MOMENT								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97887	0.98287	0.98430	0.98527	0.98583	0.98623	0.98683	0.98687	0.98687
200.000	0.95313	0.96533	0.96880	0.97053	0.97167	0.97247	0.97327	0.97333	0.97333
300.000	0.92970	0.94800	0.95290	0.95580	0.95750	0.95870	0.95990	0.96000	0.95000
400.000	0.90687	0.93087	0.93720	0.94107	0.94333	0.94493	0.94653	0.94687	0.94687
500.000	0.88293	0.91133	0.92150	0.92533	0.92917	0.93117	0.93317	0.93333	0.93333

ENGINEER
DATE 4-3-72

FIGURE 5.1-57
FLEXIBLE/RIGID OUTBOARD ELEVON HINGE MOMENT



$$\eta_{IM_{e_{1\alpha}}} = \frac{C^{F}_{he_{1_{\substack{\alpha=\alpha \\ \delta_e=\delta_e}}}} - C^{F}_{he_{1_{\substack{\alpha=0 \\ \delta_e=\delta_e}}}}}{C^{R}_{he_{1_{\substack{\alpha=\alpha \\ \delta_e=\delta_e}}}} - C^{R}_{he_{1_{\substack{\alpha=0 \\ \delta_e=\delta_e}}}}}$$

INBOARD ELEVON

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{IM_{e_{INBOARD}}}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98245	0.98019	0.97372	0.96749	0.94846	0.92321	0.94467	0.95807	0.97271	0.98341
200.000	0.96609	0.96174	0.94879	0.93748	0.90327	0.85779	0.89666	0.91993	0.94702	0.96741
300.000	0.95082	0.94461	0.92542	0.91006	0.86386	0.80230	0.85545	0.88529	0.92288	0.95198
400.000	0.93648	0.92872	0.90424	0.88547	0.82917	0.75409	0.81999	0.85360	0.90016	0.93713
500.000	0.92292	0.91370	0.88464	0.86289	0.79836	0.71174	0.78916	0.82438	0.87858	0.92264

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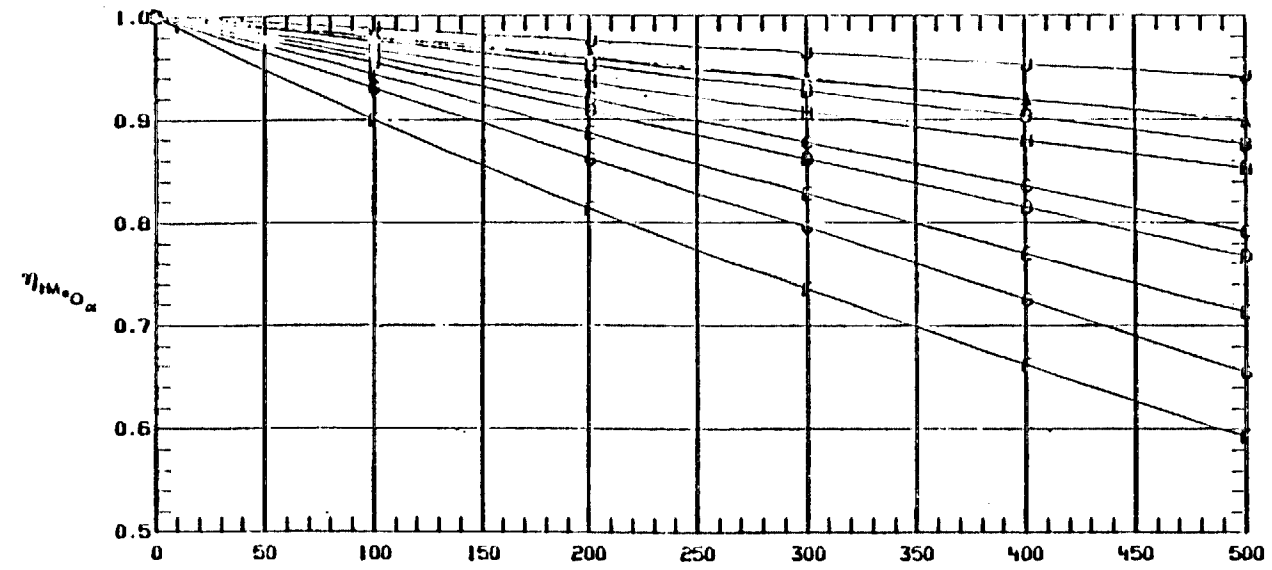
DATE: 9/7/11
REVISED:

Figure 5.1-58
AEROELASTIC RATIOS

Rockwell International
Space Division



$$\eta_{IM \cdot O_\alpha} = \frac{C^{f}_{he_{O_{\alpha=\alpha}}} - C^{f}_{he_{O_{\alpha=0}}}}{C^{R}_{he_{O_{\alpha=\alpha}}} - C^{R}_{he_{O_{\alpha=0}}}}$$

OUTBOARD ELEVON

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{IM \cdot O_\alpha}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98015	0.97556	0.96000	0.95400	0.94300	0.89097	0.92941	0.96656	0.97810	0.98764
200.000	0.95992	0.95111	0.91900	0.90700	0.88500	0.81210	0.86126	0.93521	0.95730	0.97558
300.000	0.93931	0.92660	0.87700	0.86100	0.82700	0.73478	0.79399	0.90587	0.93745	0.96380
400.000	0.91837	0.90119	0.83500	0.81400	0.76900	0.66146	0.72470	0.87833	0.91828	0.95225
500.000	0.89732	0.87522	0.79000	0.76700	0.71200	0.59174	0.65426	0.85222	0.89972	0.94078

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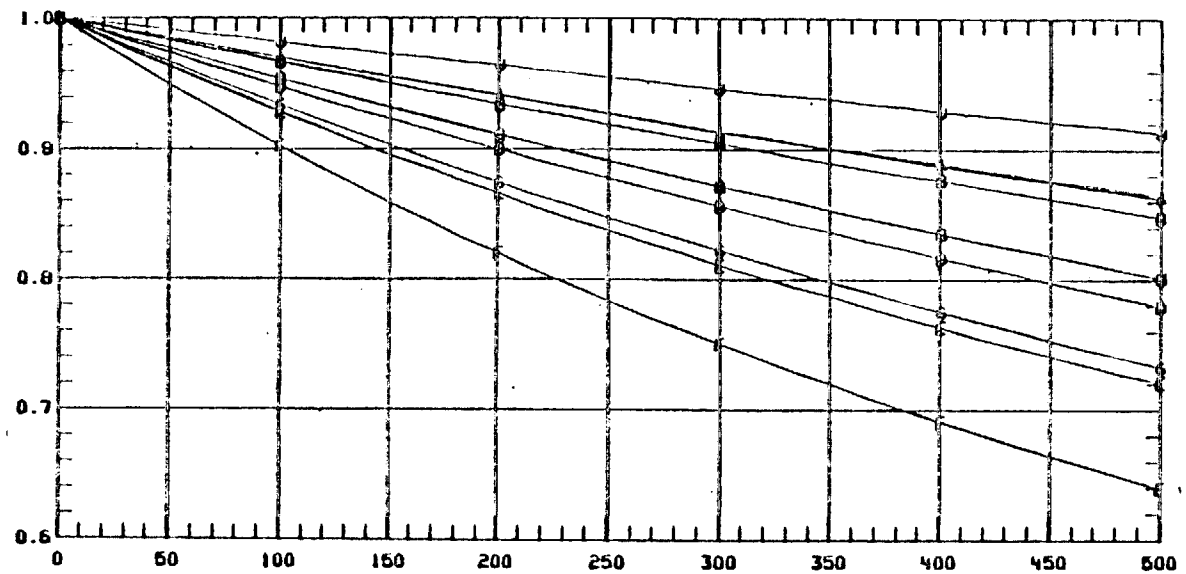
DATE: 9/8/77
REVISED: 4-5-78

Figure 5.1-59
AEROELASTIC RATIOS

Rockwell International
Space Division



$$\eta_{HM_e} = \frac{C^F_{he_{I_{\alpha=\alpha}}} - C^F_{he_{I_{\alpha=\alpha}}}}{C^R_{he_{I_{\alpha=\alpha}}} - C^R_{he_{I_{\alpha=\alpha}}}}$$

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 6.000
	Flexible-to-Rigid Ratio, $\eta_{HM_{e_{INBOARD}}}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.96965	0.96580	0.95335	0.94671	0.92743	0.90151	0.93283	0.95309	0.96913	0.98124
200.000	0.94088	0.93365	0.91047	0.89867	0.86463	0.81880	0.87353	0.91021	0.94001	0.96316
300.000	0.91374	0.90347	0.87113	0.85544	0.81047	0.74981	0.82131	0.87106	0.91259	0.94574
400.000	0.88836	0.87509	0.83485	0.81613	0.76284	0.69083	0.77469	0.83497	0.88674	0.92894
500.000	0.86428	0.84804	0.80112	0.77993	0.72049	0.63986	0.73244	0.80132	0.86214	0.91248

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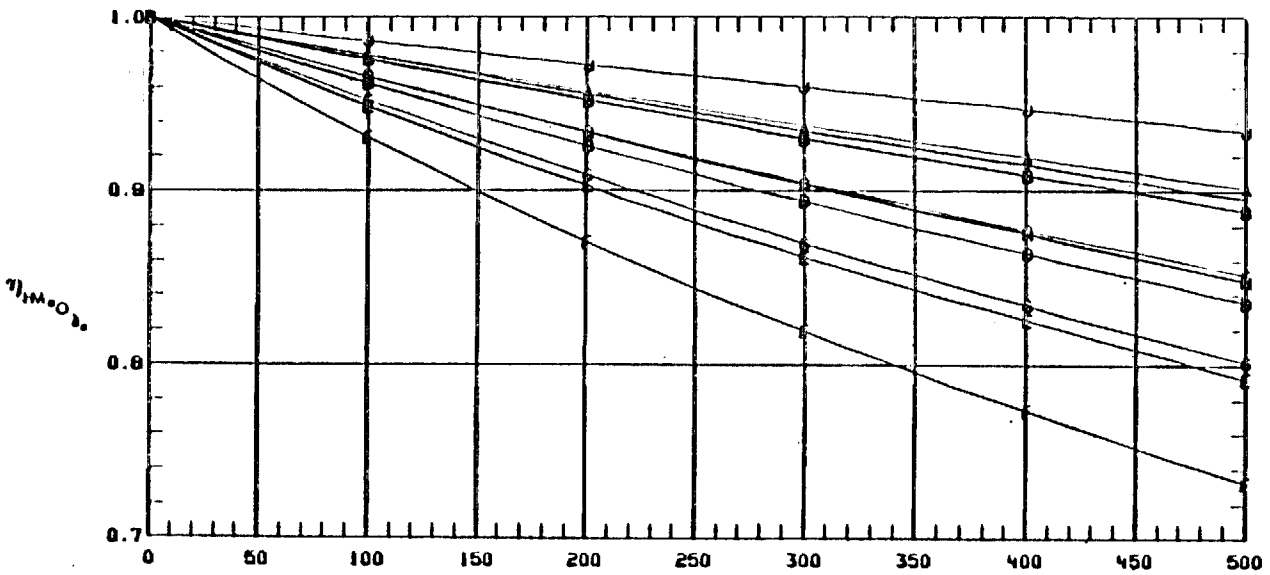
DATE: 9/7/71
REVISED:

Figure 5.1-60
AEROELASTIC RATIOS

Rockwell International
Space Division



$$\eta_{IM_{e}O_{\delta_e}} = \frac{Ch^{f}_{e_{O_{\alpha=\alpha}}} - Ch^{f}_{e_{O_{\alpha=\alpha}}}}{Ch^{R}_{e_{O_{\alpha=\alpha}}} - Ch^{R}_{e_{O_{\alpha=\alpha}}}}$$

OUTBOARD ELEVON

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{IM_{e}O_{\delta_e}}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97802	0.97525	0.96563	0.96106	0.94798	0.93033	0.95201	0.96524	0.97725	0.98575
200.000	0.95714	0.95194	0.93380	0.92551	0.90199	0.87019	0.90854	0.93289	0.95530	0.97224
300.000	0.93740	0.92990	0.90438	0.89313	0.86139	0.81839	0.86927	0.90279	0.93423	0.95925
400.000	0.91887	0.90883	0.87715	0.86346	0.82497	0.77280	0.83355	0.87467	0.91427	0.94651
500.000	0.90130	0.88870	0.85156	0.83586	0.79181	0.73206	0.80080	0.84808	0.89518	0.93400

ENGINEER: DTD
DATE: 9/8/77
REVISED:

Figure 5.1-61
AEROELASTIC RATIOS

Rockwell International
Space Division

5.2 BODY FLAP CONTROL HINGE MOMENT COEFFICIENT. The body flap control hinge moment coefficients are based on a theoretical reference area of 135.0 ft^2 and a mean chord length of 81.0 inches. The body flap hinge moment is:

$$HM_{BF} = C_{h_{BF}} (\bar{q}\, S_{BF}\, \bar{c}_{BF})$$

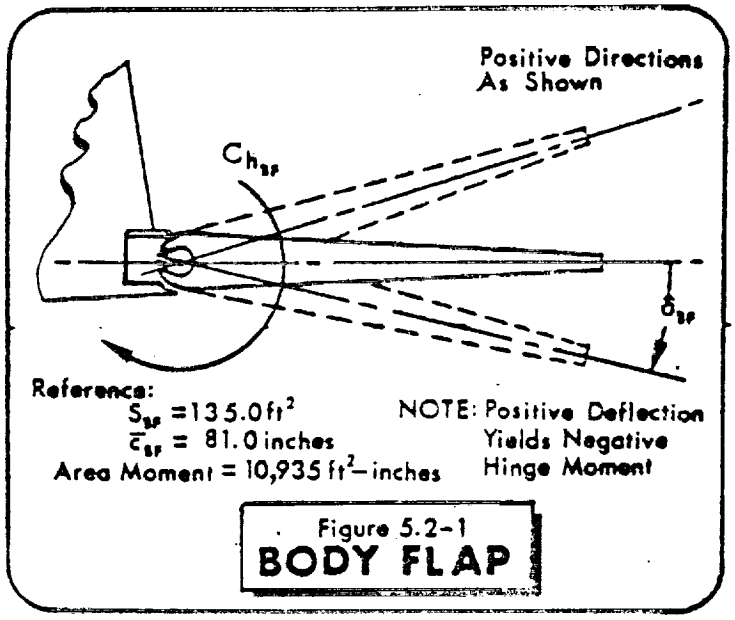


Figure 5.2-1
BODY FLAP

The effect of aeroelastic deformation on the body flap hinge moment coefficient is determined from:

$$C^F_{h_{BF}} = C^R_{h_{BF_{\substack{\alpha=0 \\ \delta_{BF}=\delta_{BF}}}}} + C^R_{h_{BF_{\substack{\alpha=\alpha \\ \delta_{BF}=0}}}} - C^R_{h_{BF_{\substack{\alpha=\alpha \\ \delta_{BF}=\delta_{BF}}}}} + \Delta C^F_{h_{BF_{\substack{\alpha=0 \\ \delta_{BF}=0}}}} + \eta_{HM_{BF_\alpha}} \left(C^R_{h_{BF_{\substack{\alpha=\alpha \\ \delta_{BF}=\delta_{BF}}}}} - C^R_{h_{BF_{\substack{\alpha=0 \\ \delta_{BF}=\delta_{BF}}}}}\right)$$

$$+ \eta_{HM_{BF_\delta}} \left(C^R_{h_{BF_{\substack{\alpha=\alpha \\ \delta_{BF}=\delta_{BF}}}}} - C^R_{h_{BF_{\substack{\alpha=\alpha \\ \delta_{BF}=0}}}}\right)$$

where,

$C^R_{h_{BF_{\substack{\alpha=0 \\ \delta_{BF}=\delta_{BF}}}}}$ = Rigid body flap hinge moment coefficient for $\alpha = 0$ and a given body flap deflection (Figures 5.2-2 through 5.2-28)

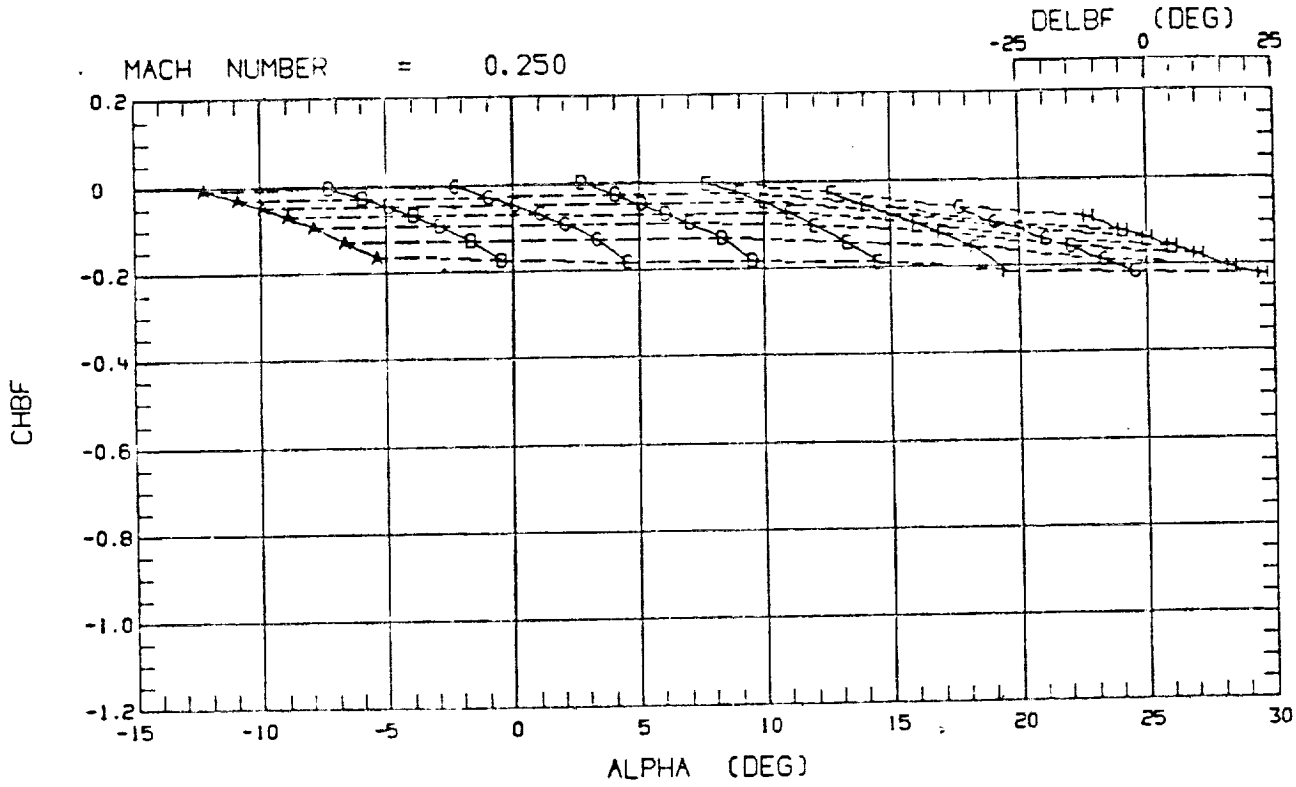
$C^R_{h_{BF_{\substack{\alpha=\alpha \\ \delta_{BF}=0}}}}$ = Rigid body flap hinge moment coefficient for $\delta_{BF} = 0$ and a given angle of attack (Figures 5.2-2 through 5.2-28)

$C^R_{h_{BF_{\substack{\alpha=\alpha \\ \delta_{BF}=\delta_{BF}}}}}$ = Rigid body flap hinge moment coefficient for a given angle of attack and given body flap deflection (Figures 5.2-2 through 5.2-28)

$\Delta C^{F}_{h_{BF}}{}_{\substack{\alpha=0 \\ \delta_{BF}=0}}$ = Body flap hinge moment coefficient offset at $\alpha = 0$, $\delta_{BF} = 0$ due to flexibility (Assume zero)

$\eta_{HM_{BF_{\alpha}}}$ = Flexible to Rigid body flap hinge moment ratio due to angle of attack (Figure 5.2-29)

$\eta_{HM_{BF_{\delta_{BF}}}}$ = Flexible to Rigid body flap hinge moment ratio due to body flap deflection (Figure 5.2-30)



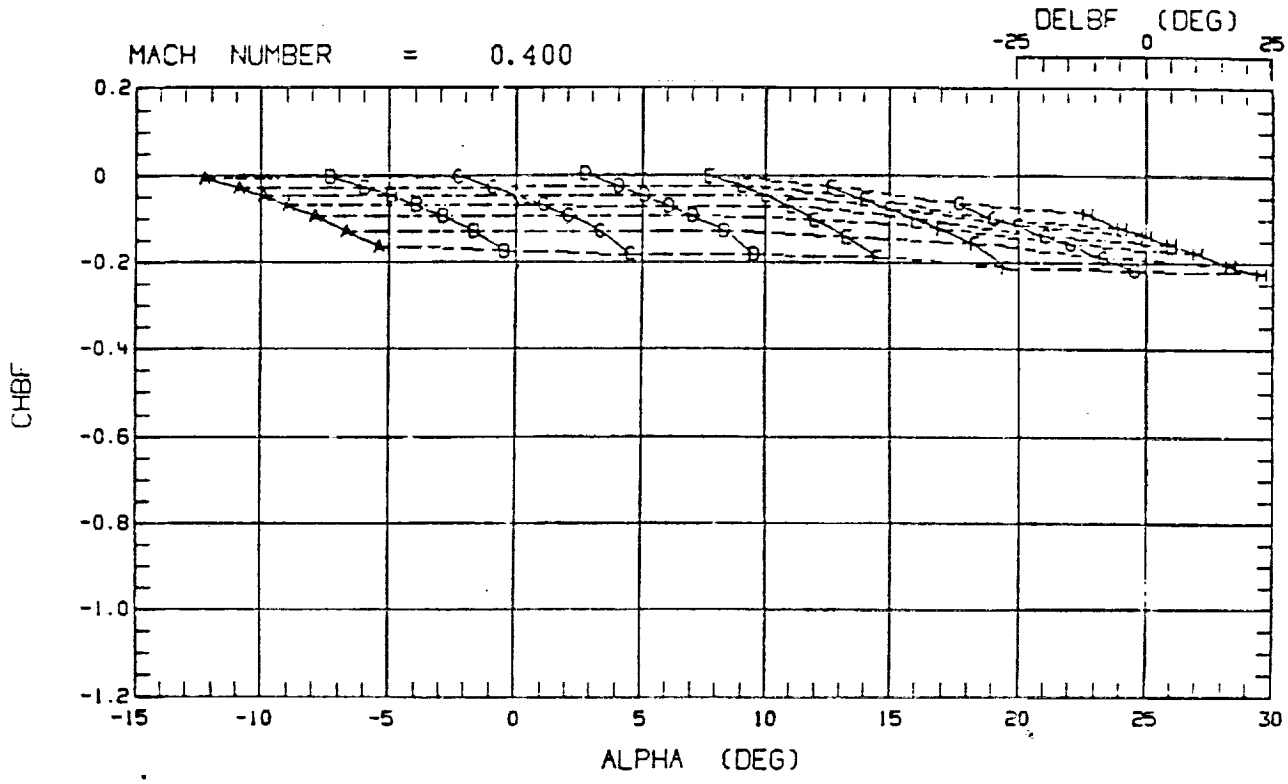
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00900	-0.00700	-0.00500	0.0	-0.00500	-0.03000	-0.06800	-0.09000
-5.000	-0.03080	-0.03015	-0.02950	-0.02797	-0.02940	-0.05787	-0.10057	-0.12200
0.0	-0.05000	-0.05000	-0.05000	-0.05000	-0.05000	-0.08000	-0.11800	-0.14000
5.000	-0.07132	-0.07152	-0.07172	-0.07279	-0.07528	-0.10279	-0.14145	-0.16000
10.000	-0.09509	-0.09478	-0.09447	-0.09601	-0.10411	-0.12601	-0.16000	-0.18000
16.300	-0.13000	-0.13000	-0.13000	-0.13000	-0.14500	-0.16000	-0.19000	-0.21000
22.500	-0.16500	-0.17500	-0.18500	-0.18500	-0.19000	-0.21500	-0.22000	-0.22500

ENGINEER LP
DATE 9/26/72

FIGURE 5.2-2
BODY FLAP HINGE MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00900	-0.00700	-0.00500	0.0	-0.00500	-0.03000	-0.06800	-0.09000
-5.000	-0.03080	-0.03015	-0.02950	-0.02787	-0.02840	-0.05787	-0.10057	-0.12200
0.0	-0.05000	-0.05000	-0.05000	-0.05000	-0.05000	-0.08000	-0.11800	-0.14000
5.000	-0.07132	-0.07152	-0.07172	-0.07279	-0.07528	-0.10279	-0.14145	-0.16000
10.000	-0.09509	-0.09478	-0.09447	-0.09601	-0.10411	-0.12601	-0.16000	-0.18000
16.300	-0.13000	-0.13000	-0.13000	-0.13000	-0.14500	-0.16000	-0.19000	-0.21000
22.500	-0.16500	-0.17500	-0.18500	-0.18500	-0.19000	-0.21500	-0.22000	-0.22500

ENGINEER MP
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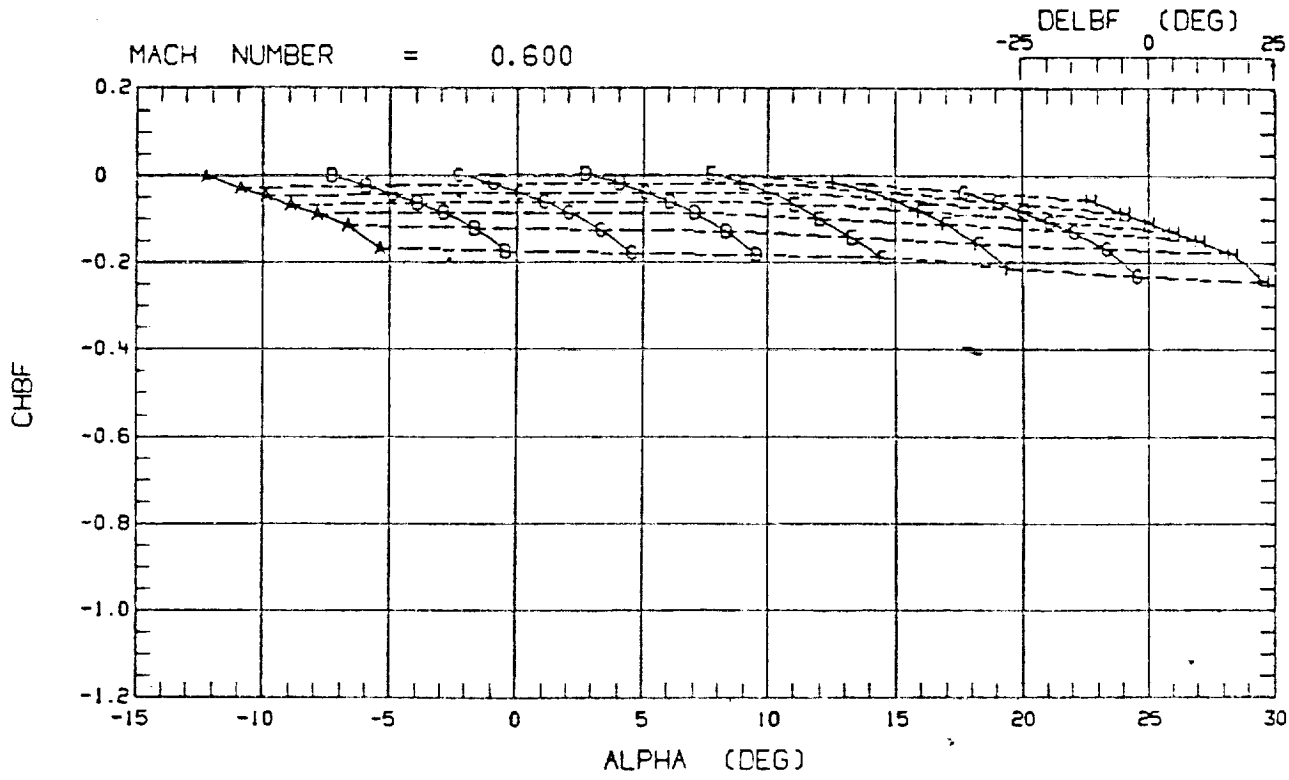
FIGURE 5.2-3
BODY FLAP HINGE MOMENT COEFFICIENT



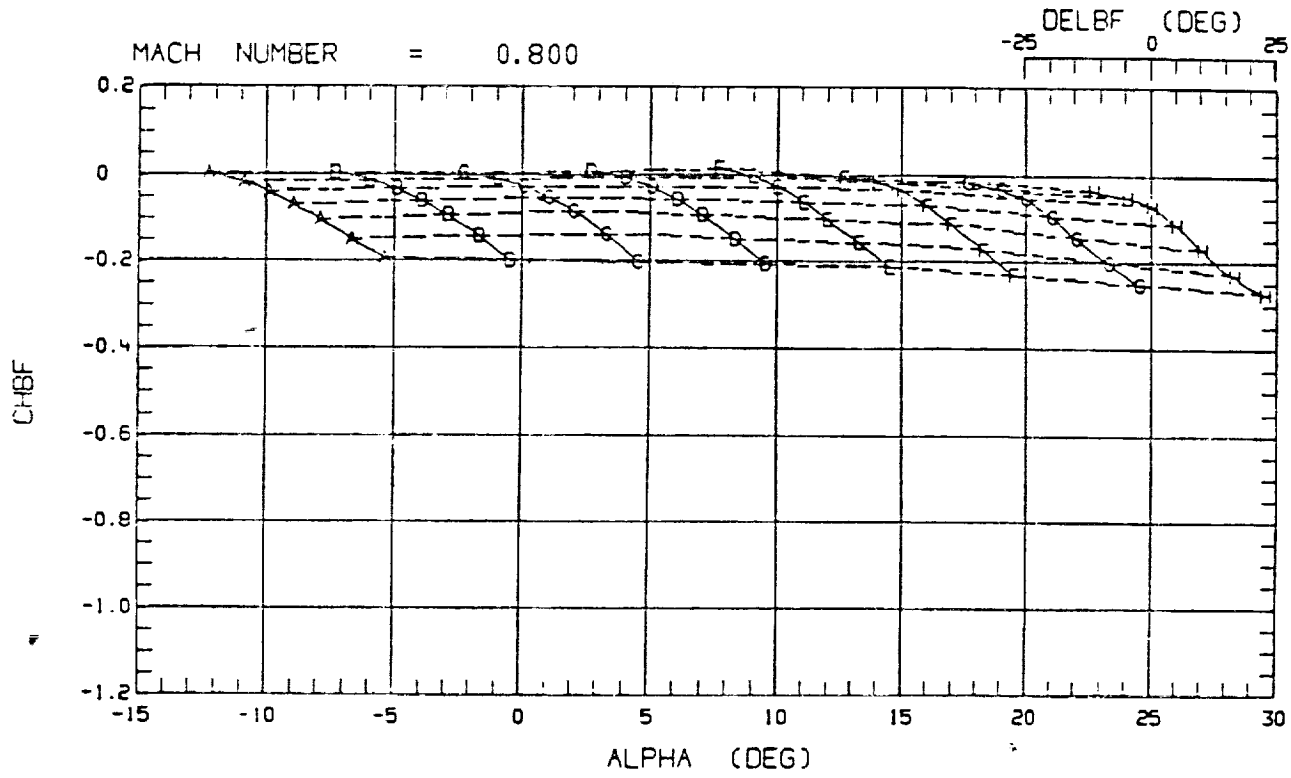
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00500	-0.00300	-0.00100	0.0	0.0	-0.02000	-0.04000	-0.06000
-5.000	-0.03045	-0.02569	-0.02094	-0.02039	-0.01929	-0.03966	-0.06413	-0.08951
0.0	-0.05000	-0.04500	-0.04000	-0.04000	-0.04000	-0.06000	-0.08500	-0.11000
5.000	-0.06980	-0.06563	-0.06191	-0.06260	-0.06841	-0.08483	-0.10743	-0.13141
10.000	-0.08967	-0.08745	-0.08688	-0.08842	-0.10134	-0.11437	-0.13116	-0.15282
16.300	-0.11700	-0.12200	-0.12700	-0.13000	-0.14500	-0.16000	-0.17000	-0.18000
22.500	-0.17000	-0.17500	-0.18000	-0.18500	-0.19000	-0.21500	-0.23500	-0.24500

ENGINEER
DATE 5/23/72

FIGURE 5.2-4
BODY FLAP HINGE MOMENT COEFFICIENT



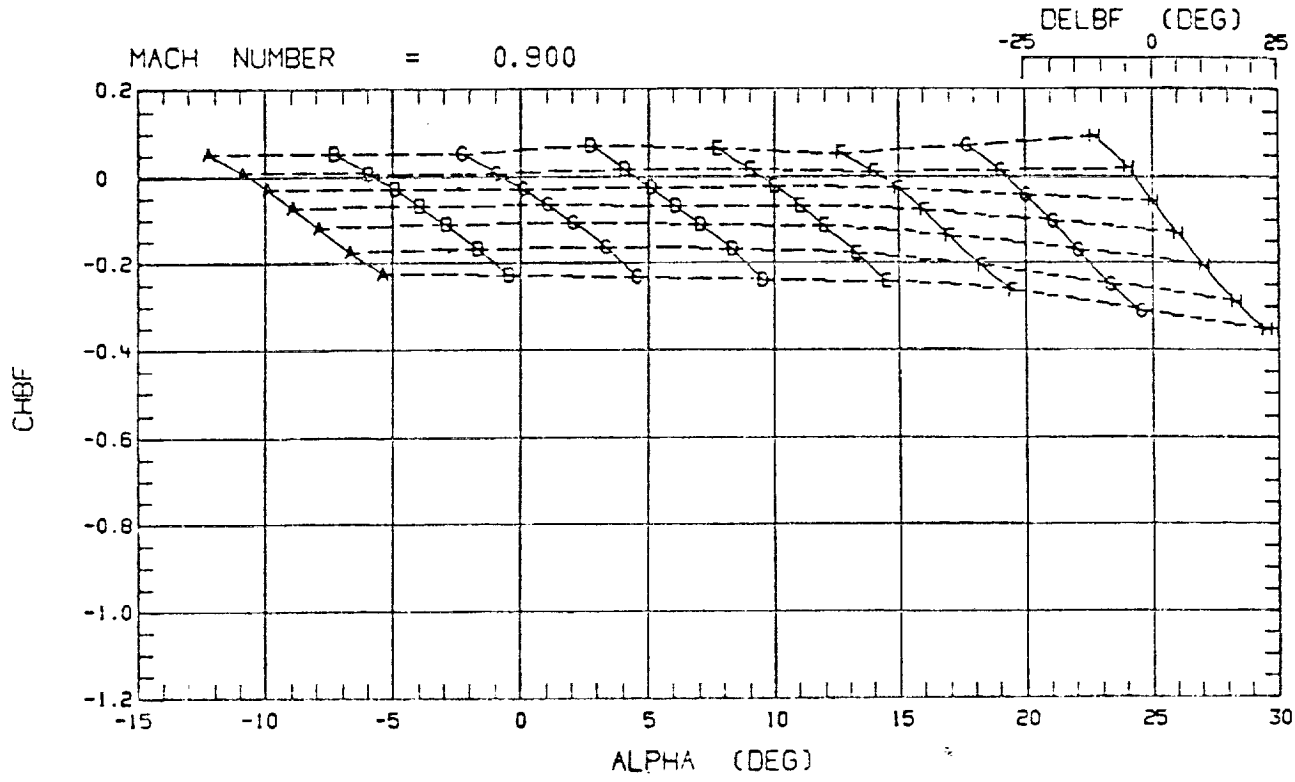
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.0	0.0	0.0	0.00500	0.01000	-0.01000	-0.02000	-0.03900
-5.000	-0.01892	-0.01555	-0.01217	-0.00981	-0.00745	-0.01864	-0.03595	-0.05288
0.0	-0.04000	-0.03500	-0.03000	-0.03000	-0.03000	-0.03900	-0.05500	-0.07200
5.000	-0.07083	-0.06203	-0.05503	-0.05920	-0.06516	-0.07349	-0.09853	-0.11696
10.000	-0.10541	-0.09577	-0.08746	-0.09615	-0.10521	-0.11707	-0.14807	-0.17474
16.300	-0.15000	-0.14500	-0.14000	-0.15000	-0.16000	-0.17500	-0.20500	-0.23500
22.500	-0.19500	-0.20000	-0.20500	-0.21000	-0.21500	-0.23500	-0.25500	-0.27500

PEER HP 5/2/58

FIGURE 5.2-5
BODY FLAP HINGE MOMENT COEFFICIENT



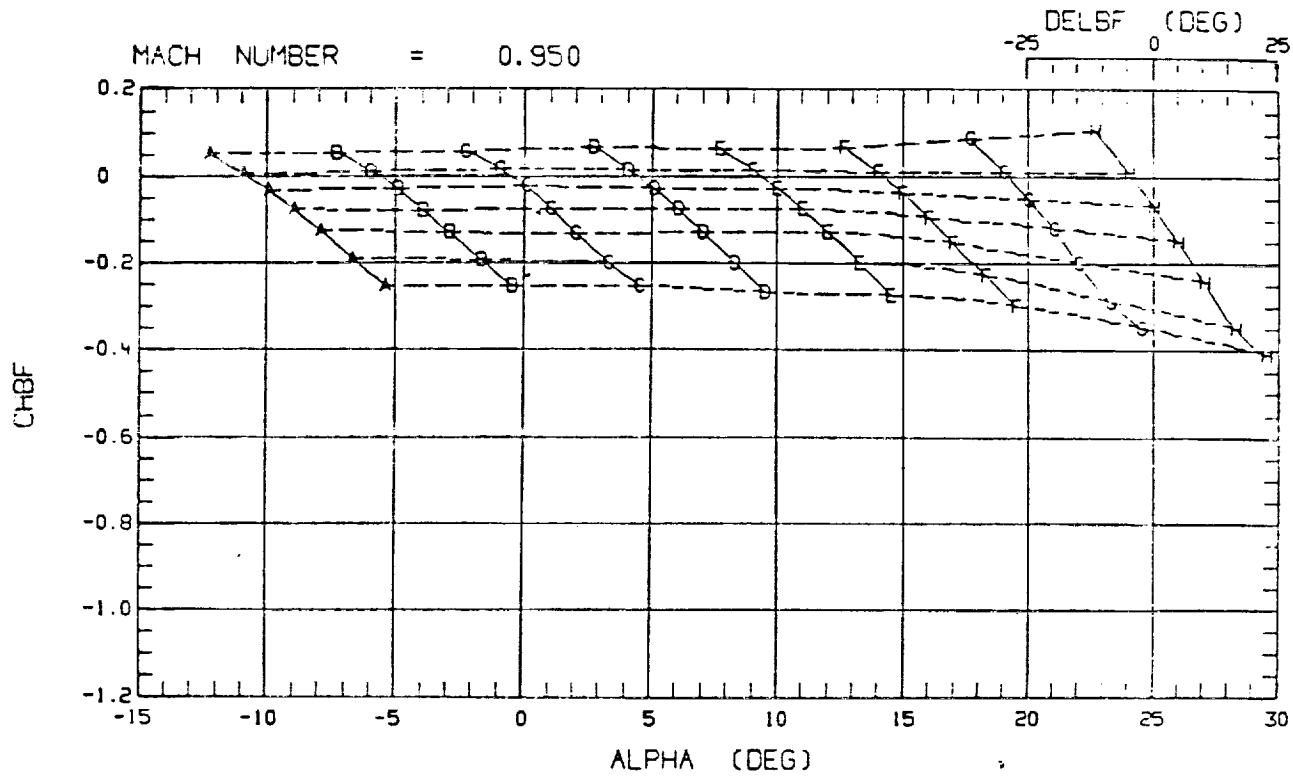
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.05000	0.05000	0.05000	0.07000	0.05000	0.05000	0.07000	0.09000
-5.000	0.00665	0.00626	0.00592	0.01503	0.01401	0.00759	0.01231	0.01702
0.0	-0.03000	-0.03000	-0.03000	-0.02700	-0.02500	-0.03000	-0.04500	-0.06000
5.000	-0.07325	-0.06970	-0.06782	-0.06955	-0.06895	-0.09225	-0.10649	-0.13480
10.000	-0.11961	-0.11255	-0.10761	-0.11247	-0.11677	-0.14207	-0.17194	-0.20730
16.300	-0.17500	-0.17000	-0.16500	-0.17000	-0.18000	-0.21000	-0.25000	-0.29000
22.500	-0.22500	-0.23000	-0.23500	-0.24000	-0.24500	-0.28500	-0.31000	-0.35500

ENGINEER H.P.
DATE 9/23/72

FIGURE 5.2-6
BODY FLAP HINGE MOMENT COEFFICIENT



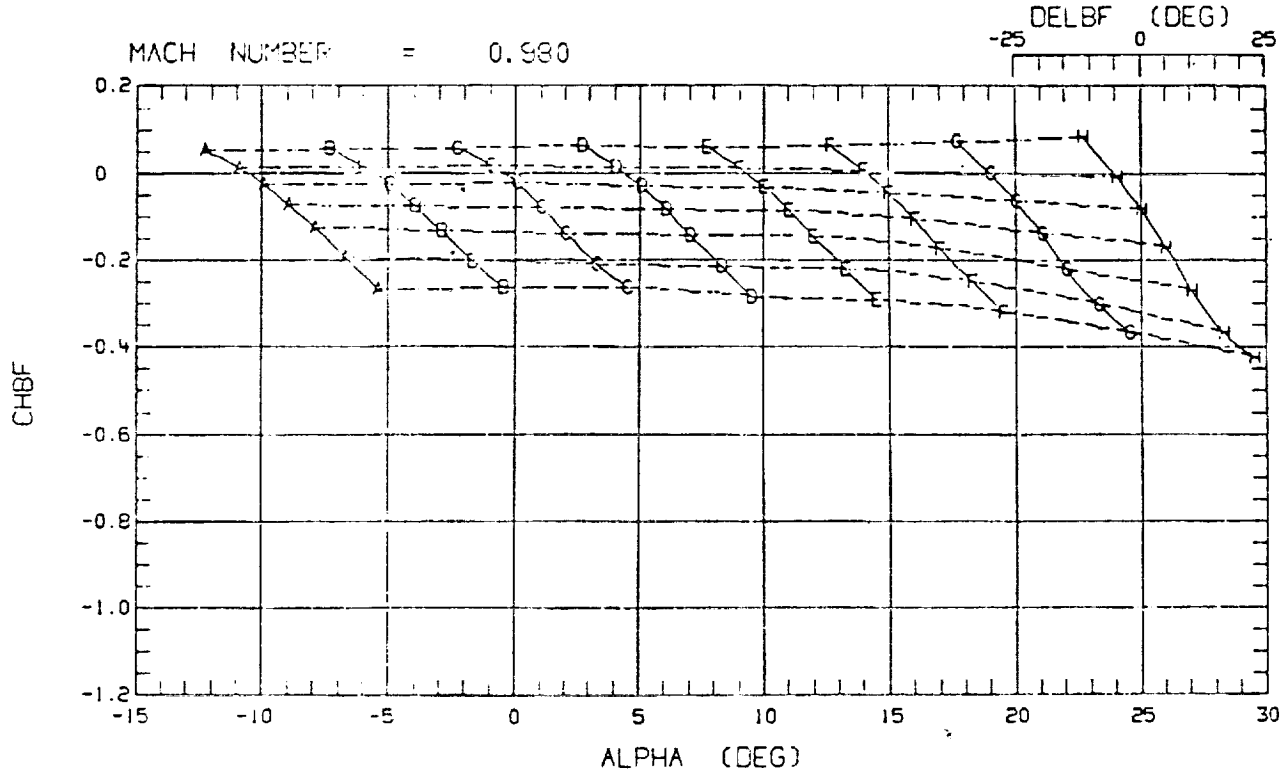
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.04900	0.05200	0.05500	0.06500	0.06000	0.06500	0.06500	0.10500
-5.000	0.00368	0.00877	0.01385	0.01336	0.01174	0.00805	0.00778	0.00744
0.0	-0.03500	-0.03000	-0.02500	-0.03000	-0.03000	-0.04000	-0.05500	-0.07000
5.000	-0.07888	-0.07961	-0.07616	-0.07871	-0.07712	-0.09745	-0.12455	-0.15350
10.000	-0.12674	-0.13164	-0.13377	-0.13125	-0.12914	-0.15621	-0.20156	-0.24430
16.300	-0.19000	-0.19500	-0.20000	-0.20000	-0.20000	-0.23000	-0.29000	-0.35000
22.500	-0.25500	-0.25500	-0.25500	-0.27000	-0.27500	-0.32000	-0.39000	-0.47000

ENGINEER [illegible]
02.26.29

FIGURE 5.2-7
BODY FLAP HINGE MOMENT COEFFICIENT



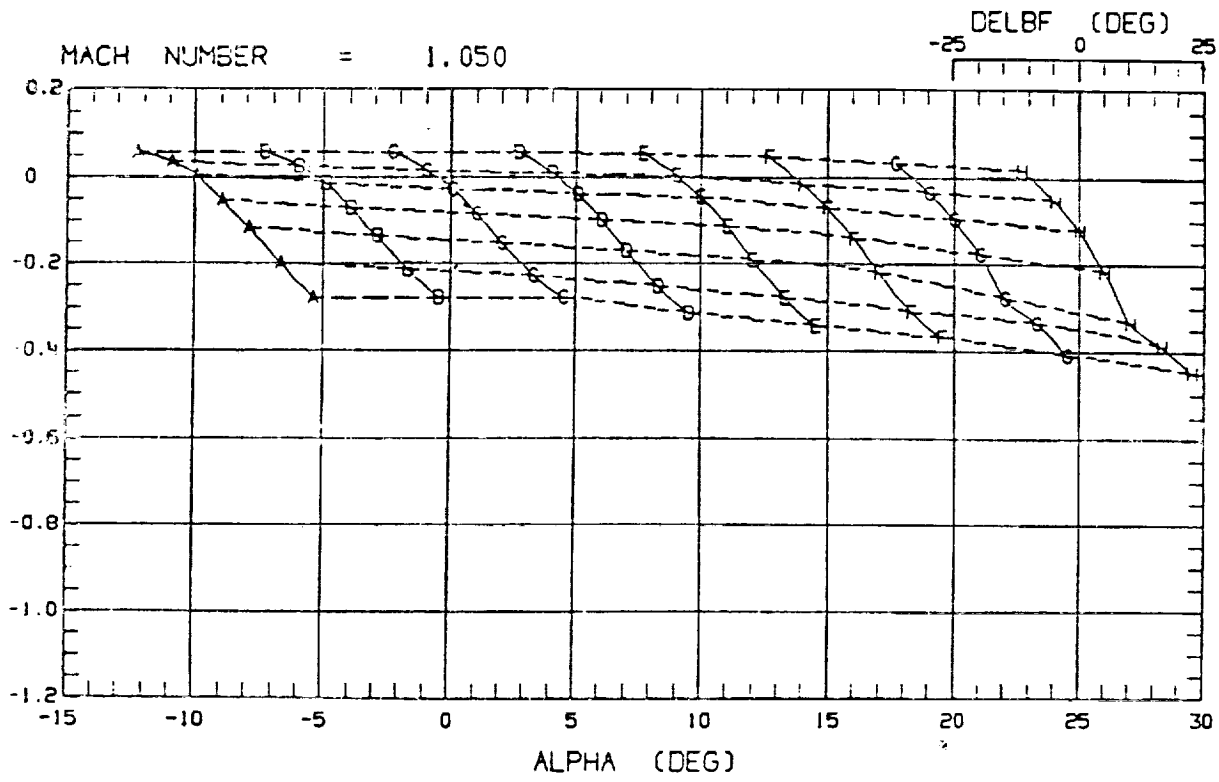
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XC = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YC = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZC = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.05332	0.04837	0.05839	0.06200	0.05700	0.06218	0.07048	0.08220
-5.000	0.01035	0.00384	0.01442	0.01194	0.00934	0.00322	-0.00424	-0.01016
0.0	-0.03702	-0.03548	-0.02518	-0.03232	-0.03435	-0.04840	-0.05691	-0.08590
5.000	-0.07415	-0.07897	-0.07973	-0.08554	-0.08749	-0.10950	-0.14071	-0.17156
10.000	-0.12587	-0.13461	-0.14011	-0.14376	-0.14682	-0.17522	-0.22362	-0.27102
16.300	-0.19515	-0.20303	-0.21193	-0.21744	-0.22196	-0.25229	-0.30588	-0.36677
22.500	-0.26819	-0.28037	-0.28791	-0.29560	-0.29934	-0.32100	-0.36924	-0.42553

ENGINEER _____
DATE 2/3/72

FIGURE 5.2-8
BODY FLAP HINGE MOMENT COEFFICIENT



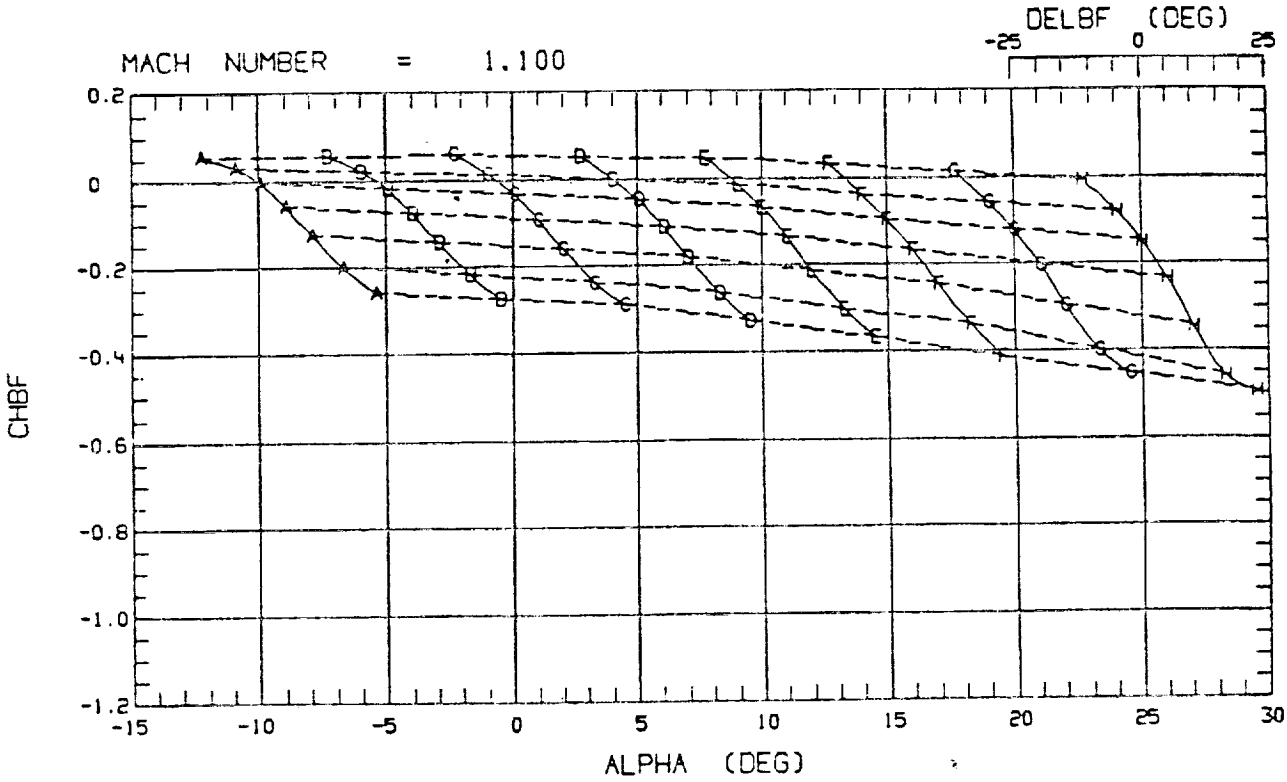
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.05500	0.05500	0.05500	0.05500	0.05000	0.04500	0.03000	0.01500
-5.000	0.03256	0.02244	0.01231	0.00666	-0.00061	-0.01674	-0.03682	-0.05490
0.0	0.0	-0.01500	-0.03000	-0.04000	-0.05000	-0.07500	-0.10000	-0.12500
5.000	-0.05715	-0.07321	-0.08739	-0.10218	-0.11650	-0.14352	-0.16129	-0.21927
10.000	-0.11939	-0.13921	-0.15533	-0.17426	-0.19359	-0.22177	-0.26010	-0.33812
16.300	-0.20000	-0.21500	-0.23000	-0.26500	-0.28000	-0.31000	-0.33500	-0.39000
22.500	-0.28300	-0.28000	-0.28000	-0.31500	-0.34500	-0.37000	-0.41000	-0.45000

ENGINEER HP 7/23/79

FIGURE 5.2-9
BODY FLAP HINGE MOMENT COEFFICIENT



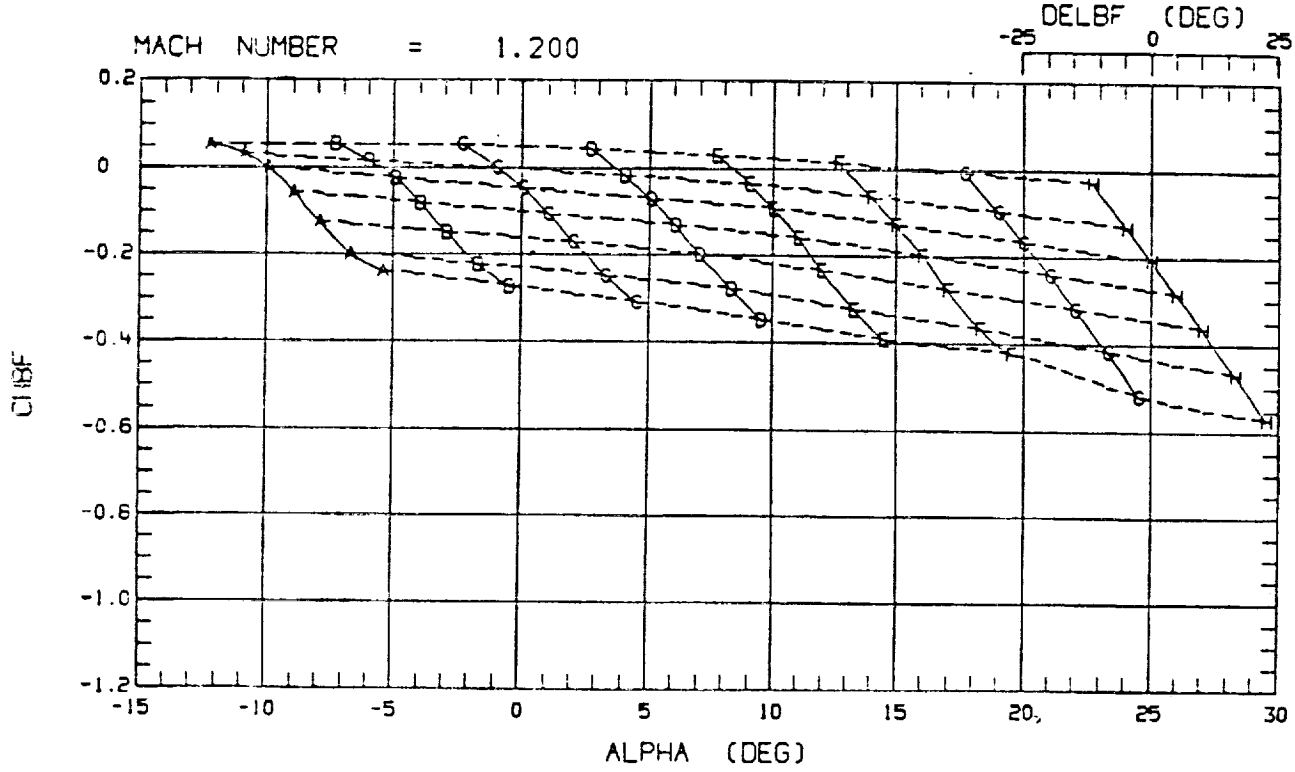
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL .0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.05300	0.05500	0.05700	0.05000	0.04500	0.03000	0.01000	-0.01000
-5.000	0.02817	0.01906	0.00996	-0.00171	-0.01537	-0.04012	-0.06093	-0.08173
0.0	-0.00500	-0.02000	-0.03500	-0.05000	-0.07000	-0.10000	-0.12500	-0.15000
5.000	-0.06104	-0.07726	-0.09402	-0.11271	-0.13844	-0.17089	-0.20451	-0.23841
10.000	-0.12652	-0.14512	-0.16344	-0.18383	-0.21661	-0.24897	-0.29752	-0.34576
16.300	-0.20000	-0.22000	-0.24000	-0.26500	-0.30500	-0.34000	-0.40000	-0.46000
22.500	-0.25000	-0.27500	-0.29000	-0.33000	-0.37000	-0.41500	-0.45500	-0.49500

ENGINEER A.C.
DATE 4/20/72

FIGURE 5.2-10
BODY FLAP HINGE MOMENT COEFFICIENT



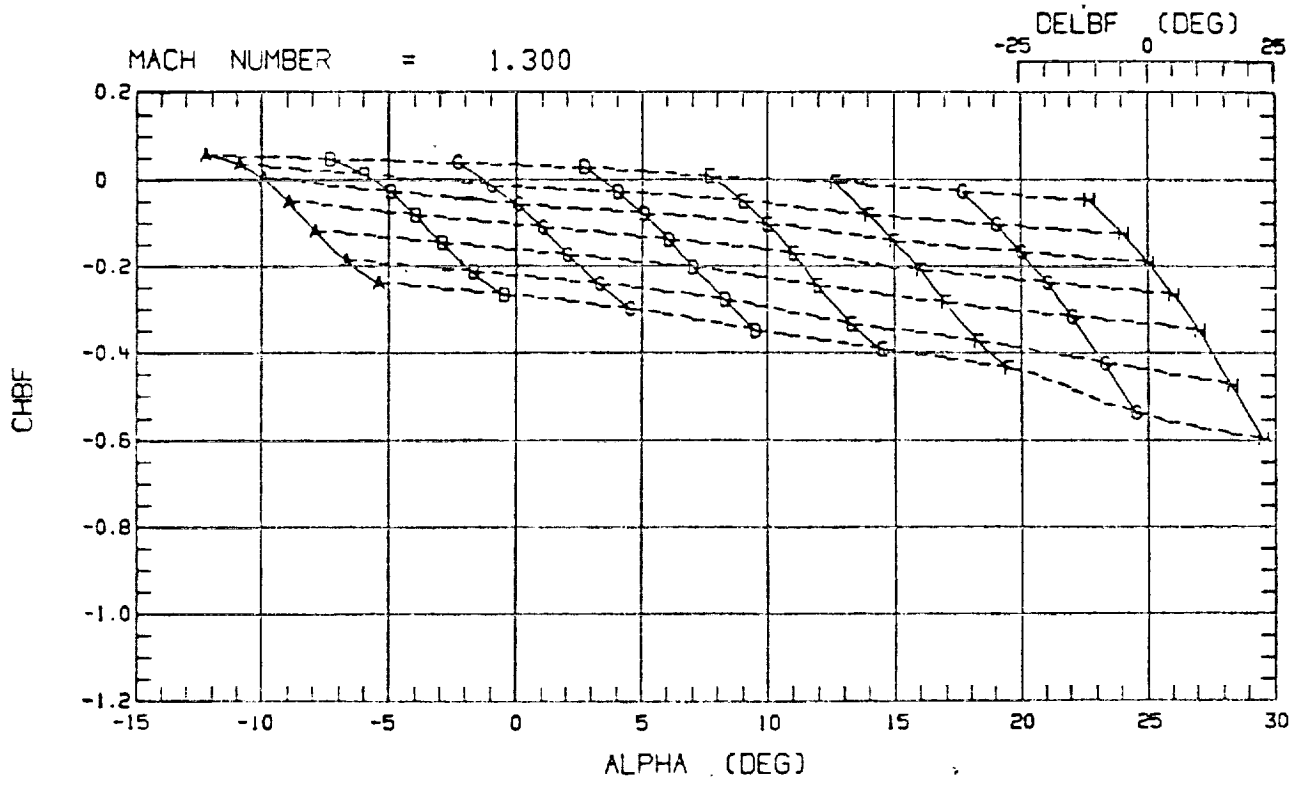
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.05000	0.05000	0.05000	0.04000	0.02500	0.01000	-0.01000	-0.03000
-5.000	0.02794	0.01257	-0.00291	-0.02107	-0.03911	-0.06697	-0.09954	-0.13240
0.0	-0.00400	-0.02700	-0.05000	-0.07300	-0.09500	-0.13000	-0.17000	-0.21000
5.000	-0.05646	-0.08352	-0.10856	-0.13456	-0.16263	-0.20036	-0.24392	-0.28815
10.000	-0.12788	-0.15116	-0.17444	-0.20106	-0.23796	-0.27952	-0.32074	-0.36650
16.300	-0.20000	-0.22500	-0.25000	-0.28000	-0.32500	-0.37000	-0.42000	-0.47000
22.500	-0.24000	-0.27500	-0.31000	-0.35000	-0.39500	-0.42500	-0.52000	-0.57500

ENGINEER [illegible]

FIGURE 5.2-11
BODY FLAP HINGE MOMENT COEFFICIENT



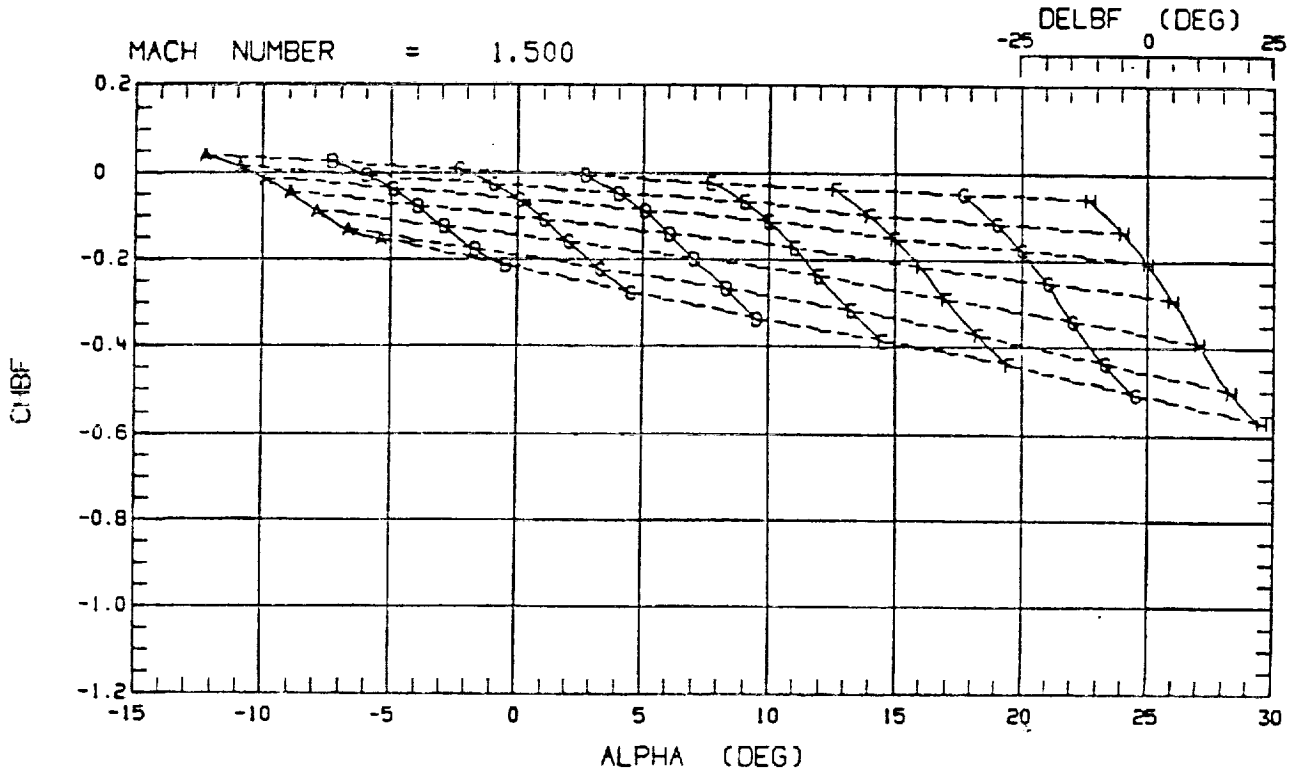
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.05500	0.04500	0.03500	0.02500	0.00500	-0.01000	-0.03000	-0.05000
-5.000	0.03175	0.00811	-0.01554	-0.03119	-0.05236	-0.08423	-0.10577	-0.12731
0.0	0.0	-0.03000	-0.06000	-0.08000	-0.10500	-0.14500	-0.17000	-0.19500
5.000	-0.05349	-0.08384	-0.11427	-0.13956	-0.17171	-0.21315	-0.24084	-0.26895
10.000	-0.11847	-0.14681	-0.17510	-0.20352	-0.24875	-0.28806	-0.31825	-0.34933
16.300	-0.18900	-0.21700	-0.24500	-0.28000	-0.33500	-0.37500	-0.42500	-0.47500
22.500	-0.24000	-0.27000	-0.30000	-0.35000	-0.39500	-0.43500	-0.54000	-0.60000

ENGINEER M P
DATE 9/20/79

FIGURE 5.2-12
BODY FLAP HINGE MOMENT COEFFICIENT



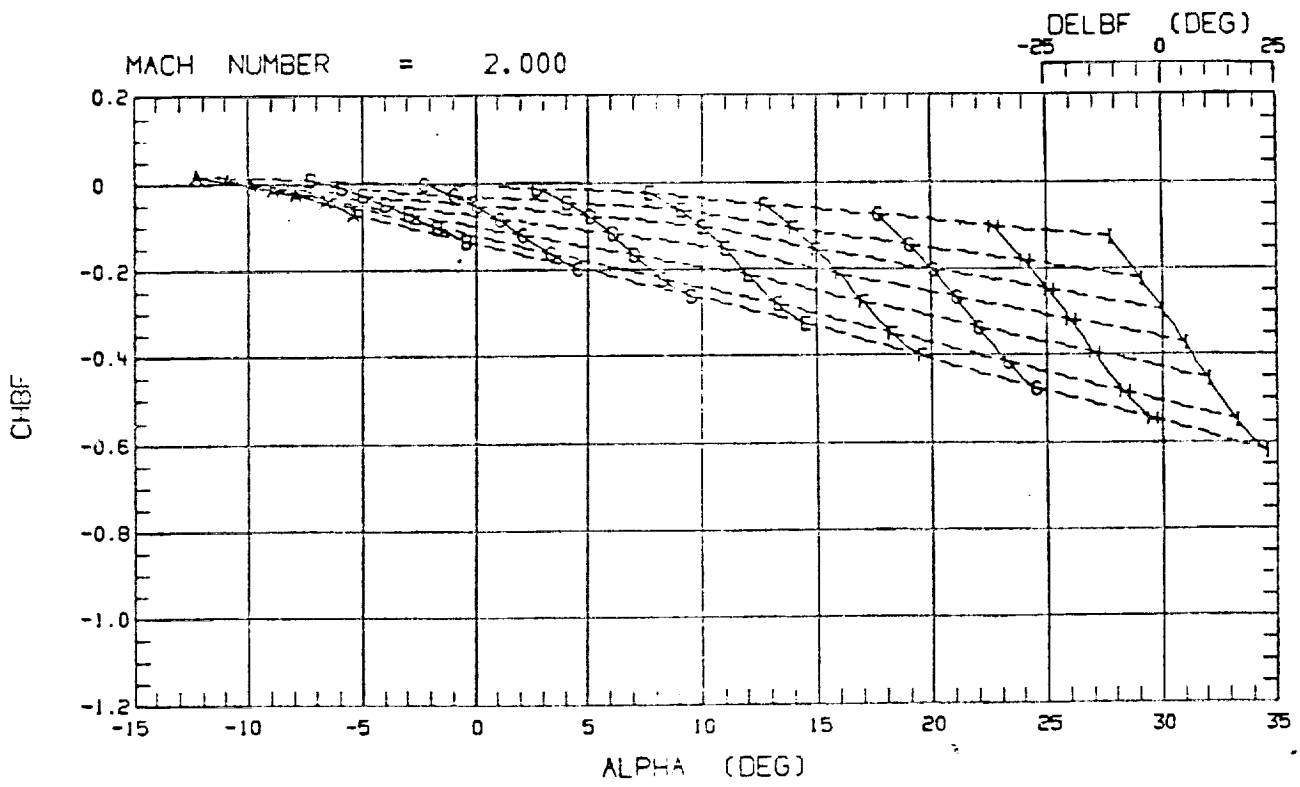
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.03700	0.02100	0.00500	-0.01100	-0.02600	-0.04000	-0.05100	-0.06200
-5.000	0.01071	-0.00989	-0.03050	-0.05111	-0.07102	-0.10132	-0.11973	-0.13814
0.0	-0.01500	-0.04000	-0.06500	-0.09000	-0.11500	-0.15500	-0.18100	-0.20700
5.000	-0.04921	-0.08034	-0.11200	-0.14465	-0.17553	-0.22021	-0.25603	-0.29220
10.000	-0.09061	-0.12758	-0.16420	-0.20004	-0.24187	-0.29304	-0.34345	-0.39344
16.300	-0.13500	-0.18000	-0.22500	-0.27000	-0.32000	-0.37700	-0.44000	-0.50300
22.500	-0.15600	-0.21700	-0.27800	-0.33900	-0.39000	-0.44400	-0.51000	-0.57300

ENGINEER [signature]
DATE 9/26/74

FIGURE 5.2-13
BODY FLAP HINGE MOMENT COEFFICIENT



CONFIGURATION

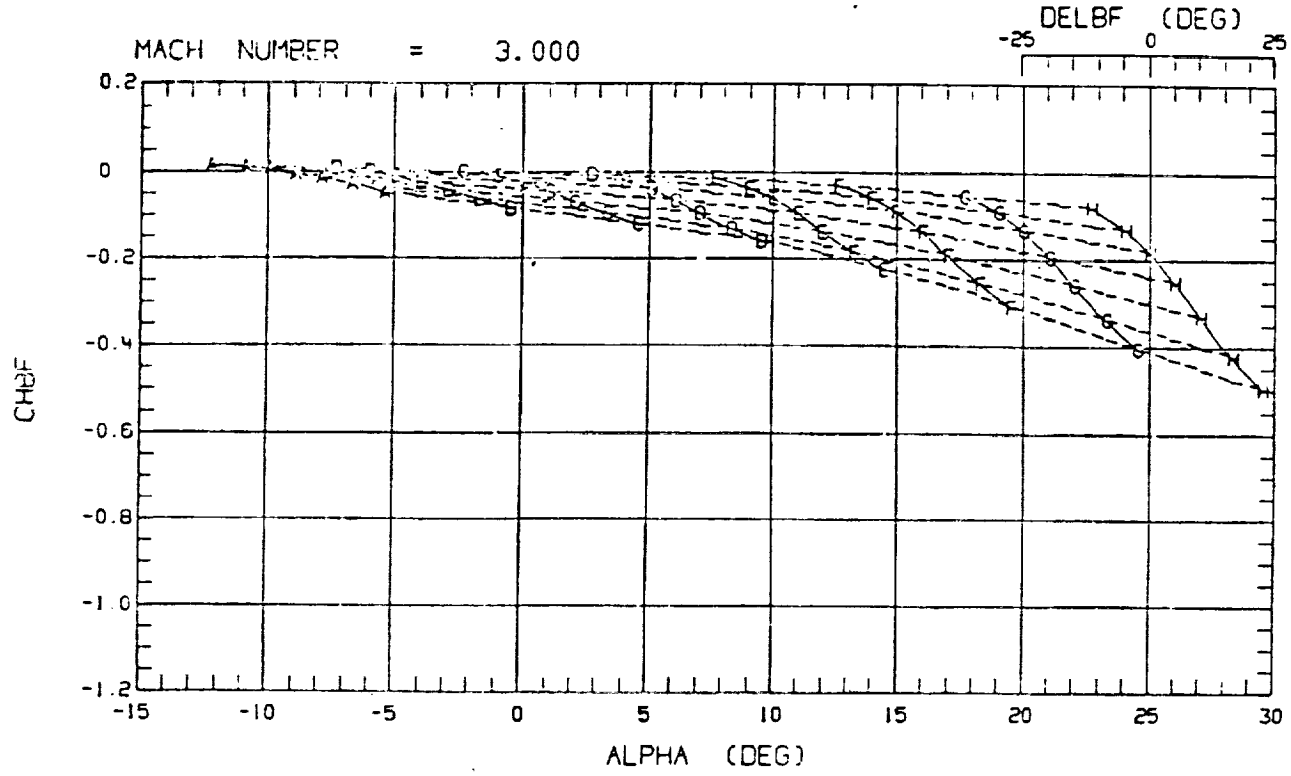
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELBF (DEG)	BODY FLAP HINGE MOMENT								
-11.700	0.01500	0.00500	-0.00500	-0.01500	-0.02700	-0.05500	-0.07800	-0.10500	-0.13000
-5.000	0.00294	-0.01367	-0.03067	-0.04768	-0.06855	-0.11020	-0.14793	-0.18547	-0.22609
0.0	-0.00700	-0.03100	-0.05500	-0.07900	-0.10500	-0.15600	-0.20500	-0.25000	-0.30000
5.000	-0.01744	-0.05170	-0.08719	-0.12111	-0.15651	-0.21511	-0.26883	-0.32064	-0.37683
10.000	-0.02827	-0.07471	-0.12333	-0.17030	-0.21708	-0.27959	-0.33857	-0.39714	-0.45688
16.300	-0.04500	-0.10500	-0.16500	-0.22500	-0.28400	-0.35300	-0.42000	-0.48700	-0.55400
22.500	-0.07200	-0.13500	-0.20000	-0.26400	-0.33000	-0.40500	-0.48000	-0.55000	-0.62500

ENGINEER MP
DATE 8/22/79

FIGURE 5.2-14
BODY FLAP HINGE MOMENT COEFFICIENT

SD 72-SH-0060 IM



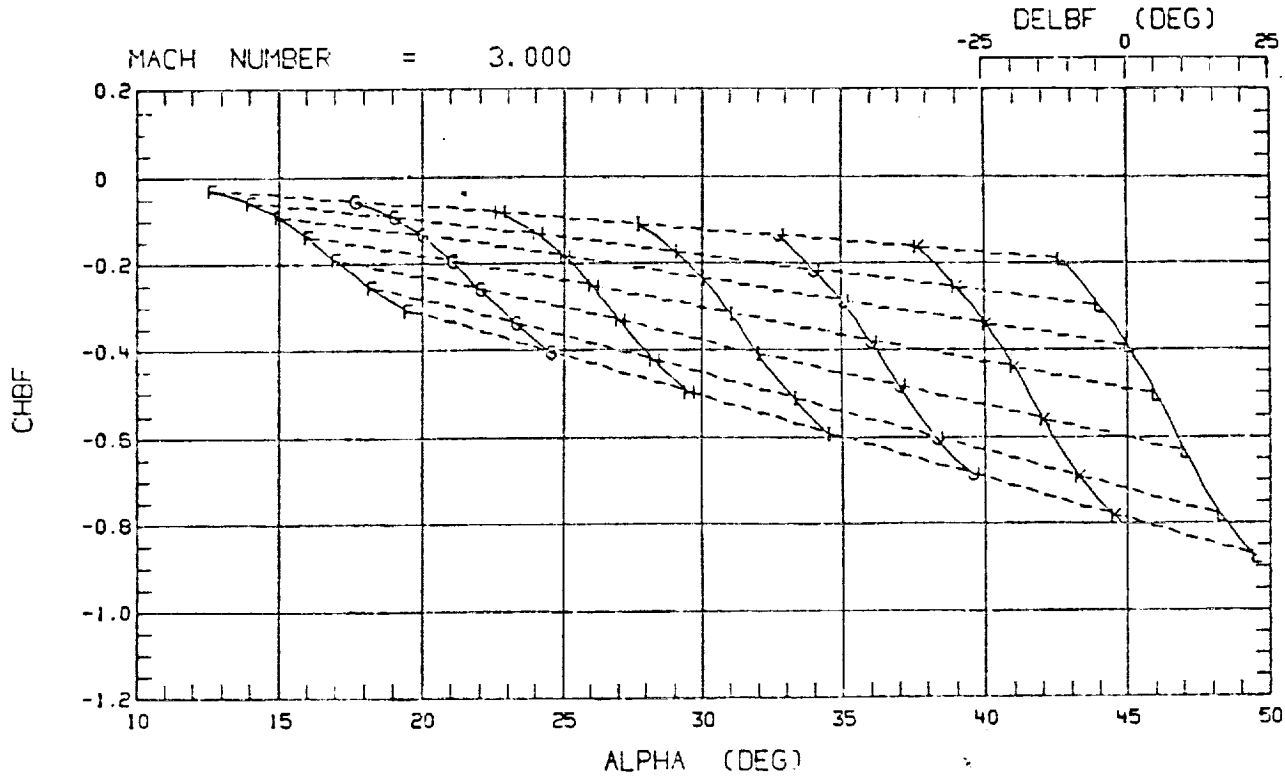
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.01100	0.00400	-0.00300	-0.01000	-0.01800	-0.03400	-0.05800	-0.08500
-5.000	0.00602	-0.00291	-0.01384	-0.02477	-0.03934	-0.06246	-0.09642	-0.13562
0.0	0.00300	-0.01200	-0.02700	-0.04200	-0.05400	-0.09400	-0.13700	-0.18600
5.000	-0.00902	-0.02927	-0.04646	-0.06265	-0.09035	-0.14160	-0.19339	-0.25502
10.000	-0.01639	-0.04429	-0.07219	-0.10003	-0.14114	-0.19593	-0.26293	-0.33482
16.300	-0.03000	-0.06500	-0.10000	-0.13500	-0.18830	-0.25800	-0.34000	-0.42600
22.900	-0.05100	-0.08800	-0.12500	-0.16300	-0.22700	-0.31000	-0.42700	-0.50300

ENGINEER

FIGURE 5.2-15
BODY FLAP HINGE MOMENT COEFFICIENT



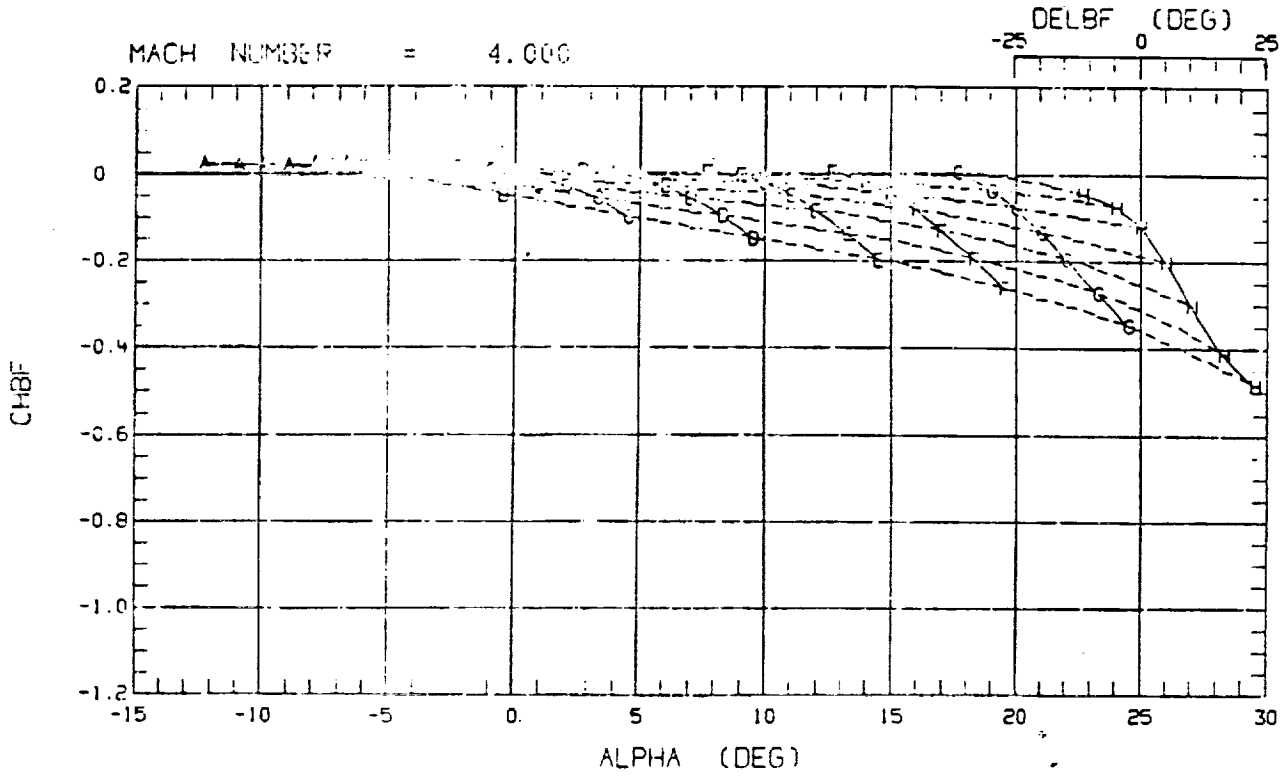
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP HINGE MOMENT						
-11.700	-0.03400	-0.05000	-0.08500	-0.11200	-0.13000	-0.16500	-0.19300
-5.000	-0.06246	-0.09642	-0.13562	-0.17671	-0.21780	-0.25839	-0.29999
0.0	-0.09400	-0.13700	-0.18600	-0.23800	-0.29000	-0.34300	-0.39400
5.000	-0.14160	-0.19539	-0.25562	-0.31843	-0.38124	-0.44405	-0.50686
10.000	-0.19598	-0.26293	-0.33492	-0.41074	-0.48698	-0.56299	-0.63910
16.300	-0.25000	-0.34000	-0.42500	-0.51500	-0.60500	-0.69500	-0.78500
22.500	-0.31000	-0.40700	-0.50000	-0.59500	-0.69000	-0.78500	-0.88000

ENGINEER HC
DATE 3/29/72

FIGURE 5.2-16
BODY FLAP HINGE MOMENT COEFFICIENT



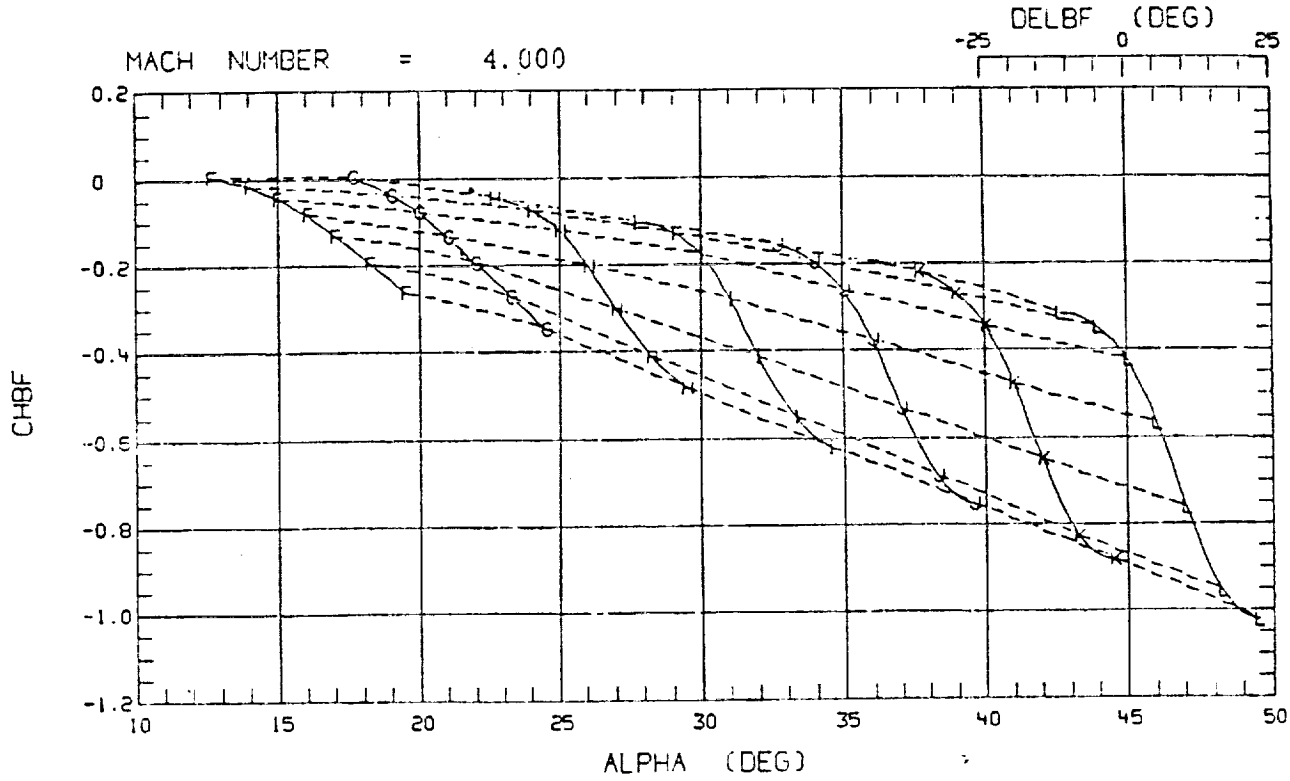
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XCG = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YCG = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZCG = WL	375.0 IN.	M.A.C.	CW = 39.550	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.02100	0.01937	0.01000	0.00477	0.0	0.0	0.0	-0.04853
-5.000	0.01669	0.01210	0.00541	-0.00127	-0.00768	-0.02112	-0.04043	-0.07855
0.0	0.01600	0.00750	-0.00200	-0.01350	-0.03400	-0.04750	-0.08100	-0.12419
5.000	0.01699	0.00180	-0.01503	-0.03251	-0.05093	-0.08586	-0.13722	-0.20566
10.000	0.02103	-0.00473	-0.03004	-0.05844	-0.08590	-0.13272	-0.19783	-0.30507
16.300	0.02300	-0.01325	-0.05100	-0.10000	-0.14000	-0.19750	-0.27500	-0.41350
22.500	-0.00200	-0.02157	-0.07407	-0.15050	-0.20000	-0.26663	-0.35000	-0.48750

ENGR MP
7/24/79

FIGURE 5.2-17
BODY FLAP HINGE MOMENT COEFFICIENT

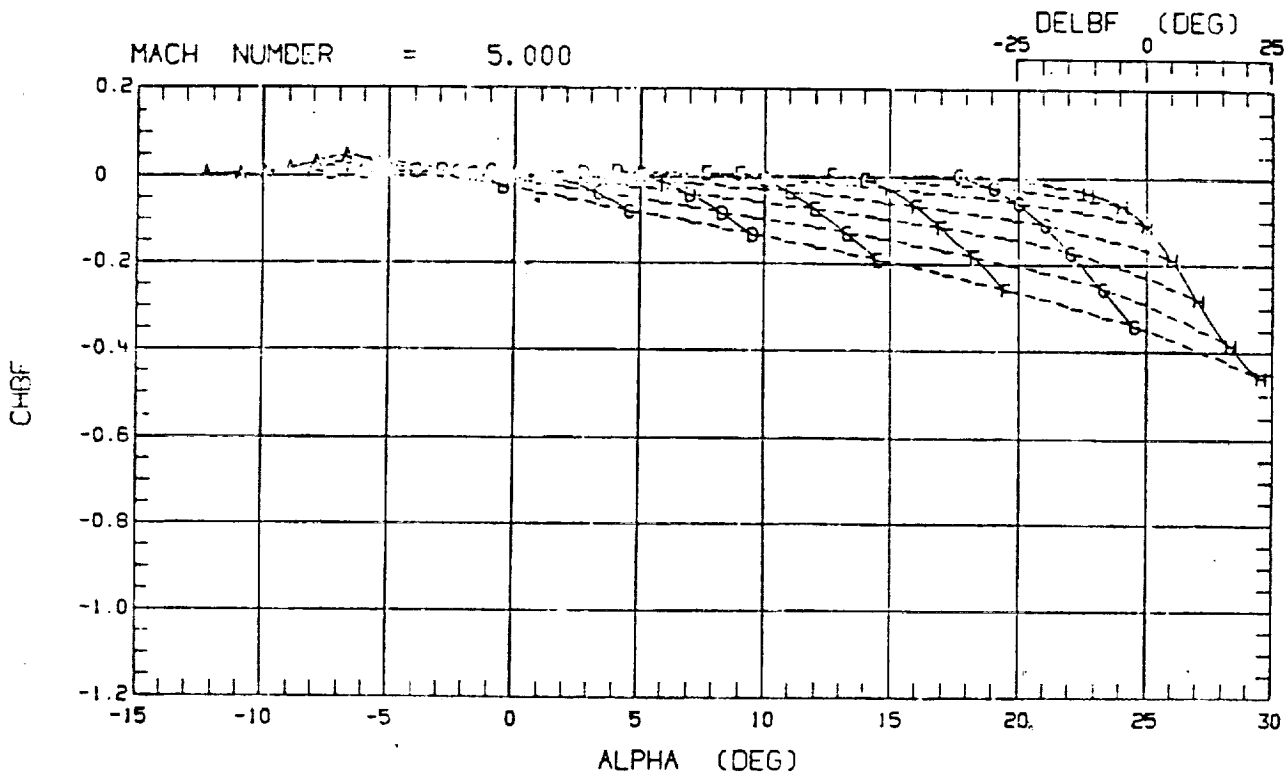


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP HINGE MOMENT						
-11.700	0.0	0.0	-0.04853	-0.10400	-0.16050	-0.22400	-0.31812
-5.000	-0.02112	-0.04043	-0.07858	-0.12874	-0.19908	-0.27163	-0.35248
0.0	-0.04760	-0.08100	-0.12449	-0.18100	-0.23400	-0.34700	-0.42700
5.000	-0.08585	-0.13723	-0.20565	-0.26274	-0.33085	-0.47870	-0.57135
10.000	-0.13272	-0.19763	-0.30607	-0.41618	-0.53514	-0.65429	-0.78719
16.300	-0.19759	-0.27500	-0.41350	-0.55200	-0.68050	-0.82900	-0.98000
22.500	-0.26693	-0.35900	-0.48750	-0.62300	-0.75591	-0.88400	-1.00500

ENGINEER N.C.
DATE 9/25/75

FIGURE 5.2-18
BODY FLAP HINGE MOMENT COEFFICIENT

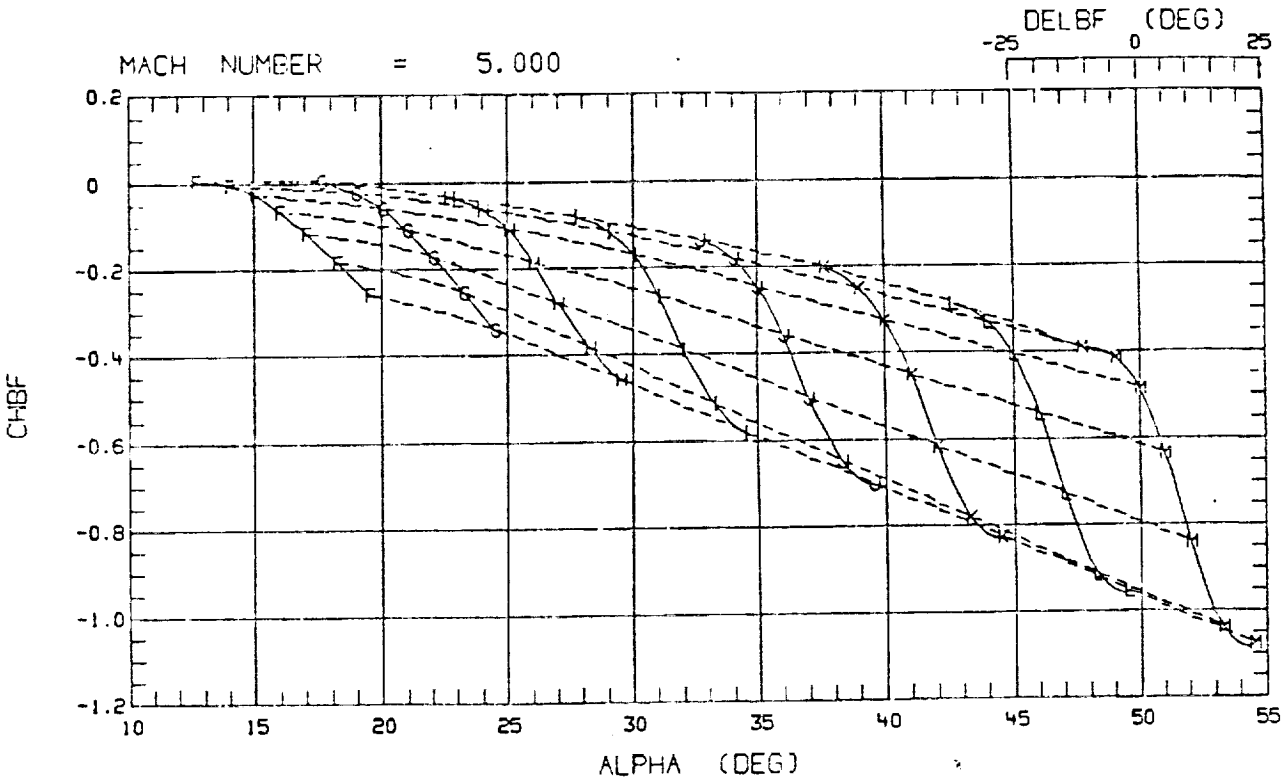


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.00300	0.00300	0.00300	0.00300	0.00300	0.00222	0.0	-0.03597
-5.000	0.00149	0.00600	0.00780	0.00746	0.00325	-0.00851	-0.03821	-0.05658
0.0	0.00500	0.00687	0.00500	0.00019	-0.01300	-0.03084	-0.06300	-0.11104
5.000	0.01479	0.00707	-0.00253	-0.01719	-0.03870	-0.07014	-0.11421	-0.18909
10.000	0.03084	0.00685	-0.01514	-0.04365	-0.07774	-0.12009	-0.17554	-0.28419
16.300	0.04400	0.00163	-0.04200	-0.09541	-0.13300	-0.18970	-0.25600	-0.38729
22.500	0.02600	-0.02837	-0.08300	-0.13776	-0.19300	-0.26148	-0.34400	-0.46359

ENGINEER [illegible]
[illegible]

FIGURE 5.2-19
BODY FLAP HINGE MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

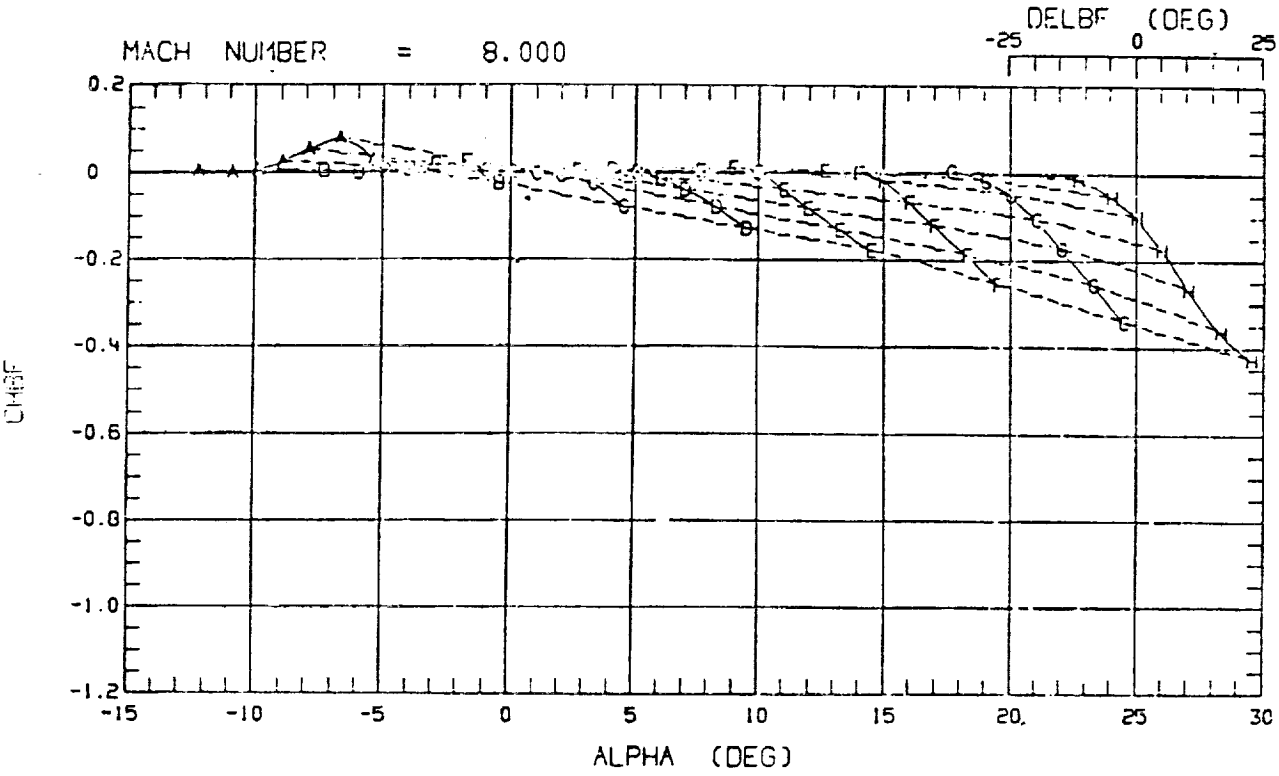
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.00822	0.0	-0.03697	-0.09600	-0.14033	-0.20500	-0.29150	-0.39400
-5.000	-0.00851	-0.02821	-0.06668	-0.11857	-0.16453	-0.25554	-0.33372	-0.41835
0.0	-0.03054	-0.06300	-0.11104	-0.17200	-0.24958	-0.32900	-0.40900	-0.49000
5.000	-0.07014	-0.11421	-0 18909	-0.26769	-0.36016	-0.45376	-0.54591	-0.63738
10.000	-0.12009	-0.17554	-0.29419	-0.39185	-0.50656	-0.61987	-0.73221	-0.84351
16.300	-0.18870	-0.25800	-0.32729	-0.51900	-0.65200	-0.78500	-0.91425	-1.04100
22.500	-0.25146	-0.34400	-0.45259	-0.58400	-0.70640	-0.83000	-0.95450	-1.08300

ENGINEER AP
DATE 7/22/76

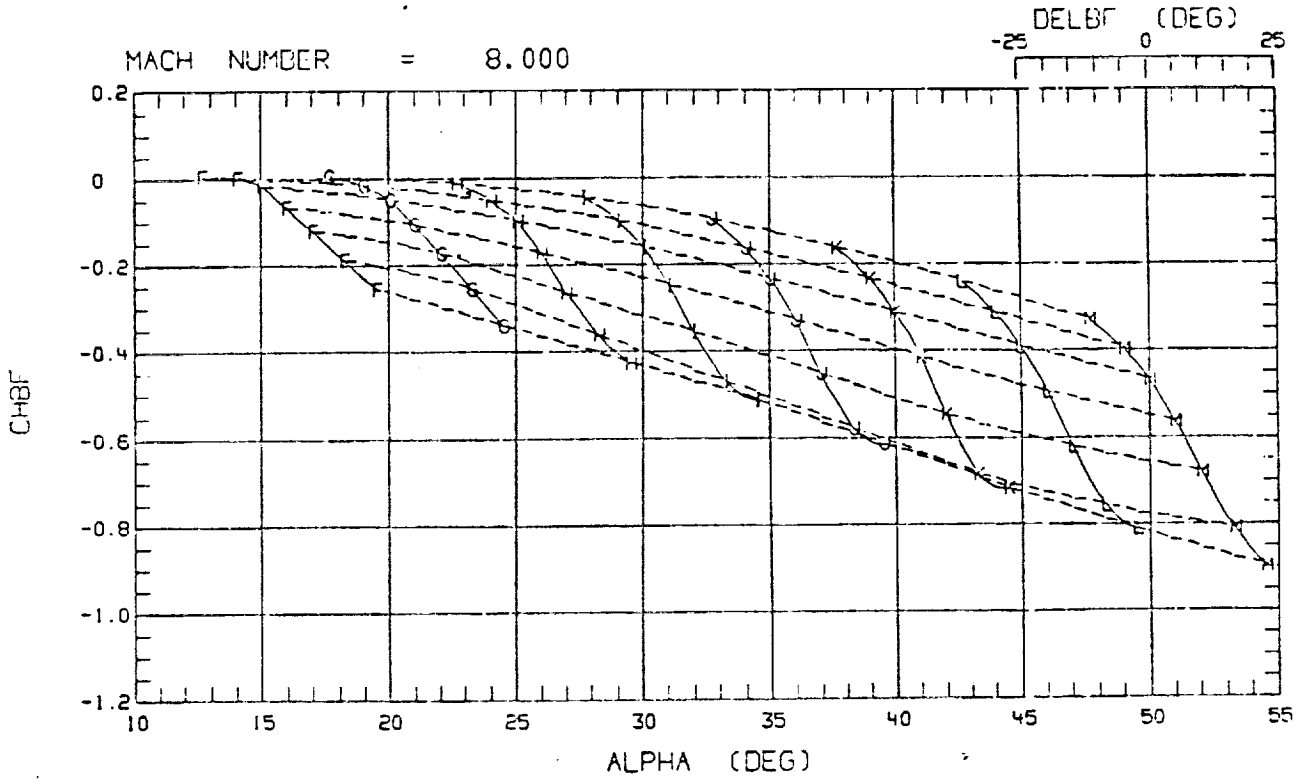
FIGURE 5.2-20
BODY FLAP HINGE MOMENT COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.01635
-5.000	-0.00251	-0.00105	0.00138	0.00522	0.00909	-0.00095	-0.02055	-0.05477
0.0	0.00400	0.00087	-0.00100	-0.00100	-0.00100	-0.02015	-0.05300	-0.10199
5.000	0.02174	0.00631	-0.00521	-0.01656	-0.03994	-0.07107	-0.11053	-0.17631
10.000	0.05129	0.01596	-0.01090	-0.04092	-0.08331	-0.12470	-0.17555	-0.26816
16.300	0.07500	0.02312	-0.02900	-0.08126	-0.13400	-0.19342	-0.25902	-0.36600
22.500	0.02700	-0.02887	-0.08200	-0.13100	-0.18000	-0.25952	-0.34301	-0.42723

FIGURE 5.2-21
BODY FLAP HINGE MOMENT COEFFICIENT

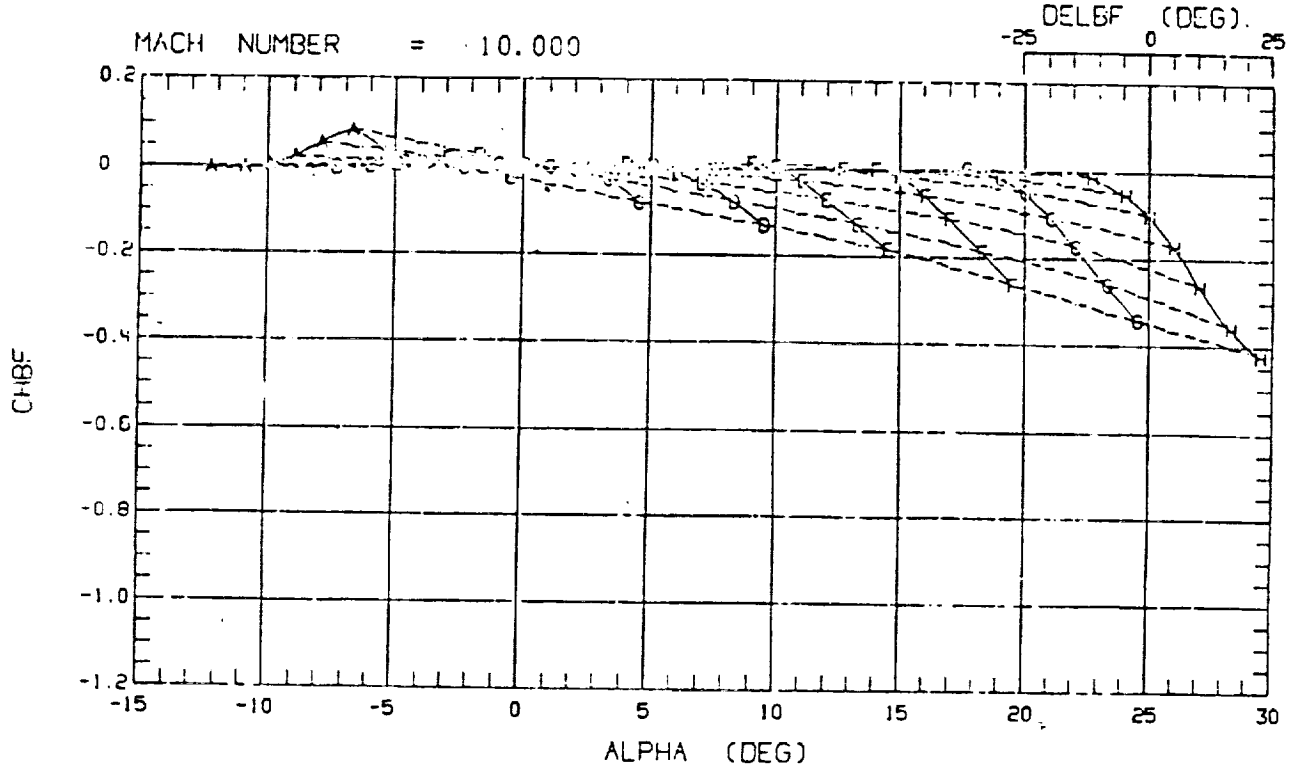


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	0.0	0.0	-0.01635	-0.04700	-0.09985	-0.16700	-0.24162	-0.33400
-5.000	-0.00095	-0.02065	-0.05477	-0.10254	-0.16735	-0.23883	-0.31684	-0.40143
0.0	-0.02015	-0.05300	-0.10199	-0.16300	-0.23719	-0.31400	-0.39175	-0.47100
5.000	-0.07107	-0.11053	-0.17631	-0.24999	-0.33378	-0.41881	-0.49585	-0.56875
10.000	-0.12470	-0.17556	-0.26816	-0.35936	-0.45435	-0.55063	-0.63499	-0.69450
16.300	-0.19242	-0.25900	-0.36500	-0.47300	-0.58300	-0.68700	-0.76062	-0.81200
22.500	-0.25953	-0.34300	-0.42723	-0.51500	-0.61750	-0.72000	-0.81387	-0.90300

ENGINEER HP
DATE 9/30/72

FIGURE 5.2-22
BODY FLAP HINGE MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

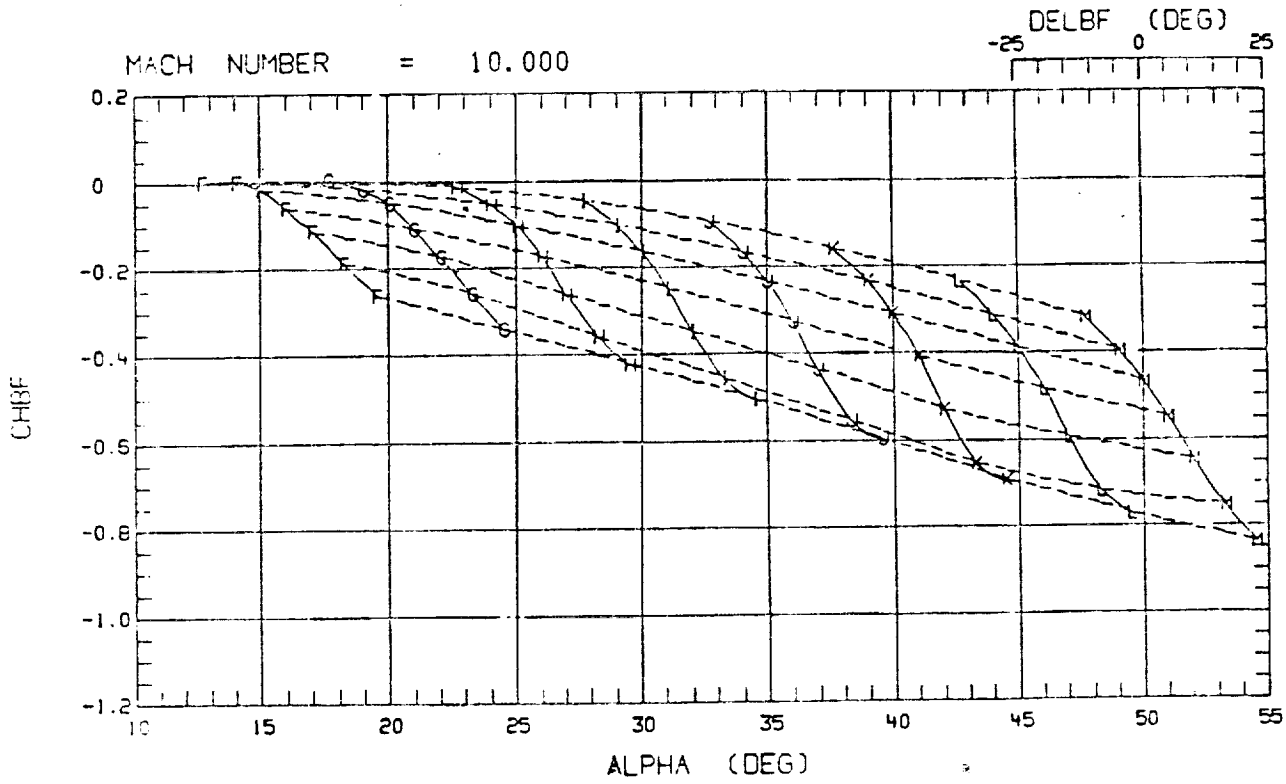
CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ FT.
WING SPAN BW = 70.056 FT.
M.A.C. CW = 39.550 FT
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00250	0.0	-0.01613
-5.000	-0.00735	-0.00326	0.00065	0.00428	0.00782	-0.00099	-0.01975	-0.05689
0.0	0.0	0.0	0.0	0.0	0.0	-0.01768	-0.05200	-0.10431
5.000	0.01954	0.00681	-0.00350	-0.01419	-0.03215	-0.05733	-0.11592	-0.17672
10.000	0.05190	0.01470	0.00972	-0.03759	-0.07419	-0.11777	-0.17777	-0.25166
16.300	0.07600	0.02385	-0.03100	-0.09050	-0.13000	-0.19006	-0.26100	-0.36000
22.500	0.02600	-0.02900	-0.00300	-0.13560	-0.18200	-0.26466	-0.34400	-0.46378

FIGURE 5.2-23
BODY FLAP HINGE MOMENT COEFFICIENT

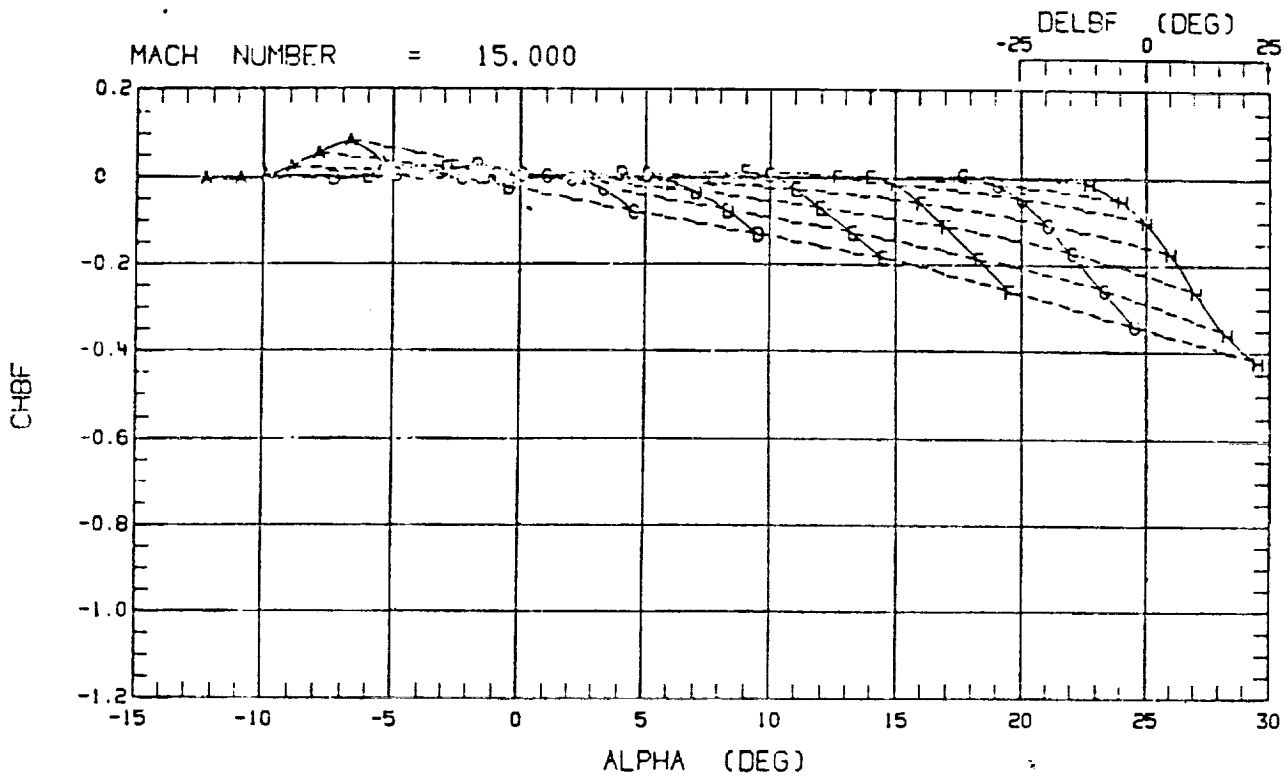


CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00250	0.0	-0.01613	-0.04700	-0.09754	-0.16200	-0.23675	-0.32300
-5.000	-0.00099	-0.01975	-0.05686	-0.10656	-0.16086	-0.23856	-0.31610	-0.40115
0.0	-0.01982	-0.05200	-0.10431	-0.16700	-0.23797	-0.31300	-0.39012	-0.47000
5.000	-0.06290	-0.11222	-0.17678	-0.24975	-0.32904	-0.41079	-0.49453	-0.55405
10.000	-0.11777	-0.17777	-0.26486	-0.35134	-0.44005	-0.53045	-0.59731	-0.64671
16.300	-0.19009	-0.26100	-0.36000	-0.45800	-0.55900	-0.65700	-0.71825	-0.75700
22.800	-0.28466	-0.34400	-0.42378	-0.50600	-0.60000	-0.69400	-0.77825	-0.84000

FIGURE 5.2-24
BODY FLAP HINGE MOMENT COEFFICIENT



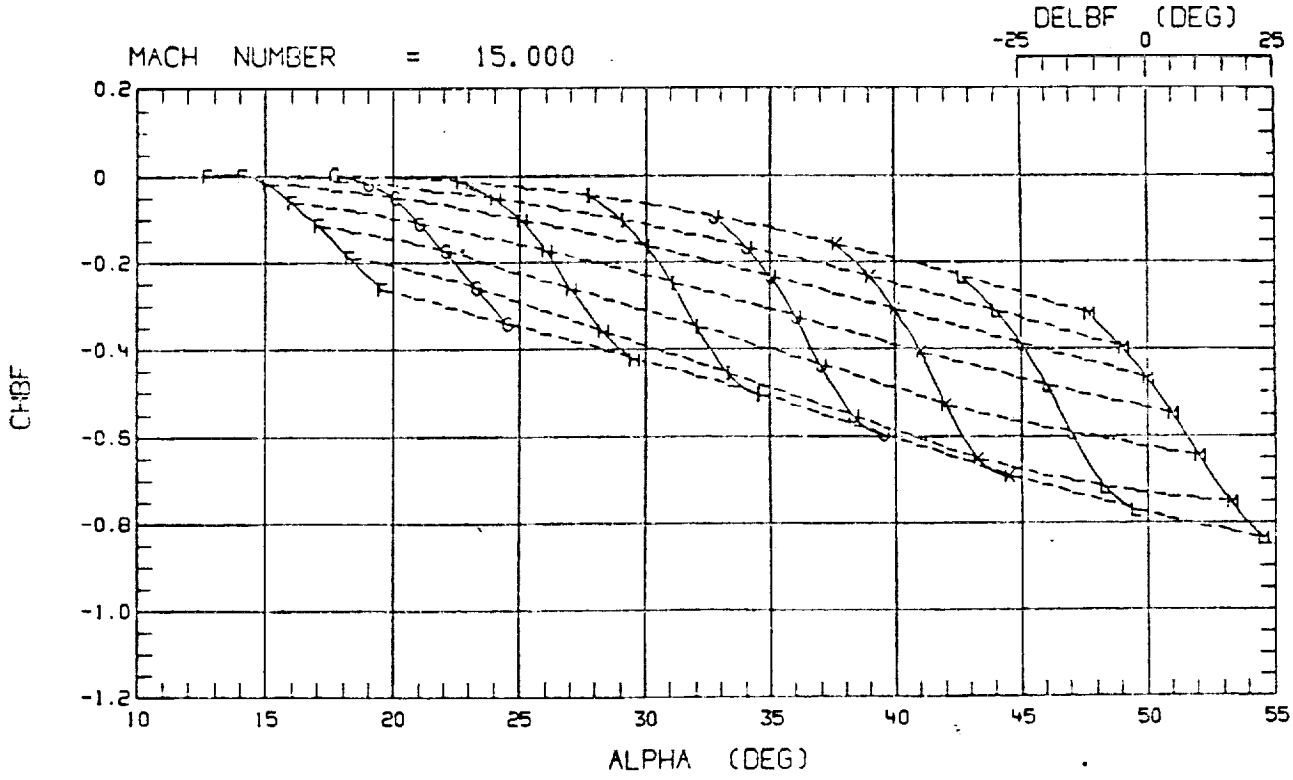
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1075.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00250	0.0	-0.01613
-5.000	-0.00735	-0.00326	0.00065	0.00428	0.00792	-0.00099	-0.01975	-0.05568
0.0	0.0	0.0	0.0	0.0	0.0	-0.01689	-0.05200	-0.10431
5.000	0.01954	0.00581	-0.00350	-0.01418	-0.03215	-0.06292	-0.11232	-0.17878
10.000	0.05190	0.01475	-0.00972	-0.03799	-0.07419	-0.11777	-0.17777	-0.26486
16.300	0.07800	0.02225	-0.03100	-0.08050	-0.13000	-0.19009	-0.28100	-0.36000
22.500	0.02600	-0.02900	-0.08300	-0.13550	-0.18600	-0.26468	-0.34400	-0.40379

ENGINEER HP
9/20/72

FIGURE 5.2-25
BODY FLAP HINGE MOMENT COEFFICIENT



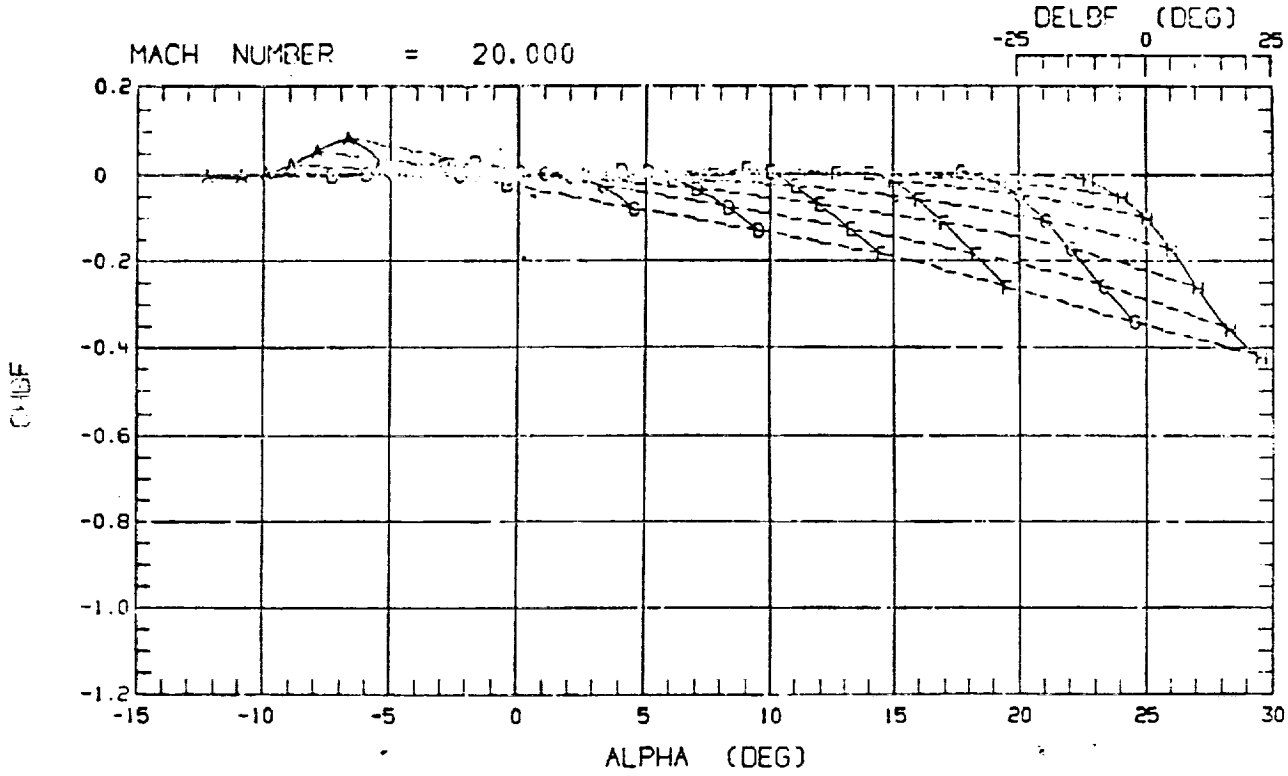
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00250	0.0	-0.01613	-0.04700	-0.09764	-0.16200	-0.23675	-0.32300
-5.000	-0.00099	-0.01975	-0.05688	-0.10656	-0.16826	-0.23956	-0.31610	-0.40115
0.0	-0.01888	-0.05200	-0.10431	-0.16700	-0.23797	-0.31300	-0.39012	-0.47000
5.000	-0.06292	-0.11222	-0.17678	-0.24975	-0.32904	-0.41079	-0.48453	-0.55405
10.000	-0.11777	-0.17777	-0.26486	-0.35134	-0.44005	-0.53045	-0.59731	-0.64971
16.300	-0.19009	-0.26100	-0.36000	-0.45900	-0.55800	-0.65700	-0.71925	-0.75700
22.500	-0.26466	-0.34400	-0.42378	-0.50600	-0.60000	-0.69400	-0.77205	-0.84000

ENGINEER MP
DATE 8/24/79

FIGURE 5.2-26
BODY FLAP HINGE MOMENT COEFFICIENT

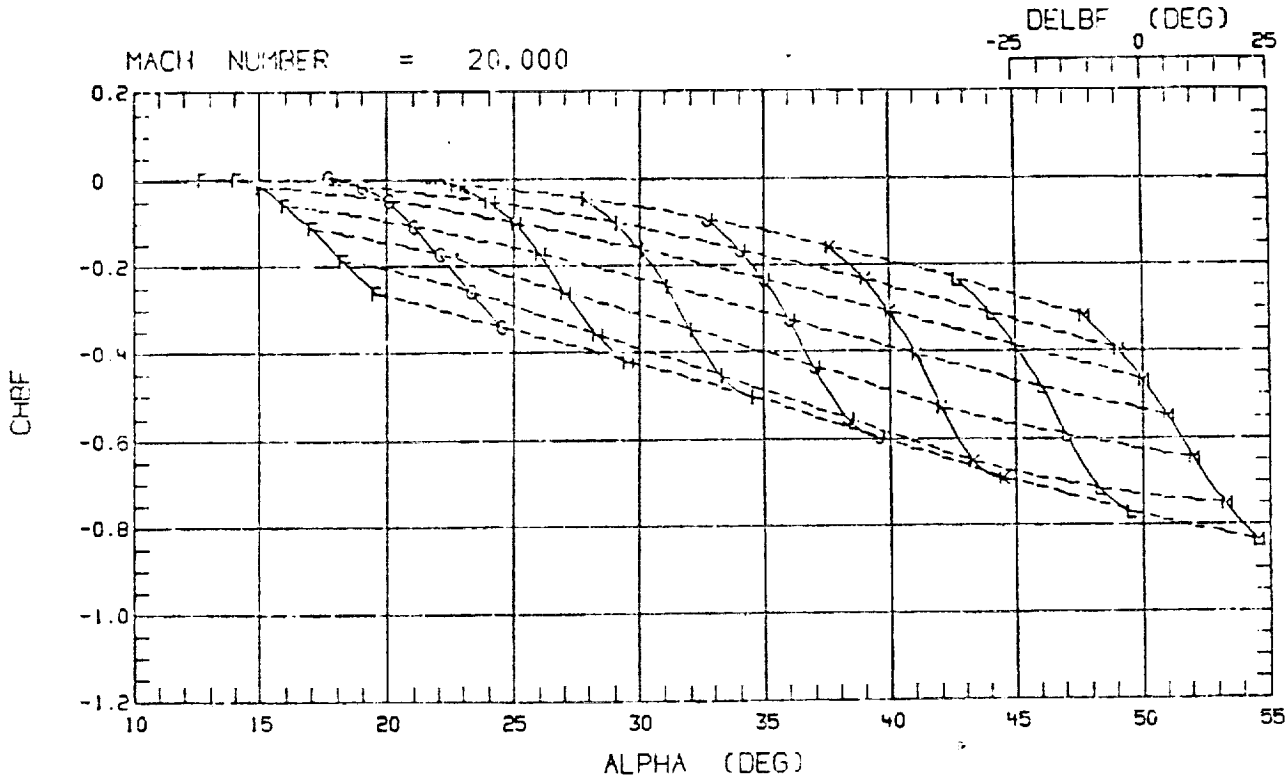


CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00500	-0.00500	-0.00500	-0.00500	-0.00500	-0.00550	0.0	-0.01613
-5.000	-0.00735	-0.00326	0.00065	0.00408	0.00732	-0.00093	-0.01975	-0.05600
0.0	0.0	0.0	0.0	0.0	0.0	-0.01995	-0.05800	-0.10431
5.000	0.01954	0.00531	-0.00350	-0.01418	-0.03215	-0.05782	-0.11282	-0.17678
10.000	0.05190	0.01475	-0.00972	-0.03798	-0.07418	-0.11777	-0.17777	-0.26466
16.300	0.07800	0.02225	-0.03100	-0.08050	-0.13000	-0.19709	-0.28100	-0.38000
22.500	0.08600	-0.03800	-0.08700	-0.13550	-0.18300	-0.26465	-0.34400	-0.42375

FIGURE 5.2-27
BODY FLAP HINGE MOMENT COEFFICIENT



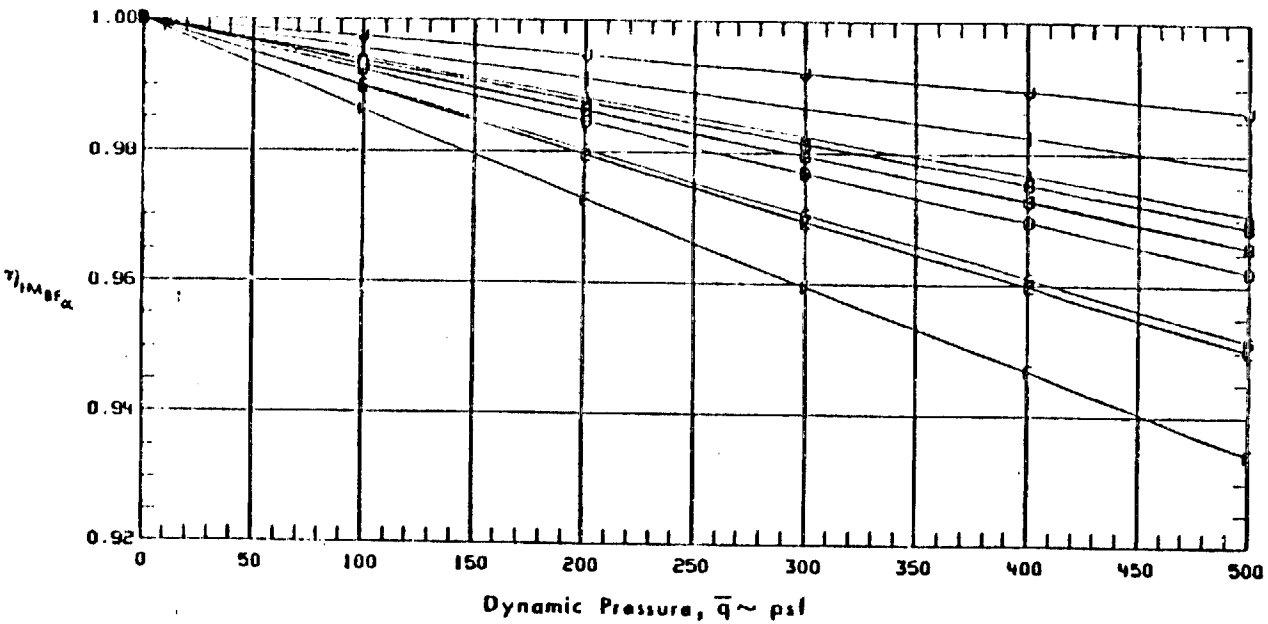
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP HINGE MOMENT							
-11.700	-0.00850	0.0	-0.01613	-0.04700	-0.09784	-0.16800	-0.23675	-0.32300
-5.000	-0.00097	-0.01975	-0.05698	-0.10656	-0.16995	-0.23908	-0.31810	-0.40115
0.0	-0.01898	-0.05200	-0.10431	-0.16700	-0.23797	-0.31300	-0.39012	-0.47000
5.000	-0.06290	-0.11282	-0.17678	-0.24975	-0.32904	-0.41079	-0.48453	-0.55405
10.000	-0.11777	-0.17777	-0.26486	-0.35134	-0.44005	-0.53045	-0.59731	-0.64871
16.300	-0.19009	-0.26100	-0.36000	-0.45900	-0.55800	-0.65700	-0.71925	-0.75700
22.500	-0.26466	-0.34400	-0.42378	-0.50900	-0.60000	-0.69400	-0.77205	-0.84300

ENGINEER [illegible]
DATE [illegible]

FIGURE 5.2-28
BODY FLAP HINGE MOMENT COEFFICIENT



$$\eta_{IM_{BF_\alpha}} = \frac{Ch^{F}_{BF_{\alpha-\alpha}} - Ch^{F}_{BF_{\alpha=0}}}{Ch^{R}_{BF_{\alpha-\alpha}} - Ch^{R}_{BF_{\alpha=0}}}$$

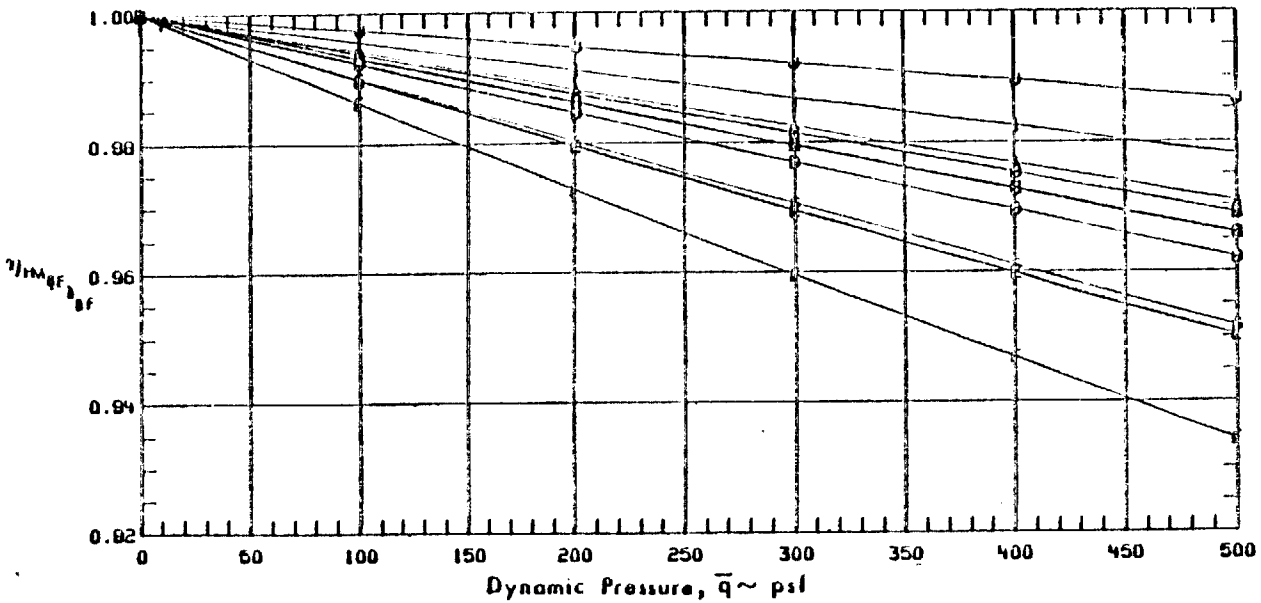
BODY FLAP

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{IM_{BF_\alpha}}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99403	0.99368	0.99301	0.99217	0.98957	0.98613	0.98995	0.99303	0.99552	0.99731
200.000	0.98813	0.98744	0.98611	0.98446	0.97936	0.97261	0.98008	0.98616	0.99108	0.99464
300.000	0.98230	0.98126	0.97929	0.97686	0.96936	0.95944	0.97041	0.97939	0.98667	0.99198
400.000	0.97656	0.97516	0.97255	0.96939	0.95959	0.94663	0.96093	0.97273	0.98230	0.98933
500.000	0.97065	0.96880	0.96565	0.96192	0.95005	0.93411	0.95147	0.96585	0.97785	0.98644

ENGINEER: DTO
DATE: 9/8/77
REVISED:

Figure 5.2-29
AEROELASTIC RATIOS

Rockwell International
Space Division



$$\eta_{IHM_{BF}}{}_{b_{BF}} = \frac{C^{f}_{h_{BF}}{}_{\substack{\alpha=\alpha \\ b_{f}=b_{fc}}} - C^{f}_{h_{BF}}{}_{\substack{\alpha=\alpha \\ b_{BF}=0}}}{C^{R}_{h_{BF}}{}_{\substack{\alpha=\alpha \\ b_{f}=b_{fc}}} - C^{R}_{h_{BF}}{}_{\substack{\alpha=\alpha \\ b_{BF}=0}}}$$

BODY FLAP

$\bar{q}$ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{IHM_{BF}}{}_{b_{BF}}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99403	0.99368	0.99301	0.99217	0.98957	0.98613	0.98995	0.99303	0.99552	0.99731
200.000	0.98813	0.98744	0.98611	0.98446	0.97936	0.97261	0.98008	0.98616	0.99108	0.99464
300.000	0.98230	0.98126	0.97929	0.97686	0.96936	0.95944	0.97041	0.97939	0.98667	0.99198
400.000	0.97656	0.97516	0.97255	0.96939	0.95959	0.94663	0.96093	0.97273	0.98230	0.98933
500.000	0.97065	0.96880	0.96565	0.96192	0.95005	0.93411	0.95147	0.96585	0.97785	0.98644

ENGINEER: DZD
DATE: 9/8/77
REVISED:

Figure 5.2-30
AEROELASTIC RATIOS

Rockwell International
Space Division

5.3 RUDDER/SPEED BRAKE CONTROL HINGE MOMENT COEFFICIENTS. The rudder/speed brake control hinge moment coefficients are based on theoretical reference dimensions. The rudder reference area (per side panel) is 100.15 ft^2. The reference length (mean aerodynamic chord) is 73.2 inches. Rudder hinge moment (for a single post-actuator operating rudder only) is:

$$HM_{Rudder} = HM_{RIGHT} - HM_{LEFT}$$

Speed brake hinge moment is:

$$HM_{Speedbrake} = HM_{RIGHT} + HM_{LEFT}$$

where,

$$HM_{RIGHT} = (C_{h_{PANEL}} + C_{h_{\beta_{RIGHT}}} \beta + C_{h_{\delta_{r_{RIGHT}}}} \delta_r)(\bar{q}\ S_r\ \bar{c}_r)$$

$$HM_{LEFT} = (C_{h_{PANEL}} + C_{h_{\beta_{LEFT}}} \beta + C_{h_{\delta_{r_{LEFT}}}} \delta_r)(\bar{q}\ S_r\ \bar{c}_r)$$

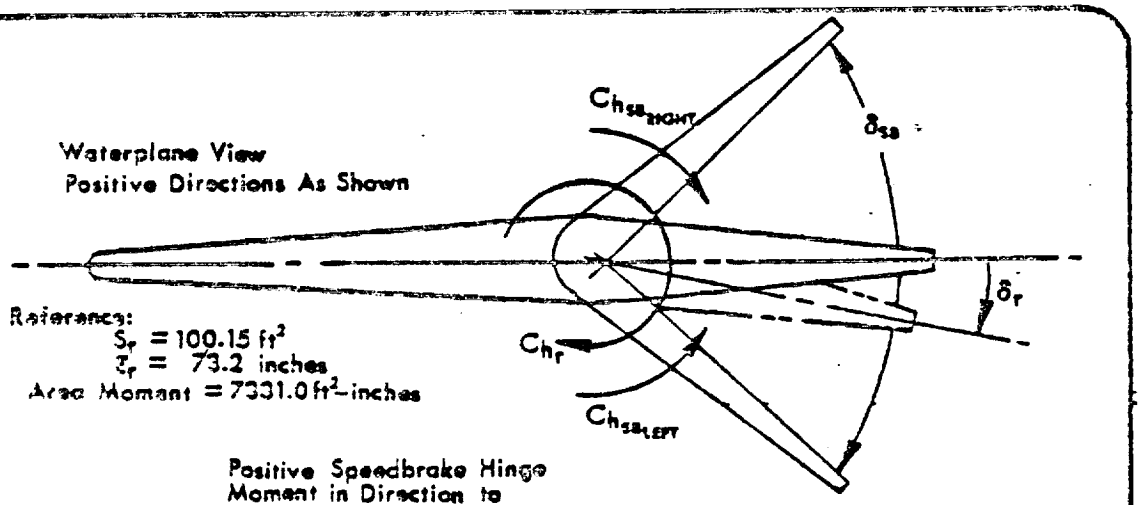


Figure 5.3-1
RUDDER / SPEEDBRAKE

The effect of aeroelastic deformation on the rudder/speedbrake hinge moment coefficients is determined by means of the following equations:

$$C^{E}_{h_{\substack{\text{RUDDER/}\\\text{SPEEDBRAKE}}}} = C^{R}_{h_{PANEL}} + \eta_{HM_\beta} C^{R}_{h_\beta} \beta + \eta_{HM_r} C^{R}_{h_{\delta r}} \delta r \qquad \text{Equation for } \begin{cases} \text{TOTAL} \\ \text{OR} \\ \text{LEFT} \\ \text{OR} \\ \text{RIGHT} \end{cases}$$

To determine the coefficients for left-hand panel and right-hand panel, note that;

$$C^{R}_{h_{\substack{PANEL\\LEFT}}} = C^{R}_{h_{\substack{PANEL\\RIGHT}}}$$

$$C^{R}_{h_{\beta_{LEFT}}} = -C^{R}_{h_{\beta_{RIGHT}}}$$

$$C^{R}_{h_{\delta r_{LEFT}}} = -C^{R}_{h_{\delta r_{RIGHT}}}$$

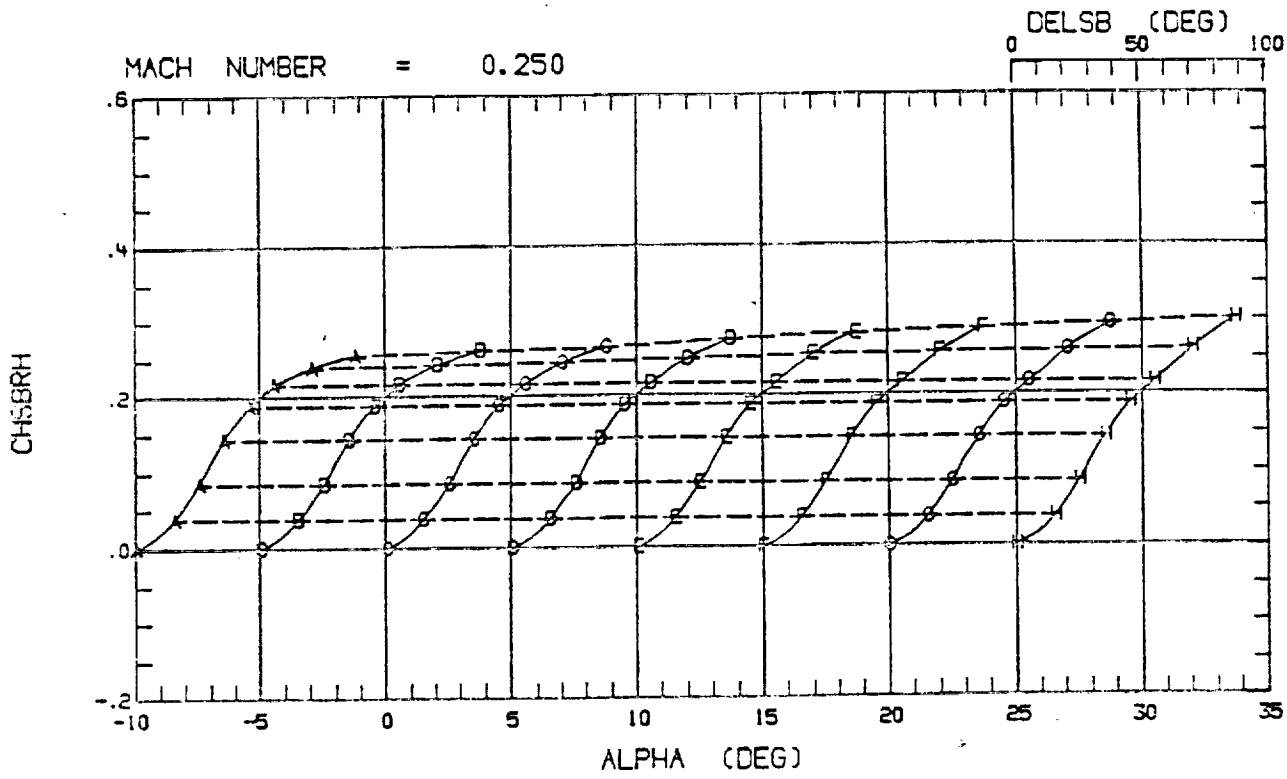
where,

$C^{R}_{h_{PANEL}}$ =	Rigid speedbrake hinge moment coefficient for one panel.	(Figures 5.3-2 through -28)
$C^{R}_{h_\beta}$ =	Rigid rudder/speedbrake hinge moment coefficient due to sideslip angle, β.	(Figures 5.3-29 through -55)
$C^{R}_{h_{\delta r}}$ =	Rigid hinge moment coefficient due to rudder deflection, δr.	(Figures 5.3-56 through -82)
η_{HM_β} =	Flexible to rigid hinge moment ratio due to sideslip.	(Figures 5.3 -83)
η_{HM_R} =	Flexible to rigid hinge moment ratio due to rudder deflection, δr.	(Figures 5.3 -84)

$$C_{h_{TOTAL}} = C_{h_{\substack{PANEL\\RIGHT}}} + C_{h_{\substack{PANEL\\LEFT}}}$$

$$C_{h_{\beta_{TOTAL}}} = C_{h_{\beta_{RIGHT}}} - C_{h_{\beta_{LEFT}}}$$

$$C_{h_{\delta r_{TOTAL}}} = C_{h_{\delta r_{RIGHT}}} - C_{h_{\delta r_{LEFT}}}$$



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700
25.000	0.08500	0.08500	0.08500	0.08500	0.08500	0.08500	0.08500	0.08500
35.000	0.14400	0.14400	0.14400	0.14400	0.14400	0.14400	0.14400	0.14400
45.000	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700
55.000	0.21600	0.21600	0.21600	0.21600	0.21600	0.21600	0.21600	0.21600
70.000	0.23900	0.24200	0.24500	0.24900	0.25400	0.25600	0.25800	0.26000
87.200	0.25500	0.26000	0.26500	0.27500	0.28200	0.28600	0.29400	0.30000

ENGINEER
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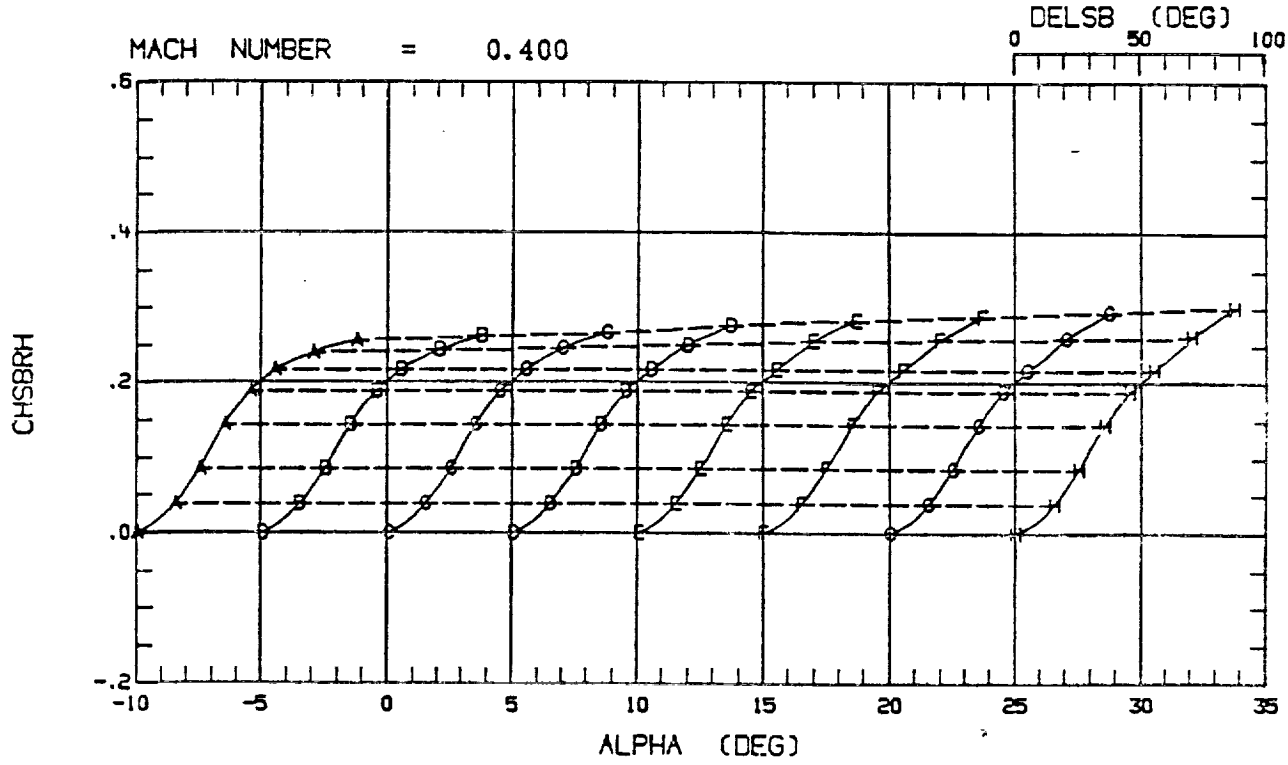
FIGURE 5.3-2
SPEEDBRAKE HINGE MOMENT COEFFICIENT

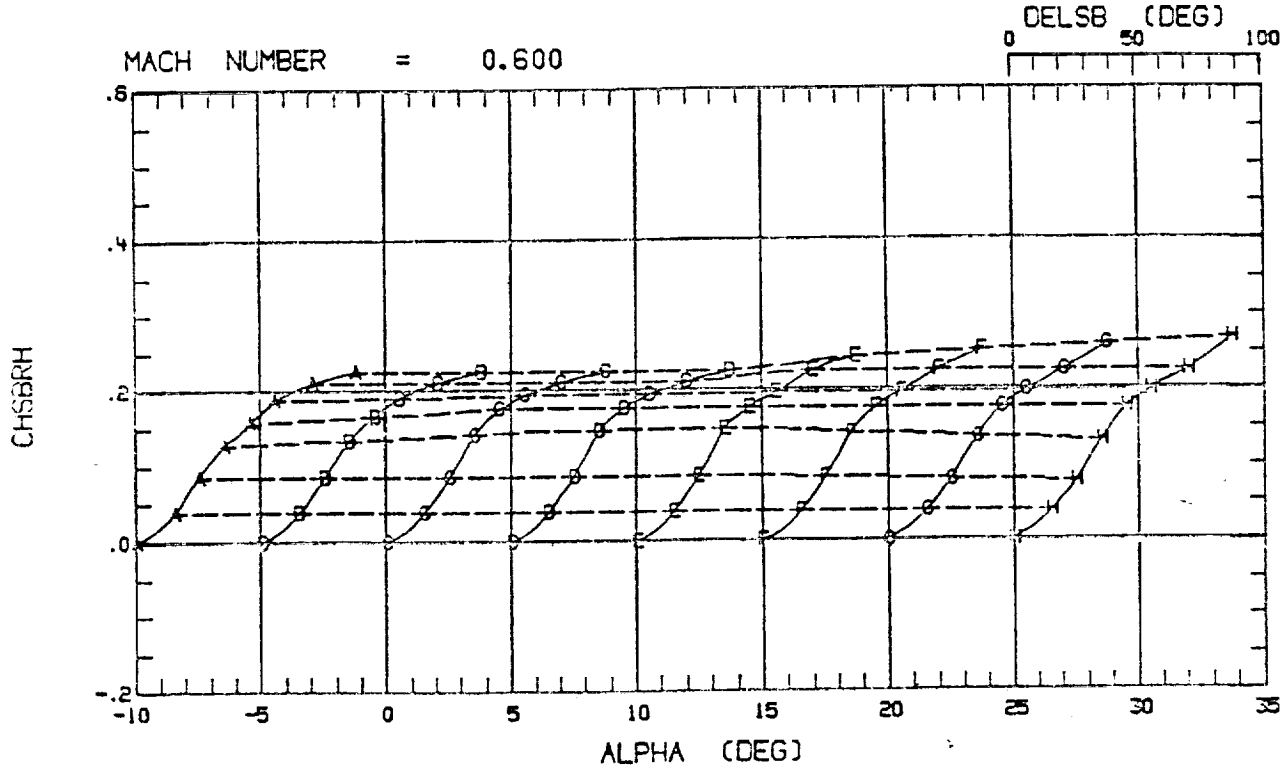


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700
25.000	0.08500	0.08500	0.08500	0.08500	0.08500	0.08500	0.08500	0.08500
35.000	0.14400	0.14400	0.14400	0.14400	0.14400	0.14400	0.14400	0.14400
45.000	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700
55.000	0.21600	0.21600	0.21600	0.21600	0.21600	0.21600	0.21600	0.21600
70.000	0.23900	0.24200	0.24500	0.24900	0.25400	0.25600	0.25800	0.26000
87.200	0.25500	0.25000	0.26500	0.27500	0.28200	0.28800	0.29400	0.30000

ENGINEER HP
DATE 10/2/73

FIGURE 5.3-3
SPEEDBRAKE HINGE MOMENT COEFFICIENT



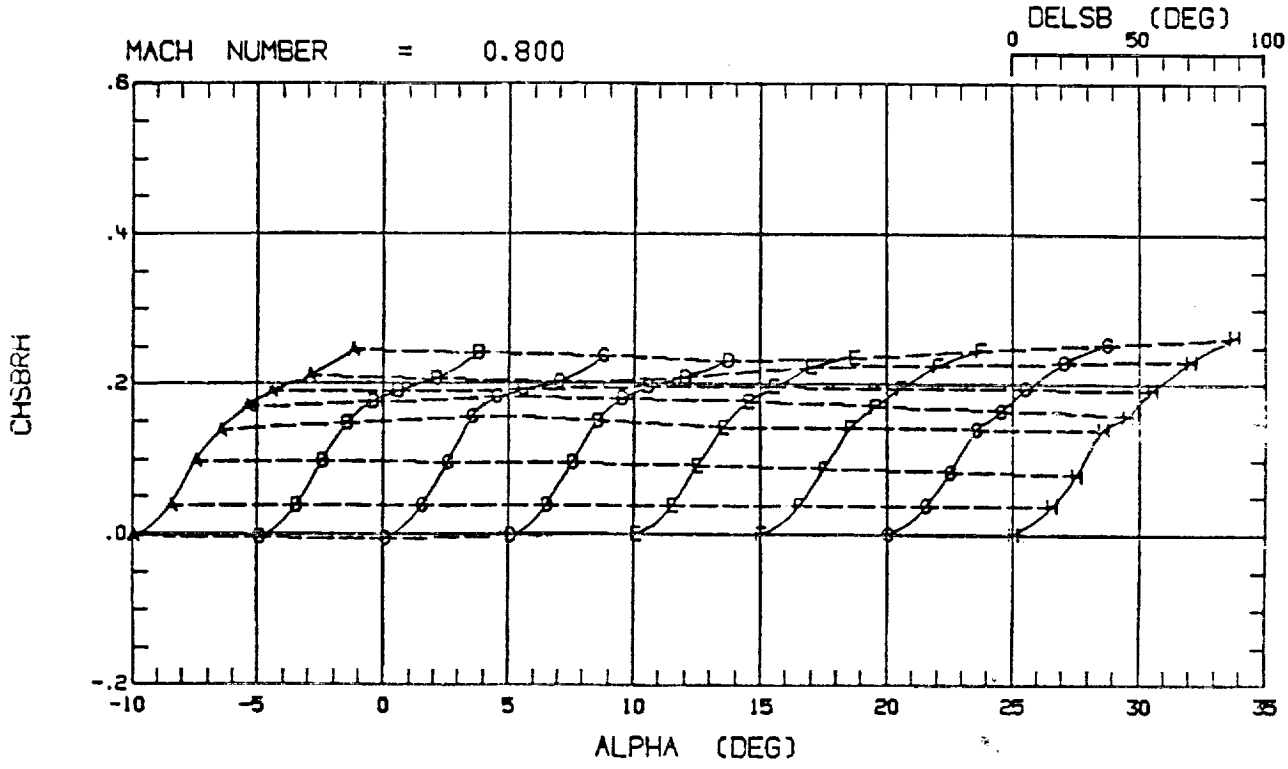
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700
25.000	0.08500	0.08500	0.08500	0.08500	0.08500	0.08200	0.07900	0.07600
35.000	0.12600	0.13400	0.14200	0.14600	0.14800	0.14200	0.13600	0.13000
45.000	0.15700	0.16600	0.17500	0.17600	0.17600	0.17600	0.17600	0.17600
55.000	0.16700	0.19000	0.19300	0.19300	0.19500	0.19600	0.19700	0.19800
70.000	0.21000	0.21000	0.21000	0.21000	0.22500	0.22500	0.22500	0.22500
87.200	0.22400	0.22400	0.22400	0.22400	0.24200	0.25000	0.25800	0.26600

ENGINEER HP
DATE 10/12/72

FIGURE 5.3-4
SPEEDBRAKE HINGE MOMENT COEFFICIENT



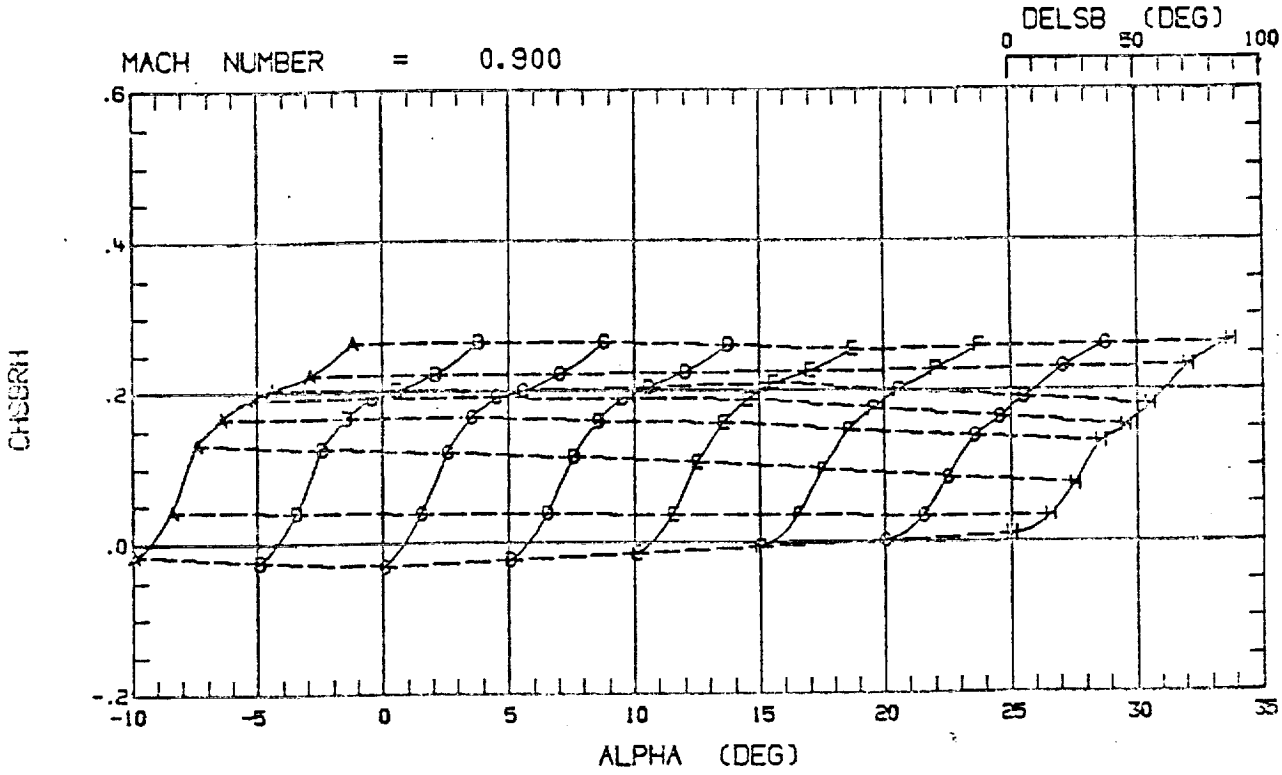
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	-0.00400	-0.00600	-0.00800	-0.00400	0.0	0.0	0.0	0.0
15.000	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700	0.03700
25.000	0.09700	0.09600	0.09500	0.09400	0.09100	0.08700	0.08300	0.07900
35.000	0.13800	0.14700	0.15600	0.15000	0.14200	0.14100	0.14000	0.13900
45.000	0.16900	0.17500	0.18100	0.17900	0.17600	0.17000	0.16400	0.15800
55.000	0.18900	0.19000	0.19100	0.19500	0.19500	0.19400	0.19300	0.19200
70.000	0.21000	0.20600	0.20200	0.20900	0.22200	0.22500	0.22900	0.23100
87.200	0.24400	0.24000	0.23600	0.23000	0.23500	0.24400	0.25300	0.26200

ENGINEER HP
DATE 6/22/78

FIGURE 5.3-5
SPEEDBRAKE HINGE MOMENT COEFFICIENT

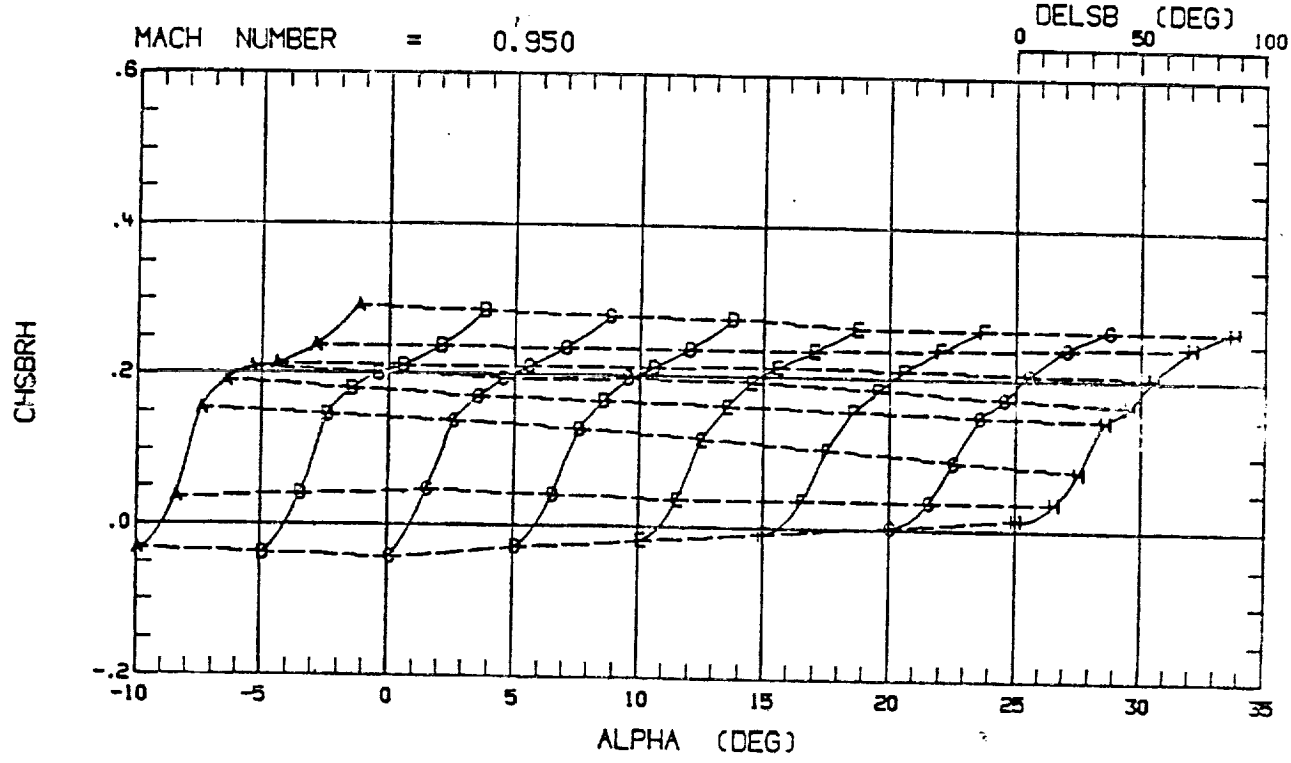


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	-0.01800	-0.02500	-0.03200	-0.02400	-0.01500	-0.00700	0.00100	0.00900
15.000	0.04200	0.04000	0.03800	0.03700	0.03600	0.03500	0.03400	0.03300
25.000	0.13000	0.12400	0.11800	0.11200	0.10500	0.09500	0.08500	0.07500
35.000	0.16500	0.16500	0.16500	0.16000	0.15700	0.14800	0.13900	0.13000
45.000	0.19100	0.19100	0.19100	0.19000	0.18800	0.17600	0.16400	0.15200
55.000	0.20400	0.20200	0.20000	0.20500	0.21000	0.20000	0.19000	0.18000
70.000	0.22200	0.22200	0.22200	0.22500	0.22600	0.22800	0.23000	0.23200
87.200	0.26500	0.26500	0.26500	0.26000	0.25500	0.25800	0.26100	0.26400

ENGINEER [illegible]
DATE 10/2/72

FIGURE 5.3-6
SPEEDBRAKE HINGE MOMENT COEFFICIENT

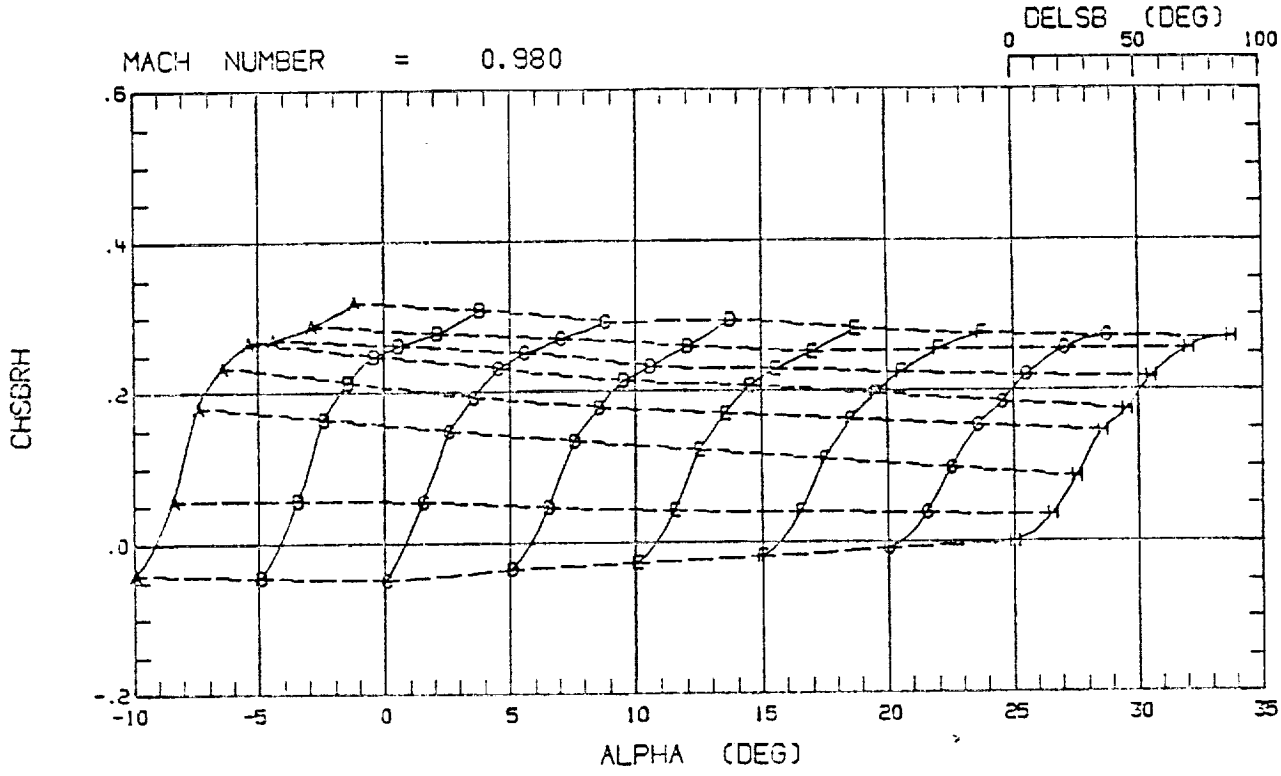


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	-0.03400	-0.03900	-0.04400	-0.03000	-0.02000	-0.00900	0.00200	0.01300
15.000	0.03500	0.04000	0.04500	0.04000	0.03500	0.03500	0.03500	0.03500
25.000	0.15300	0.14500	0.13700	0.12700	0.11500	0.10200	0.08900	0.07600
35.000	0.19000	0.18000	0.17000	0.16500	0.16000	0.15500	0.15000	0.14500
45.000	0.20900	0.20100	0.19300	0.19500	0.19200	0.18300	0.17400	0.16500
55.000	0.21200	0.21100	0.21000	0.21000	0.21300	0.21000	0.20700	0.20400
70.000	0.23700	0.23600	0.23500	0.23500	0.23500	0.23800	0.24100	0.24400
87.200	0.28900	0.28300	0.27700	0.27500	0.26500	0.26500	0.26500	0.26500

ENGINEER AP
DATE 6/12/78

FIGURE 5.3-7
SPEEDBRAKE HINGE MOMENT COEFFICIENT



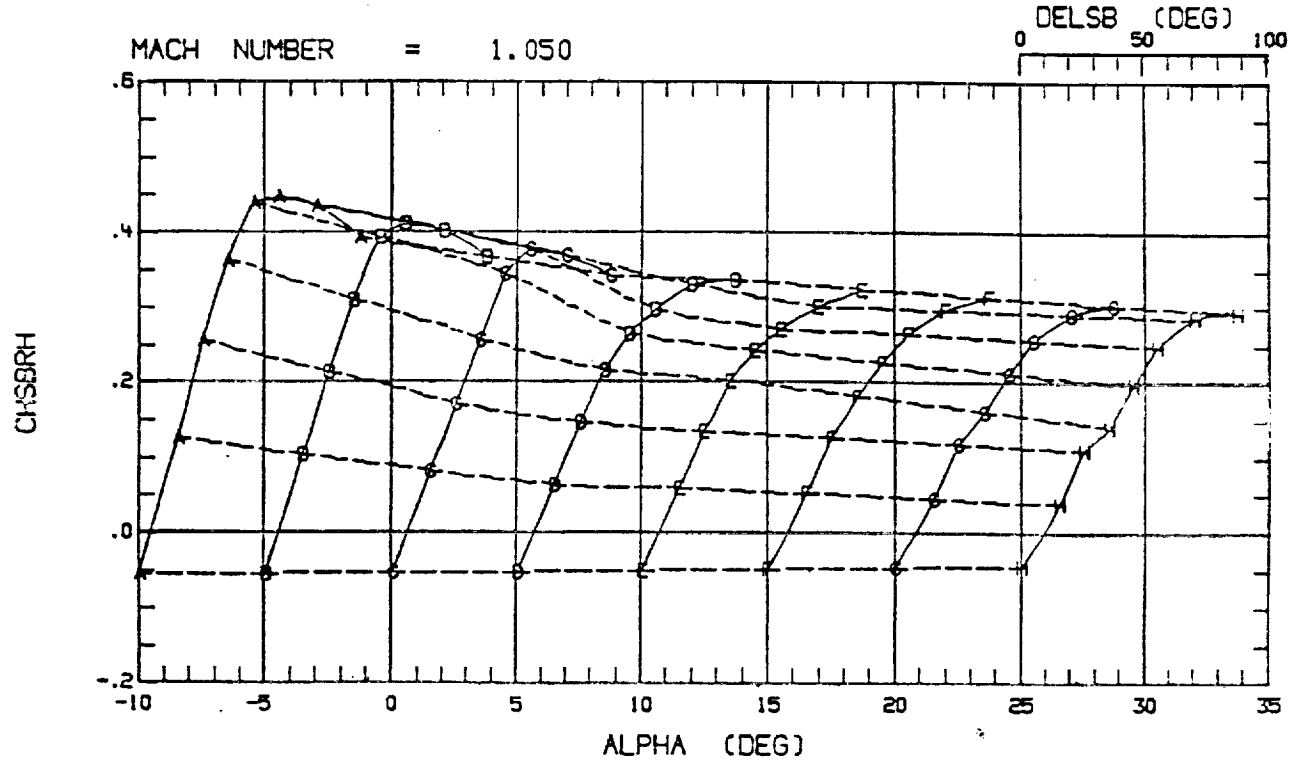
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	-0.04244	-0.04594	-0.04938	-0.03610	-0.02788	-0.01876	-0.00972	-0.00074
15.000	0.05611	0.05532	0.05458	0.04542	0.04099	0.03980	0.03665	0.03575
25.000	0.17955	0.16338	0.14703	0.13298	0.12027	0.10819	0.09611	0.08404
35.000	0.23316	0.21208	0.19130	0.17956	0.17043	0.16164	0.15380	0.14564
45.000	0.26525	0.24723	0.22945	0.21333	0.20556	0.19560	0.18451	0.17378
55.000	0.26937	0.26022	0.25107	0.23255	0.22687	0.22415	0.21987	0.21694
70.000	0.28673	0.27769	0.26864	0.25935	0.25160	0.25392	0.25526	0.25555
87.200	0.31708	0.30698	0.29197	0.29300	0.28192	0.27466	0.27131	0.26864

ENGINEER _____
DATE _____

FIGURE 5.3-8
SPEEDBRAKE HINGE MOMENT COEFFICIENT

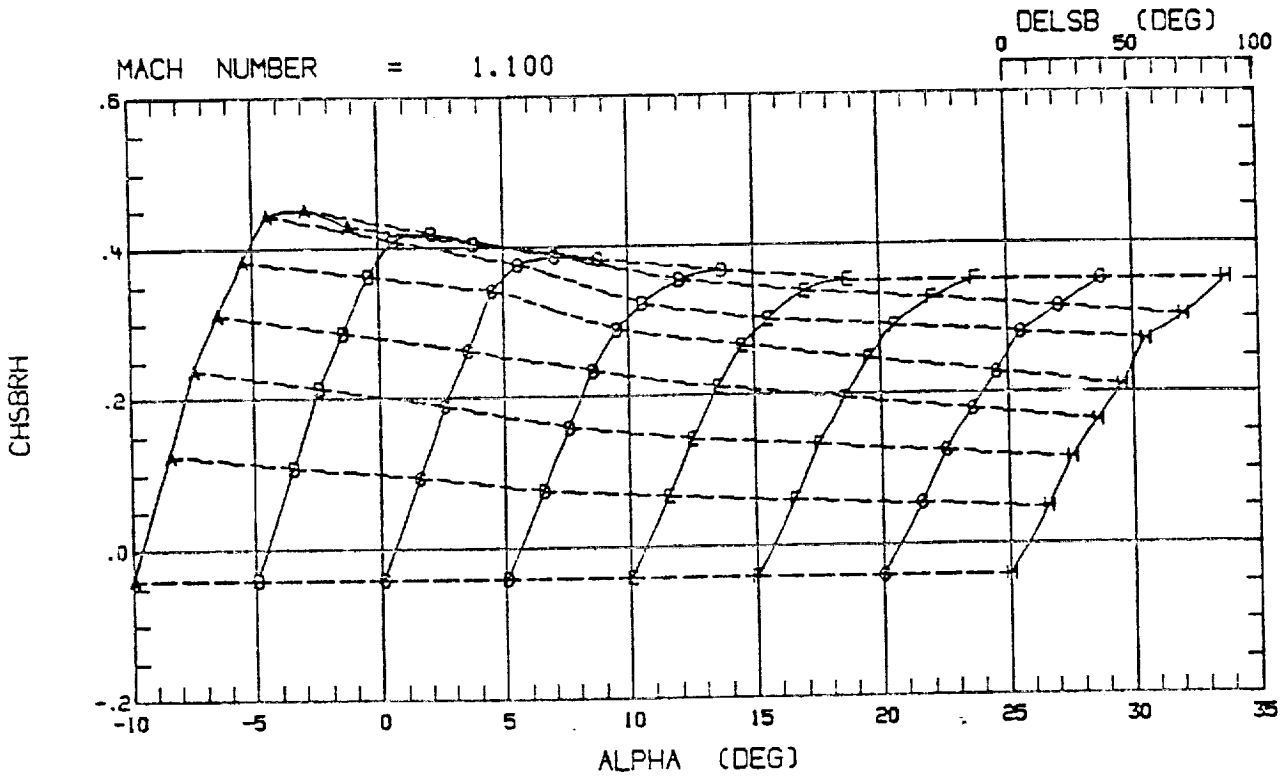


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	-0.05600	-0.05500	-0.05400	-0.05300	-0.05100	-0.04900	-0.04700	-0.04500
15.000	0.12400	0.10200	0.08000	0.06200	0.05800	0.05100	0.04400	0.03700
25.000	0.25400	0.21200	0.17000	0.14500	0.13200	0.12400	0.11600	0.10800
35.000	0.36100	0.30800	0.25500	0.21500	0.20000	0.18000	0.16000	0.14000
45.000	0.43800	0.39000	0.34200	0.26300	0.24000	0.22500	0.21000	0.19500
55.000	0.44500	0.41000	0.37500	0.29500	0.27000	0.26200	0.25400	0.24600
70.000	0.43400	0.40000	0.36600	0.32700	0.30000	0.29500	0.29000	0.28500
87.200	0.39000	0.36500	0.34000	0.33500	0.32200	0.31200	0.30200	0.29200

ENGINEER HP
DATE 10/3/78

FIGURE 5.3-9
SPEEDBRAKE HINGE MOMENT COEFFICIENT

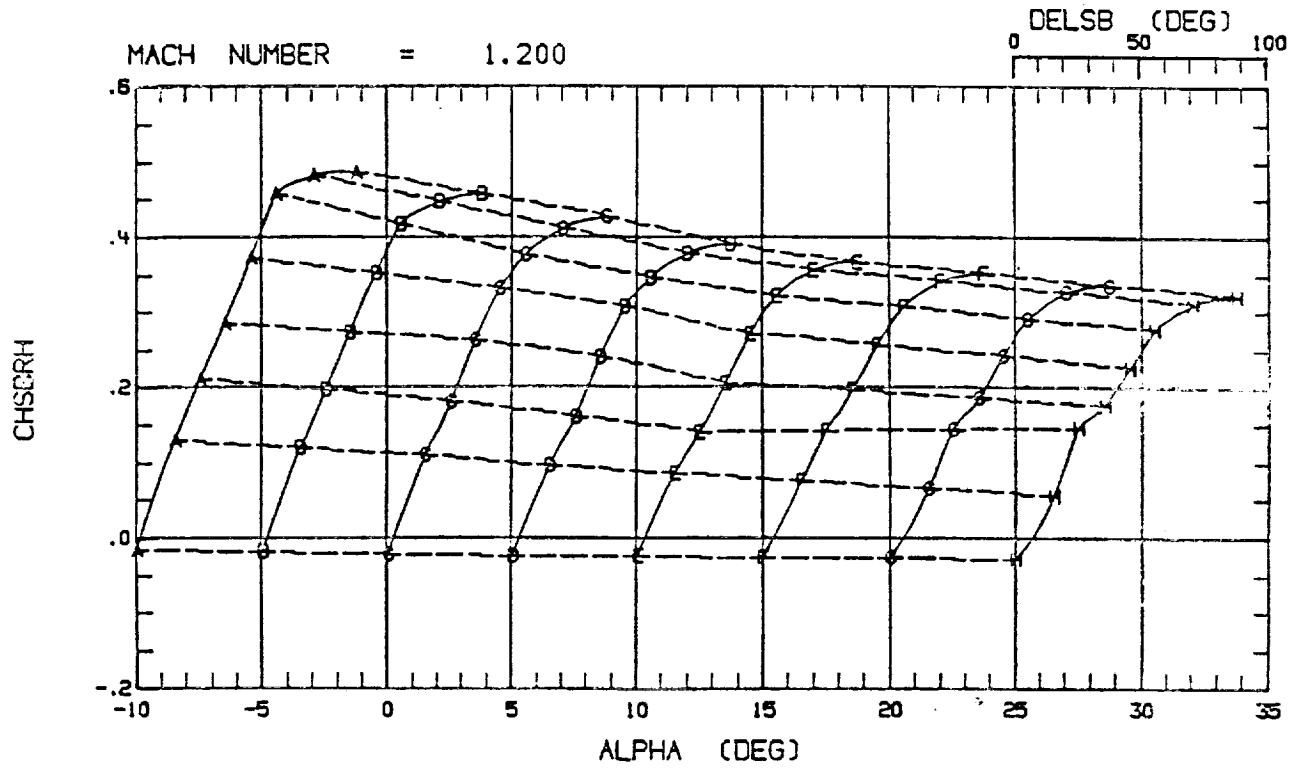


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	-0.04200	-0.04200	-0.04200	-0.04200	-0.04200	-0.04200	-0.04200	-0.04200
15.000	0.12200	0.10700	0.09200	0.07500	0.06500	0.05900	0.05300	0.04700
25.000	0.23700	0.21200	0.18700	0.15800	0.14200	0.13200	0.12200	0.11200
35.000	0.31000	0.26500	0.26000	0.23300	0.21000	0.19400	0.17800	0.16200
45.000	0.38000	0.36000	0.34000	0.28700	0.26500	0.24600	0.22700	0.20800
55.000	0.44100	0.40800	0.37500	0.32200	0.30000	0.29000	0.28000	0.27000
70.000	0.44900	0.41700	0.38500	0.35300	0.33700	0.32500	0.31300	0.30100
87.200	0.42800	0.40400	0.38000	0.36500	0.35000	0.35000	0.35000	0.35000

ENGINEER _____
DATE 10/12/78

FIGURE 5.3-10
SPEEDBRAKE HINGE MOMENT COEFFICIENT

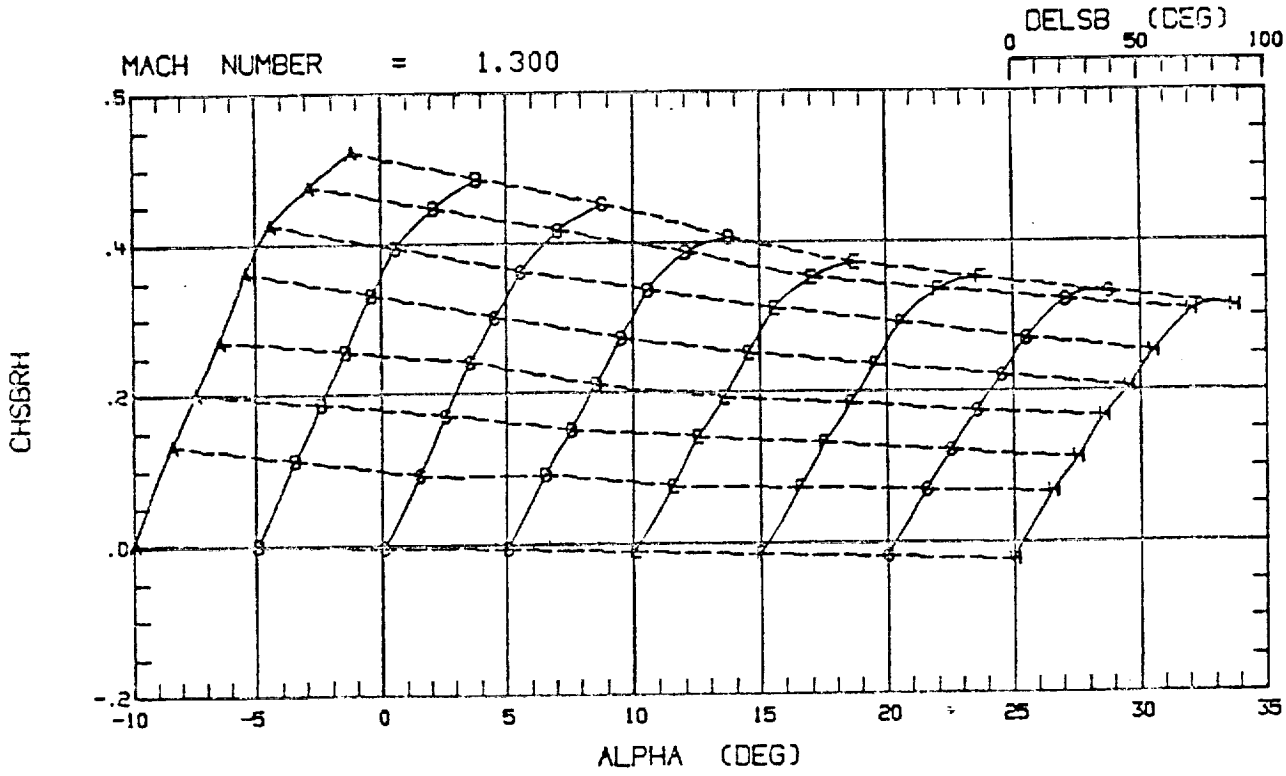


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	-0.01700	-0.02000	-0.02300	-0.02500	-0.02500	-0.02700	-0.02800	-0.02900
15.000	0.12800	0.11800	0.10800	0.09400	0.08400	0.07400	0.06400	0.05400
25.000	0.21000	0.19500	0.18000	0.16000	0.14000	0.14200	0.14400	0.14600
35.000	0.28400	0.27200	0.26000	0.23800	0.20500	0.19500	0.18500	0.17500
45.000	0.37000	0.35000	0.33000	0.30500	0.27000	0.25500	0.24000	0.22500
55.000	0.45500	0.41500	0.37500	0.34500	0.32000	0.30500	0.29000	0.27500
70.000	0.48000	0.44500	0.41000	0.37700	0.35500	0.34000	0.32500	0.31000
87.200	0.48500	0.45500	0.42500	0.38800	0.36500	0.35000	0.33500	0.32000

ENGINEER HP
DATE 6/3/28

FIGURE 5.3-11
SPEEDBRAKE HINGE MOMENT COEFFICIENT

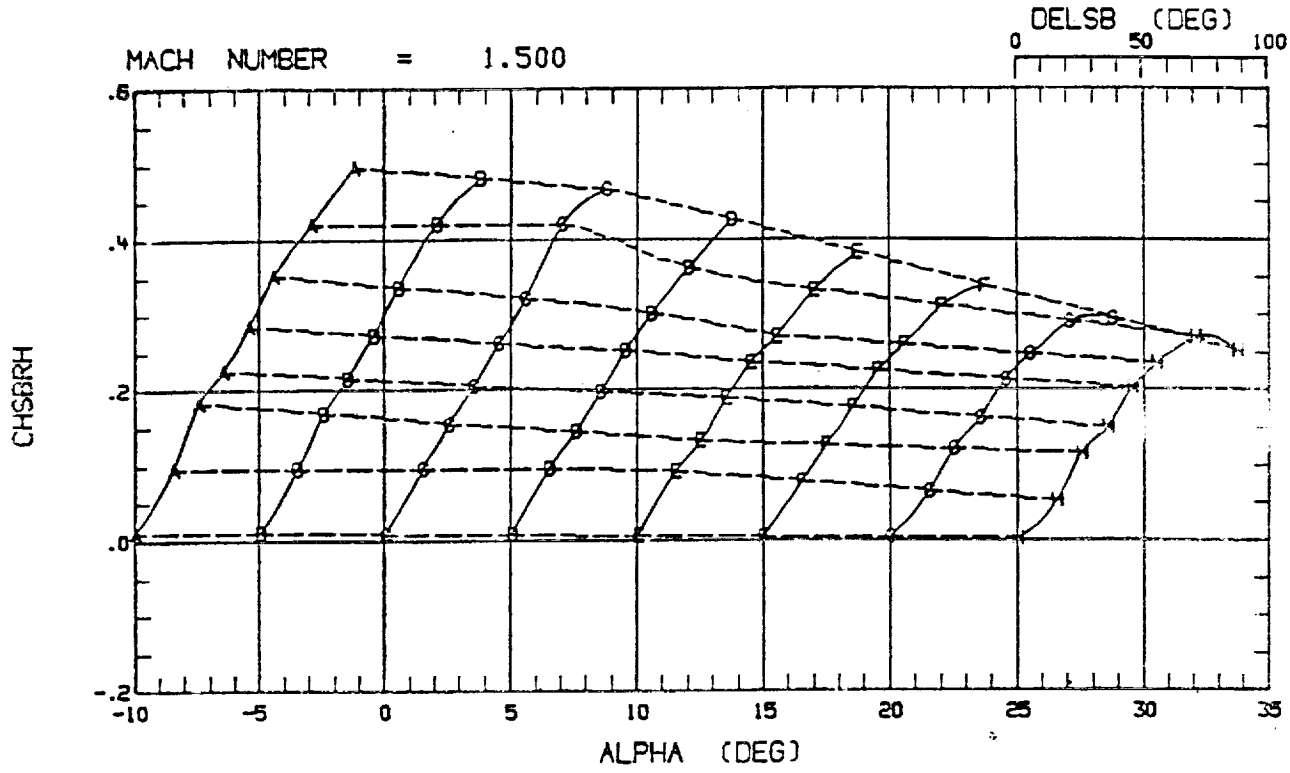


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.00100	-0.00200	-0.00500	-0.00700	-0.01200	-0.01600	-0.02000	-0.02400
15.000	0.13000	0.11000	0.09000	0.09000	0.07500	0.07200	0.06900	0.06600
25.000	0.20000	0.18500	0.17000	0.15000	0.14000	0.13000	0.12000	0.11000
35.000	0.27000	0.25500	0.24000	0.21000	0.19200	0.18300	0.17400	0.16500
45.000	0.36000	0.33000	0.30000	0.27200	0.25000	0.23500	0.22000	0.20500
55.000	0.42400	0.39200	0.36000	0.33500	0.31000	0.29000	0.27000	0.25000
70.000	0.47500	0.44500	0.41500	0.38500	0.35000	0.33500	0.32000	0.30500
87.200	0.52000	0.48500	0.45000	0.40500	0.37000	0.35000	0.33000	0.31000

ENGINEER HD
DATE 12/13/73

FIGURE 5.3-12
SPEEDBRAKE HINGE MOMENT COEFFICIENT

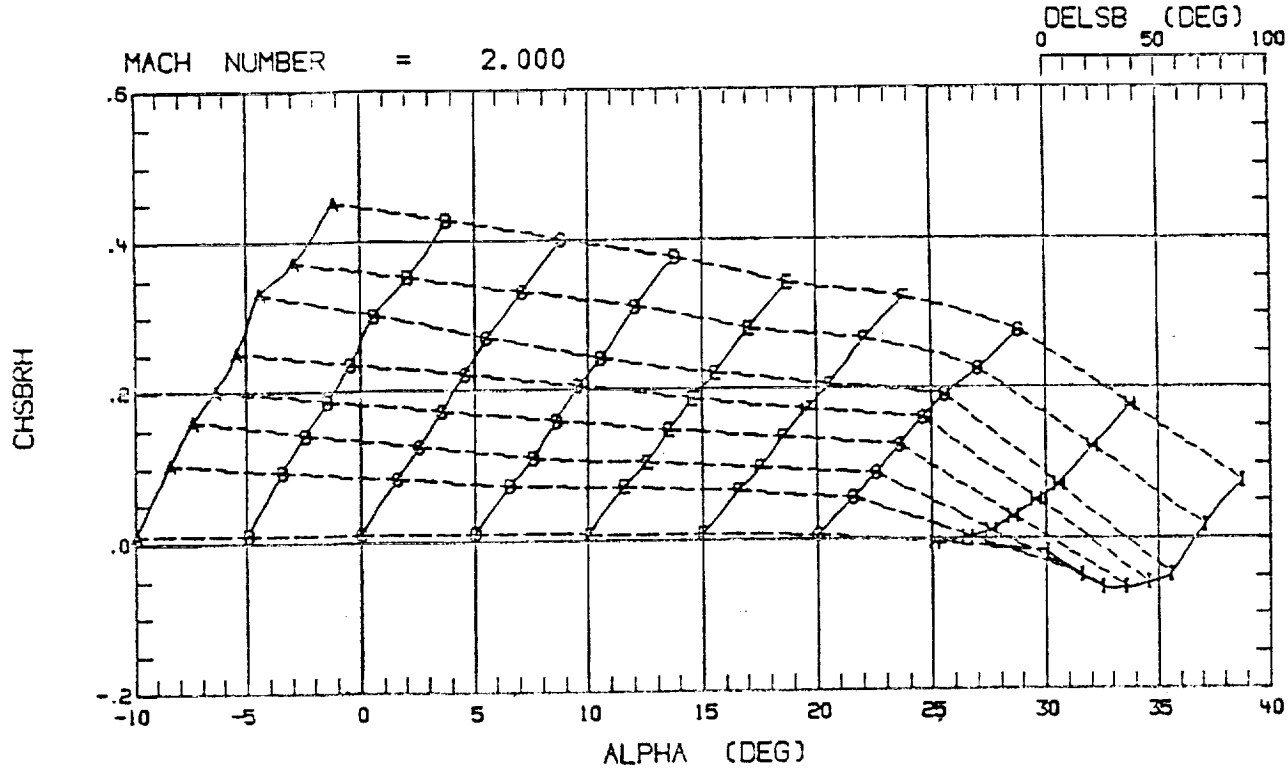


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.01000	0.00900	0.00800	0.00700	0.00500	0.00400	0.00300	0.00200
15.000	0.09600	0.09500	0.09500	0.09500	0.09000	0.07700	0.06400	0.05100
25.000	0.18200	0.16800	0.15400	0.14300	0.13000	0.12500	0.12000	0.11500
35.000	0.22500	0.21500	0.20500	0.19500	0.18800	0.17500	0.16200	0.14900
45.000	0.28400	0.27200	0.26000	0.25000	0.23500	0.22400	0.21300	0.20200
55.000	0.35000	0.33500	0.32000	0.30000	0.27000	0.25800	0.24600	0.23400
70.000	0.42000	0.42000	0.42000	0.36000	0.33000	0.31000	0.29000	0.27000
87.200	0.49600	0.48000	0.46500	0.42500	0.38000	0.33700	0.29400	0.25100

ENGINEER HP
DATE 10/2/78

FIGURE 5.3-13
SPEEDBRAKE HINGE MOMENT COEFFICIENT



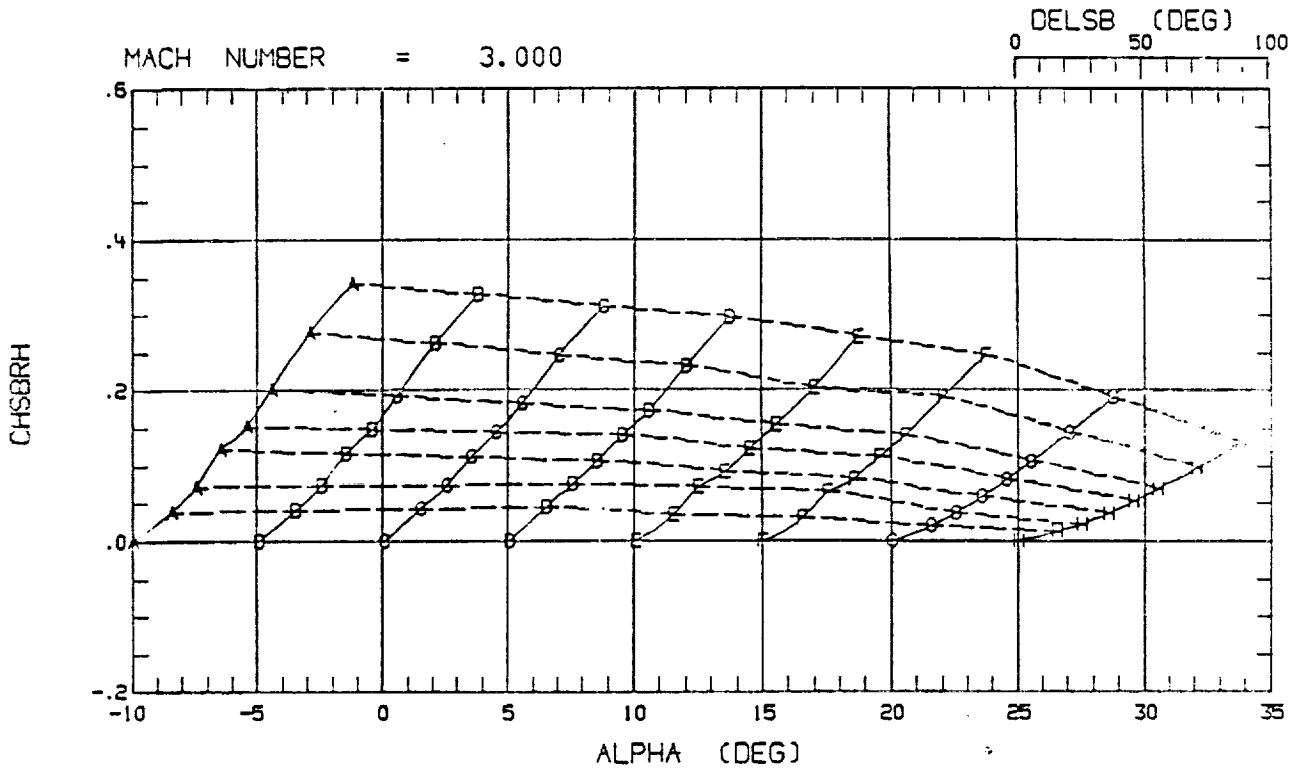
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT								
0.0	0.01000	0.01000	0.01000	0.01000	0.00800	0.00700	0.00500	-0.00700	-0.01900
15.000	0.10200	0.09200	0.08200	0.07200	0.07000	0.06300	0.05300	0.00200	-0.04900
25.000	0.15900	0.14200	0.12500	0.10900	0.10200	0.09500	0.08600	0.01000	-0.06600
35.000	0.20000	0.18600	0.17200	0.15800	0.14500	0.13500	0.12200	0.02800	-0.06600
45.000	0.25000	0.23500	0.22000	0.20500	0.18500	0.17200	0.16000	0.05000	-0.06000
55.000	0.33000	0.30000	0.27000	0.24000	0.22000	0.20500	0.19000	0.07000	-0.05000
70.000	0.37000	0.35000	0.33000	0.31000	0.29000	0.26500	0.22500	0.12000	0.01500
87.200	0.45000	0.42500	0.40000	0.37500	0.34000	0.32000	0.27500	0.17500	0.07500

ENGINEER HP
DATE 10/31/78

FIGURE 5.3-14
SPEEDBRAKE HINGE MOMENT COEFFICIENT

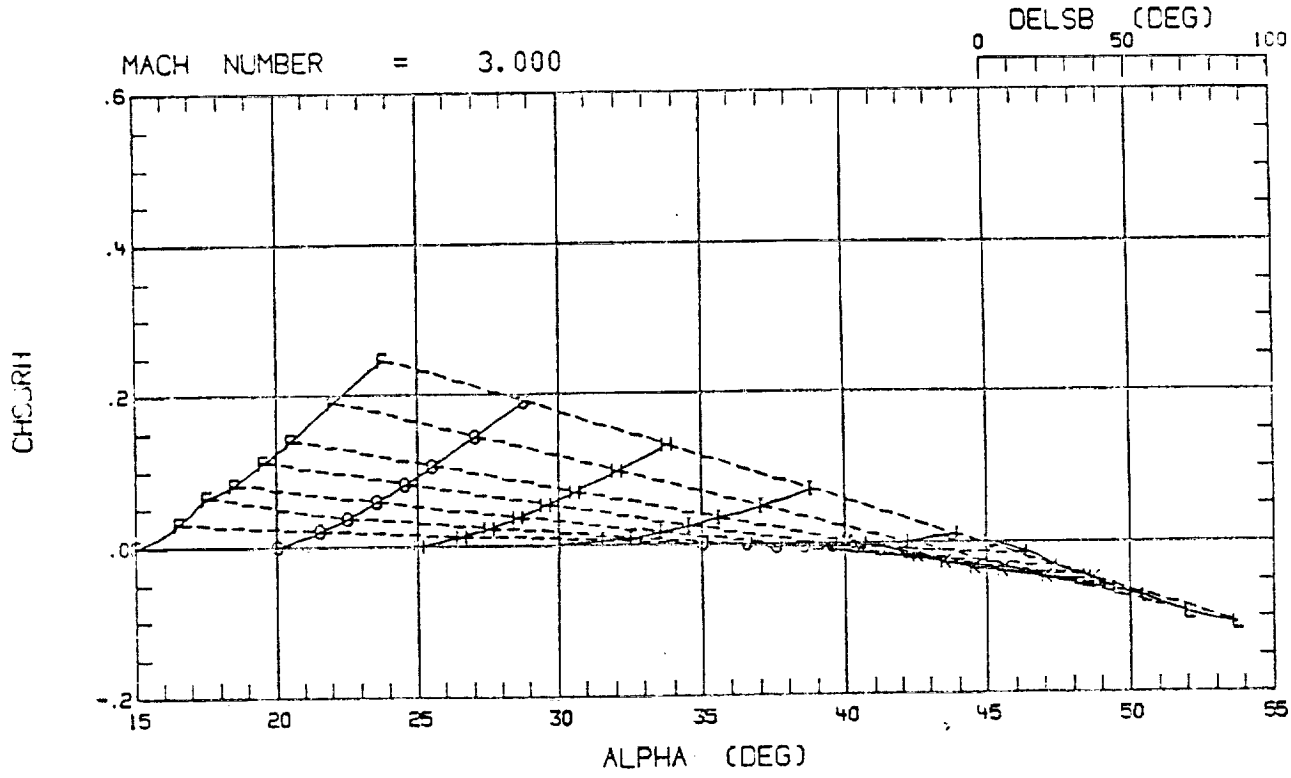


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03800	0.04000	0.04200	0.04400	0.03400	0.02900	0.01900	0.01200
25.000	0.07100	0.07200	0.07300	0.07400	0.07000	0.06400	0.03600	0.02200
35.000	0.12000	0.11500	0.11000	0.10500	0.09000	0.08100	0.05700	0.03600
45.000	0.15200	0.14800	0.14400	0.14000	0.12100	0.11000	0.08100	0.05200
55.000	0.20100	0.19100	0.18100	0.17100	0.15300	0.13900	0.10500	0.06900
70.000	0.27500	0.26000	0.24500	0.23000	0.20200	0.19000	0.14400	0.09600
87.200	0.34000	0.32500	0.31000	0.29500	0.27000	0.24500	0.19000	0.13000

ENGINEER _____
DATE 10/31/72

FIGURE 5.3-15
SPEEDBRAKE HINGE MOMENT COEFFICIENT

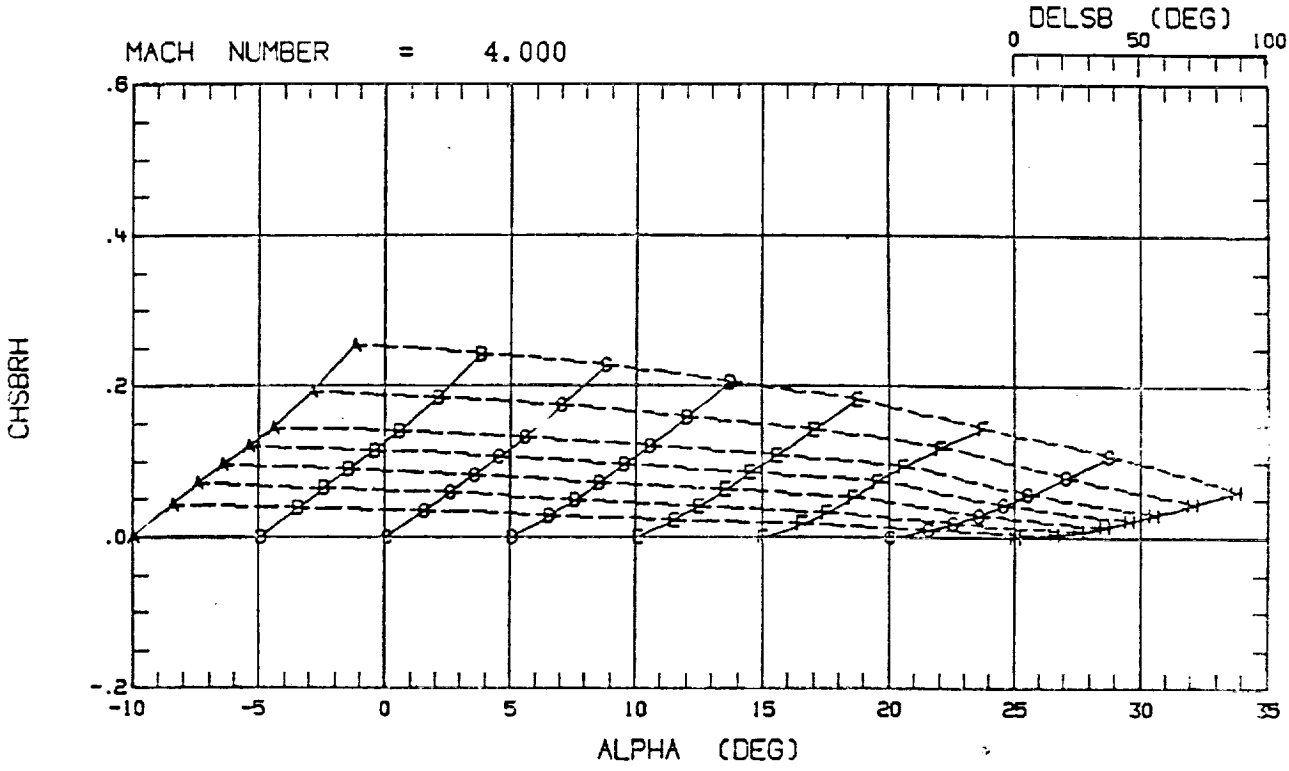


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.02900	0.01900	0.01200	0.00500	-0.00200	-0.00900	-0.01600
25.000	0.05400	0.03600	0.02200	0.00800	-0.00600	-0.02000	-0.03400
35.000	0.08100	0.05700	0.03600	0.01500	-0.00600	-0.02700	-0.04800
45.000	0.11000	0.08100	0.05200	0.02300	-0.00600	-0.03500	-0.06400
55.000	0.13900	0.10500	0.06900	0.03300	-0.00300	-0.03900	-0.07500
70.000	0.19000	0.14400	0.09600	0.04800	0.0	-0.04800	-0.09600
87.200	0.24500	0.19000	0.13000	0.07000	0.01000	-0.05000	-0.11000

ENGINEER HP
DATE 6/12/84

FIGURE 5.3-16
SPEEDBRAKE HINGE MOMENT COEFFICIENT

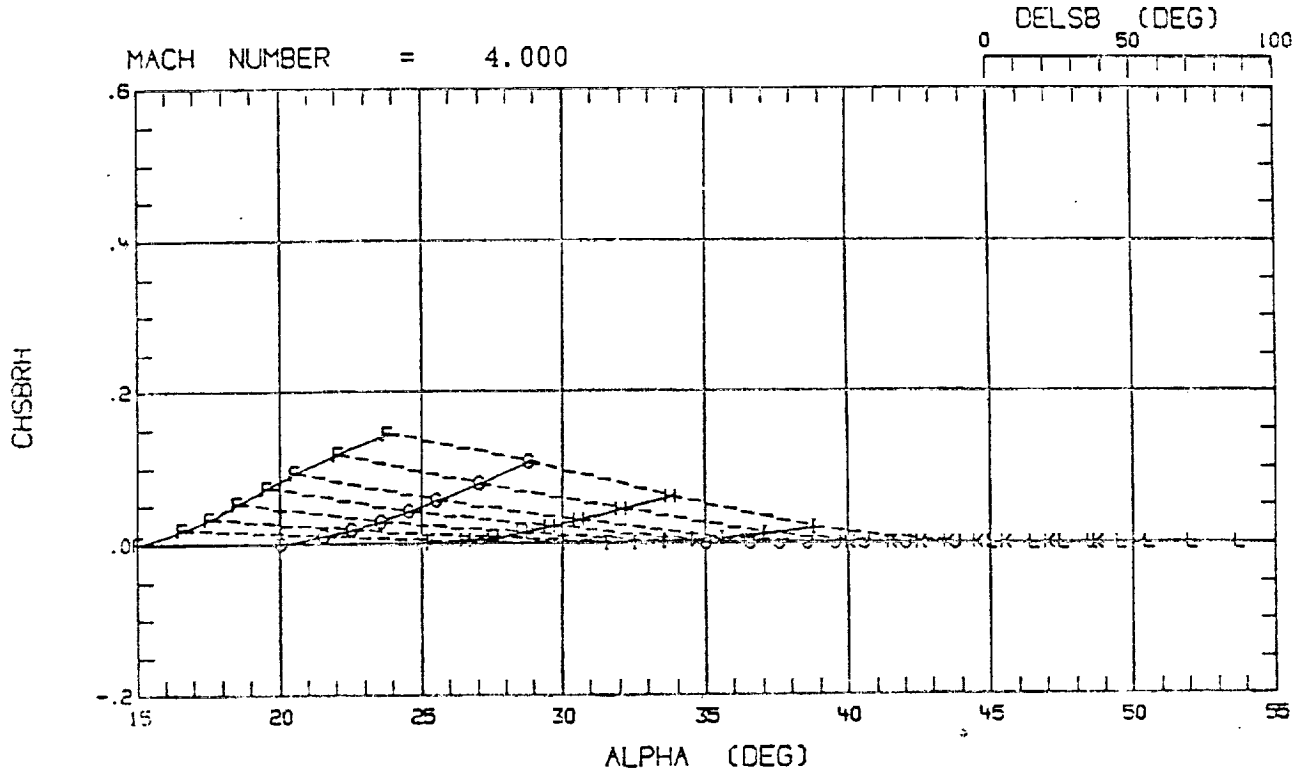


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.04250	0.03774	0.03415	0.02703	0.02224	0.01685	0.00873	0.00250
25.000	0.06950	0.06300	0.05750	0.04730	0.03990	0.03150	0.01720	0.00650
35.000	0.09482	0.08831	0.08115	0.06990	0.06130	0.05092	0.02834	0.01312
45.000	0.11861	0.11363	0.10511	0.09406	0.08381	0.07224	0.04137	0.02117
55.000	0.14410	0.13930	0.13030	0.11890	0.10650	0.09180	0.05530	0.02970
70.000	0.19135	0.18429	0.17299	0.15738	0.14098	0.11736	0.07779	0.04339
87.200	0.25370	0.24150	0.22680	0.20370	0.18150	0.14290	0.10540	0.06080

ENGINEER HP
DATE 6/13/73

FIGURE 5.3-17
SPEEDBRAKE HINGE MOMENT COEFFICIENT

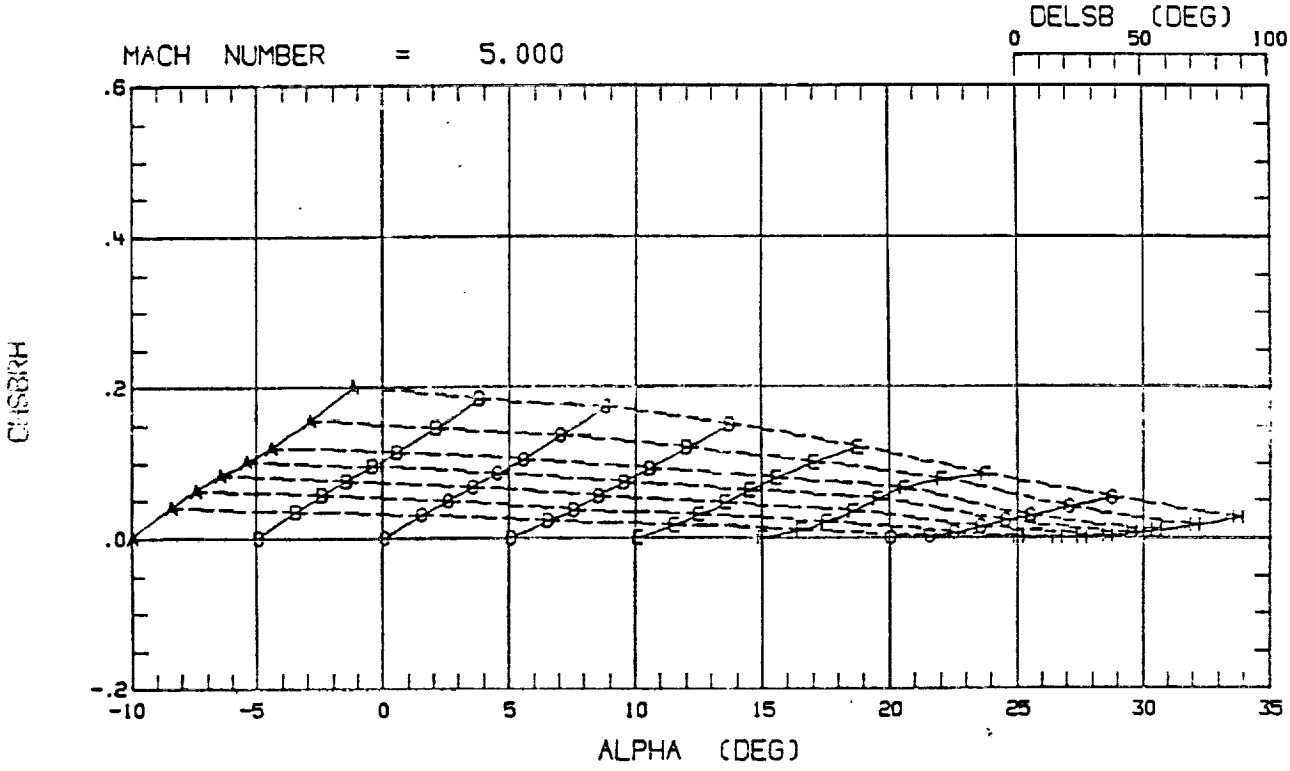


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.01685	0.00873	0.00250	0.0	0.0	0.0	0.0
25.000	0.03150	0.01720	0.00650	0.0	0.0	0.0	0.0
35.000	0.05092	0.02834	0.01312	0.00125	0.0	0.0	0.0
45.000	0.07224	0.04137	0.02117	0.00322	0.0	0.0	0.0
55.000	0.09190	0.05530	0.02970	0.00590	0.0	0.0	0.0
70.000	0.11736	0.07779	0.04339	0.01127	0.0	0.0	0.0
87.200	0.14290	0.10640	0.06080	0.01940	0.0	0.0	0.0

ENGINEER HP
DATE 10/22/73

FIGURE 5.3-18
SPEEDBRAKE HINGE MOMENT COEFFICIENT



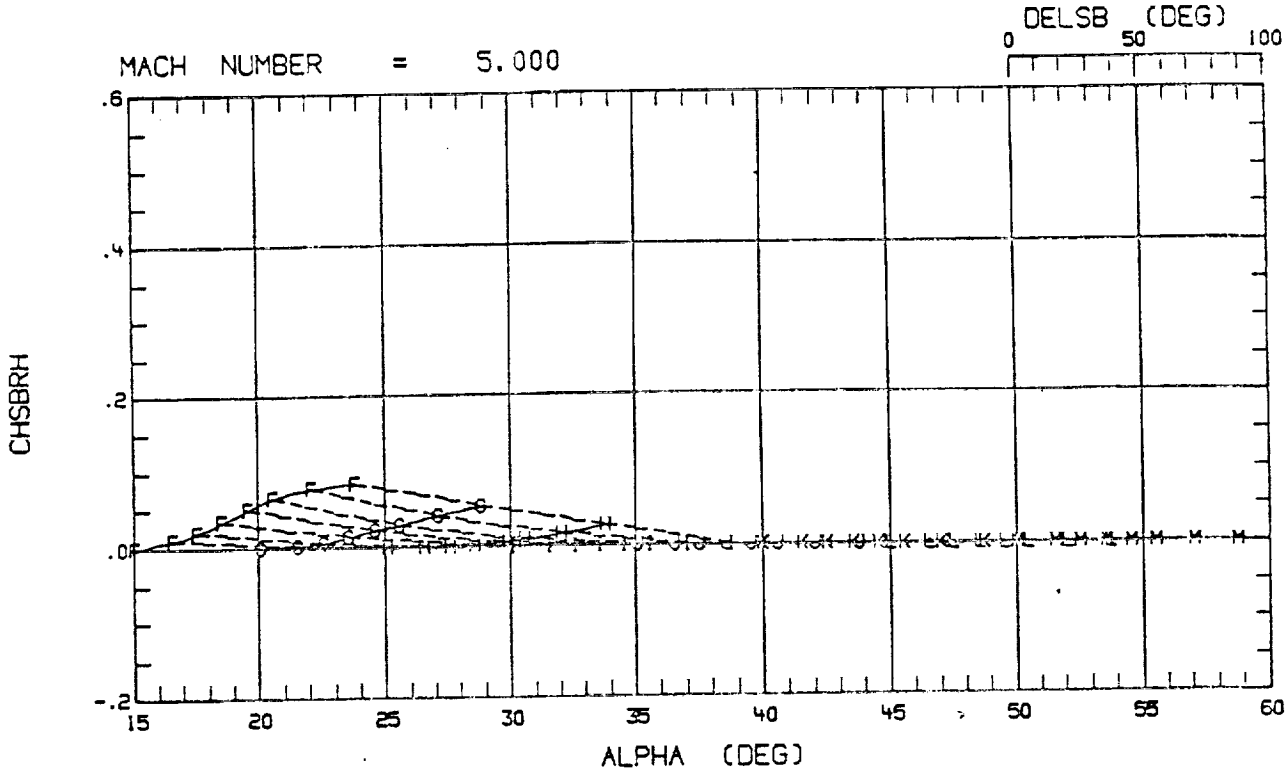
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03913	0.03396	0.02918	0.02071	0.01595	0.00968	0.00176	0.0
25.000	0.06250	0.05530	0.04820	0.03620	0.02880	0.01940	0.00540	0.0
35.000	0.08223	0.07488	0.06668	0.05438	0.04471	0.03343	0.01298	0.00184
45.000	0.09989	0.09355	0.08466	0.07261	0.06203	0.05021	0.02061	0.00467
55.000	0.11960	0.11310	0.10320	0.09080	0.07800	0.06420	0.02920	0.00830
70.000	0.15483	0.14468	0.13429	0.11803	0.09882	0.07656	0.03954	0.01518
87.200	0.20070	0.18310	0.17290	0.14920	0.11960	0.08250	0.05250	0.02530

ENGINEER HC
DATE 10/27/77

FIGURE 5.3-19
SPEEDBRAKE HINGE MOMENT COEFFICIENT

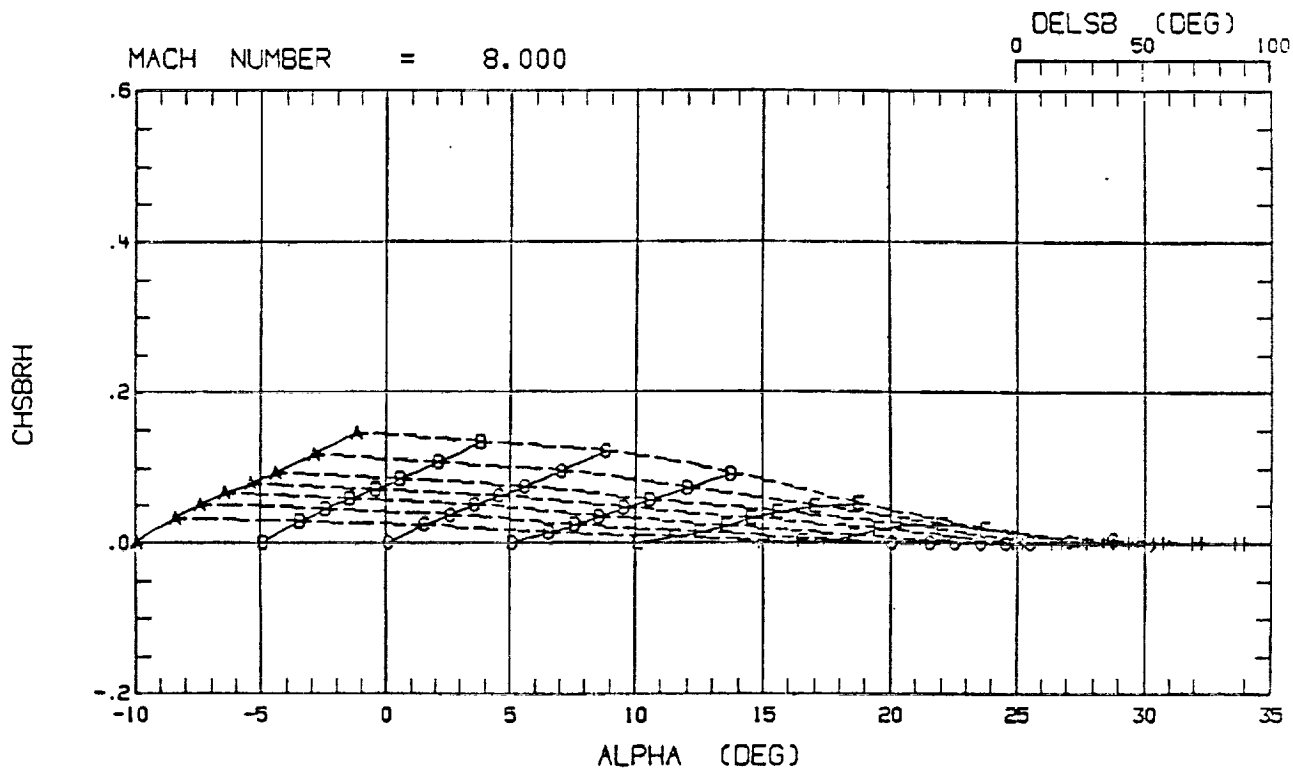


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.00968	0.00176	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.01940	0.00540	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.03343	0.01298	0.00184	0.0	0.0	0.0	0.0	0.0
45.000	0.05021	0.02061	0.00467	0.0	0.0	0.0	0.0	0.0
55.000	0.06420	0.02820	0.00830	0.0	0.0	0.0	0.0	0.0
70.000	0.07656	0.03954	0.01518	0.0	0.0	0.0	0.0	0.0
97.200	0.08250	0.05250	0.02530	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/27/71

FIGURE 5.3-20
SPEEDBRAKE HINGE MOMENT COEFFICIENT

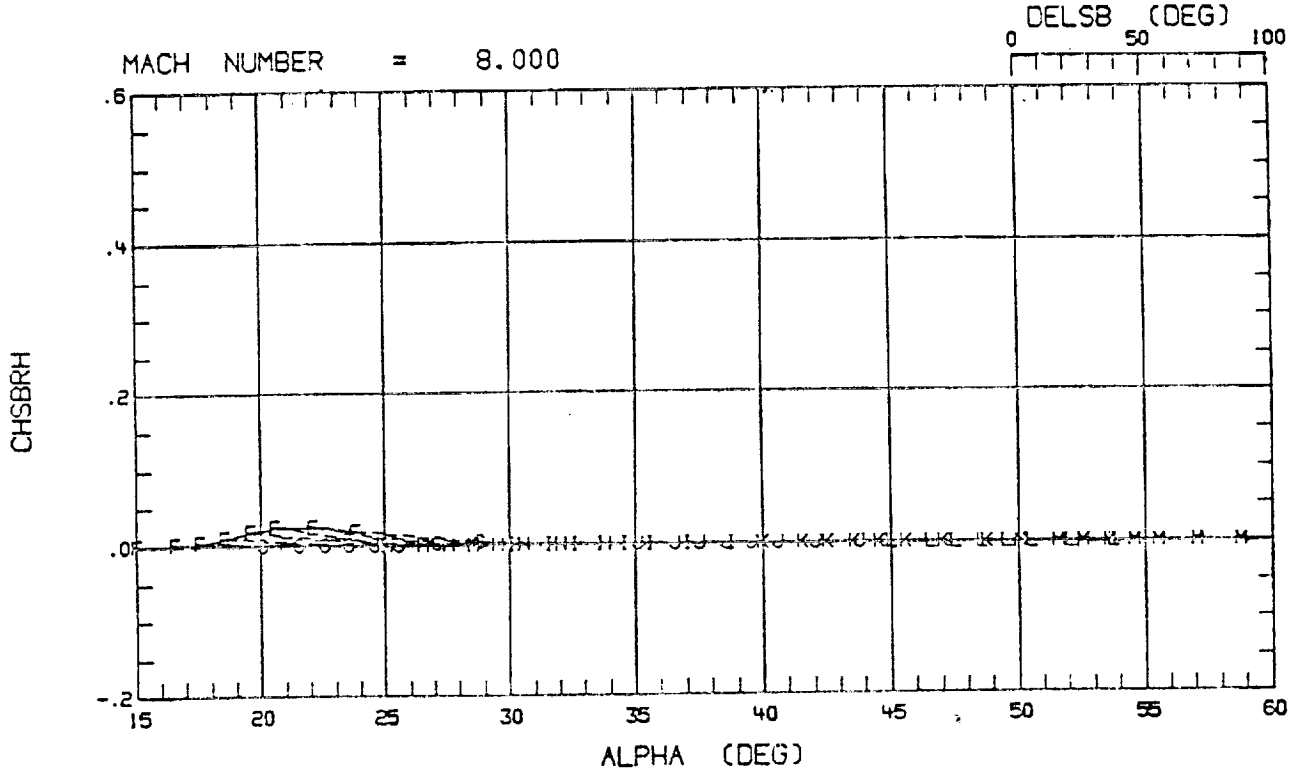


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03187	0.02756	0.02246	0.01298	0.00675	0.00002	0.0	0.0
25.000	0.05040	0.04400	0.03650	0.02260	0.01290	0.00260	0.0	0.0
35.000	0.06503	0.05767	0.04928	0.03368	0.02123	0.00856	0.0	0.0
45.000	0.07849	0.07041	0.06132	0.04498	0.03101	0.01681	0.0	0.0
55.000	0.09300	0.08400	0.07410	0.05610	0.03930	0.02270	0.0	0.0
70.000	0.11675	0.10604	0.09537	0.07249	0.04696	0.02379	0.00078	0.0
87.200	0.14600	0.13300	0.12180	0.09100	0.05120	0.01770	0.00230	0.0

ENGINEER HP
DATE 10/2/78

FIGURE 5.3-21
SPEEDBRAKE HINGE MOMENT COEFFICIENT



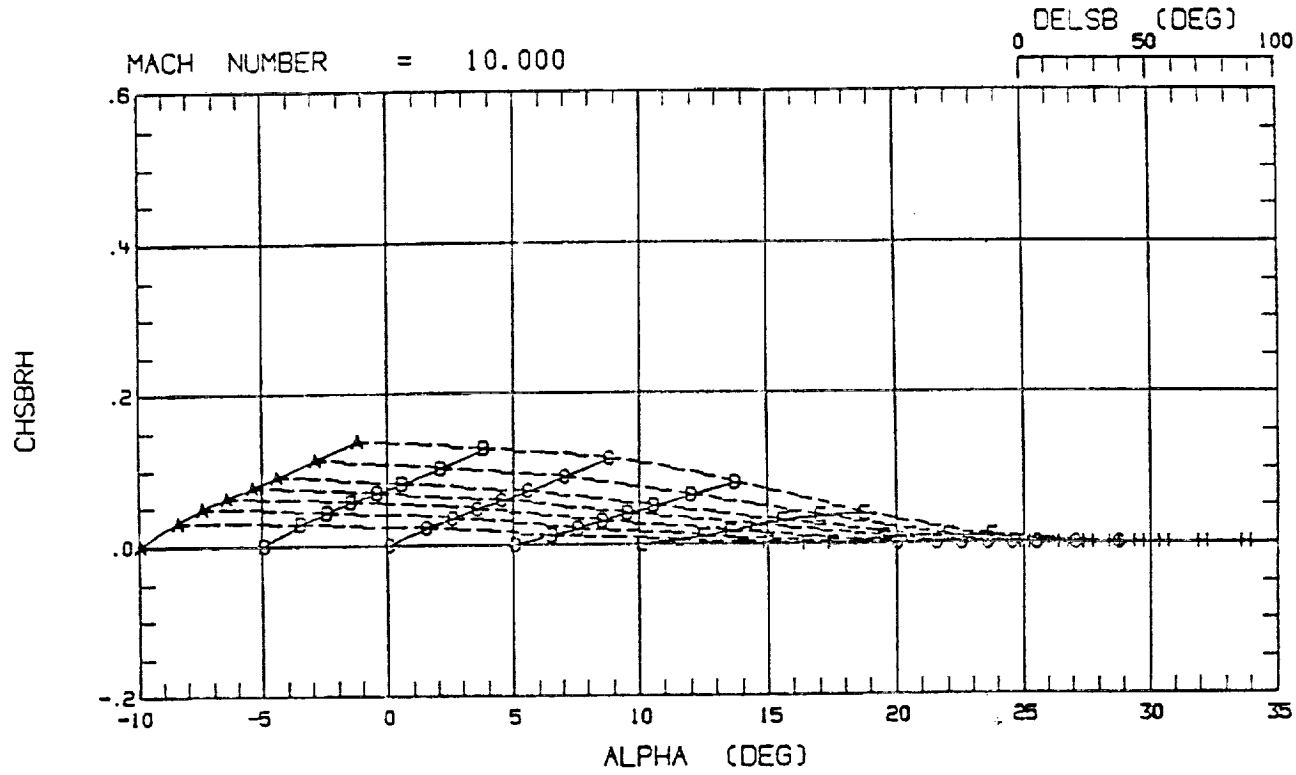
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.00002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.00260	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00656	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.01681	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.02270	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.02379	0.00078	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.01770	0.00230	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/13/78

FIGURE 5.3-22
SPEEDBRAKE HINGE MOMENT COEFFICIENT

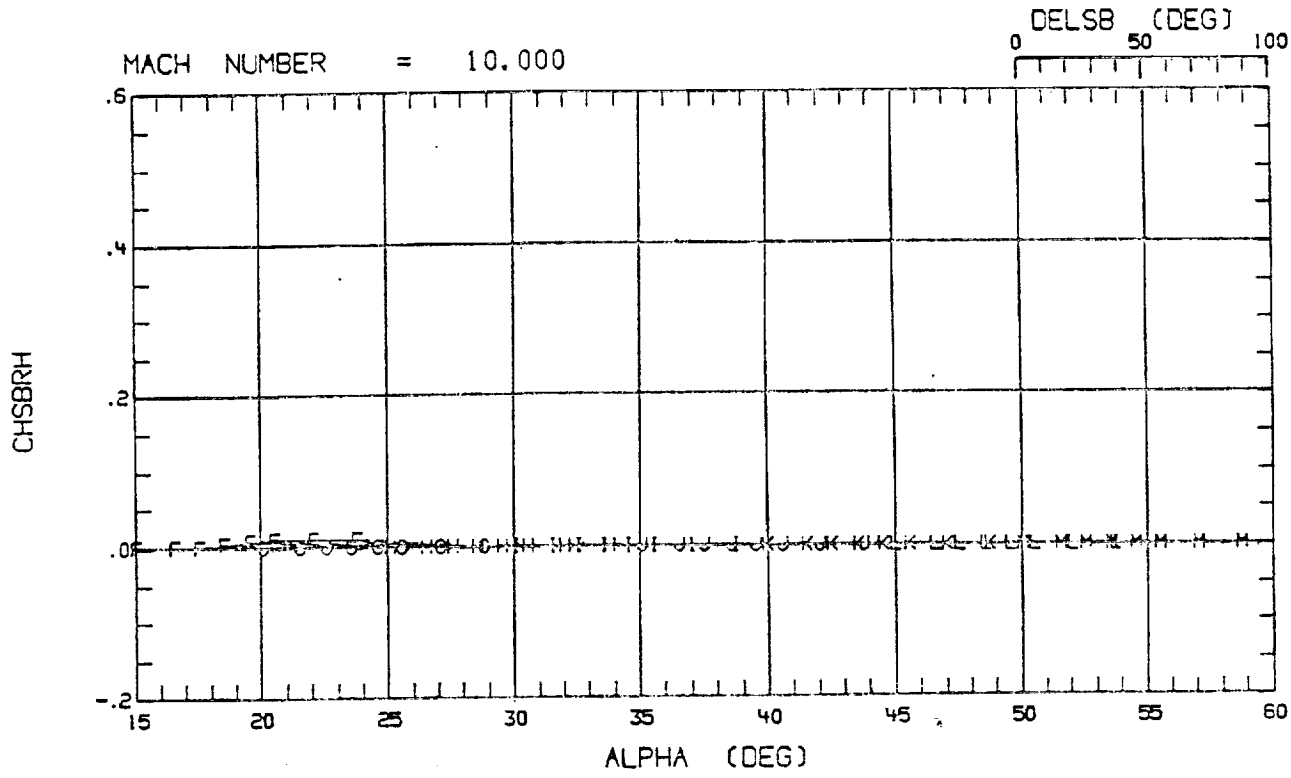


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03022	0.02949	0.02132	0.01154	0.00534	0.0	0.0	0.0
25.000	0.04800	0.04220	0.03450	0.02000	0.01000	0.0	0.0	0.0
35.000	0.06222	0.05512	0.04629	0.02969	0.01611	0.00270	0.0	0.0
45.000	0.07586	0.06717	0.05732	0.03941	0.02322	0.00650	0.0	0.0
55.000	0.09000	0.08000	0.06910	0.04910	0.02930	0.00920	0.0	0.0
70.000	0.11198	0.10073	0.08878	0.06360	0.03507	0.01013	0.0	0.0
87.200	0.13800	0.12600	0.11330	0.08020	0.03850	0.00820	0.0	0.0

ENGINEER HP
DATE 10/3/73

FIGURE 5.3-23
SPEEDBRAKE HINGE MOMENT COEFFICIENT

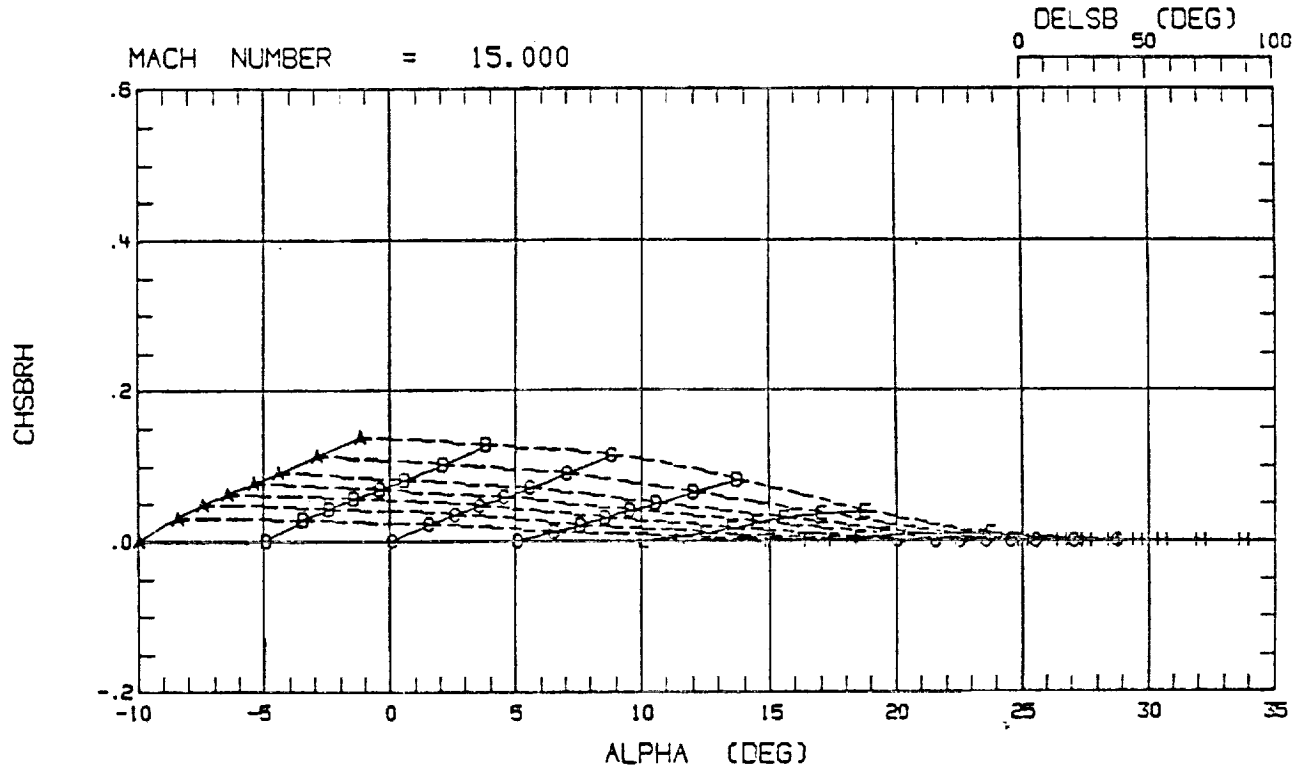


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00270	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00650	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00920	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.01013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.00820	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 6/2/78

FIGURE 5.3-24
SPEEDBRAKE HINGE MOMENT COEFFICIENT



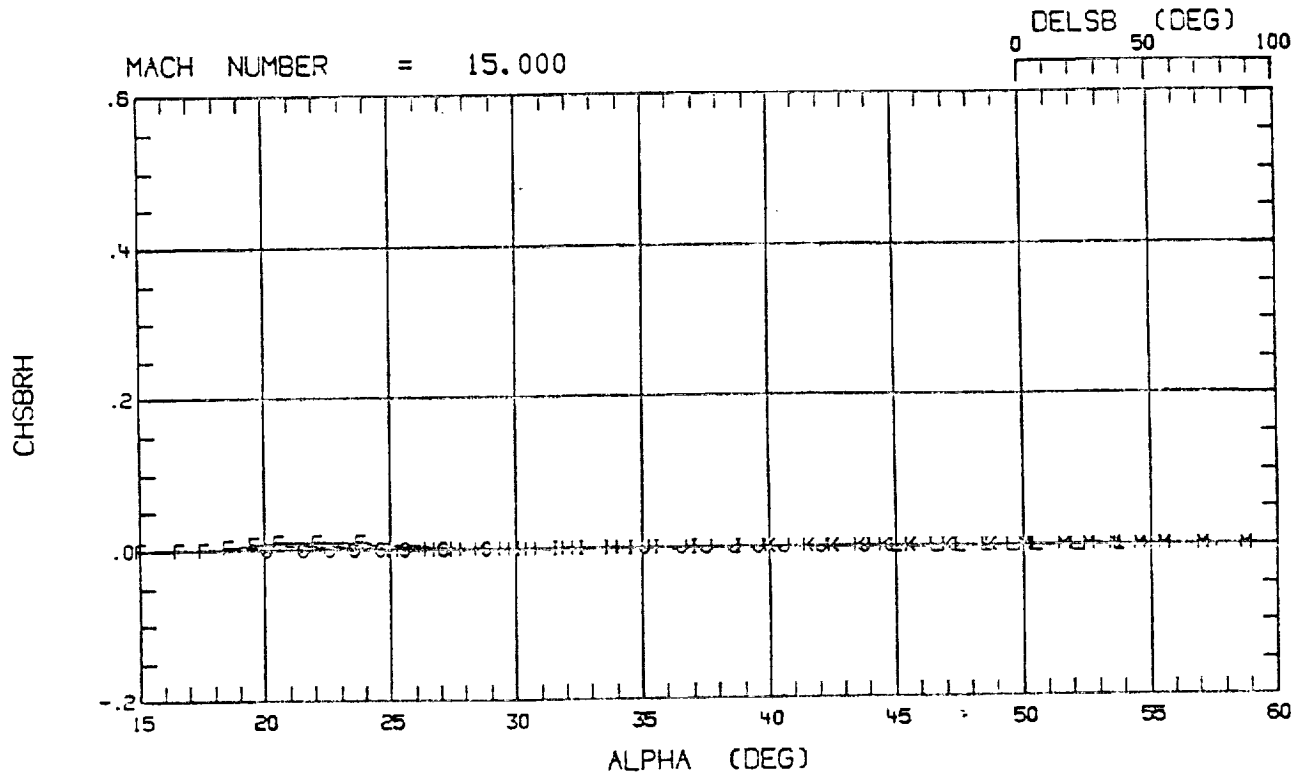
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03022	0.02649	0.02132	0.01154	0.00534	0.0	0.0	0.0
25.000	0.04800	0.04220	0.03450	0.02000	0.01000	0.0	0.0	0.0
35.000	0.06222	0.05512	0.04629	0.02969	0.01611	0.00270	0.0	0.0
45.000	0.07586	0.06717	0.05732	0.03941	0.02322	0.00650	0.0	0.0
55.000	0.09000	0.08000	0.06910	0.04910	0.02930	0.00920	0.0	0.0
70.000	0.11198	0.10073	0.08878	0.06360	0.03507	0.01013	0.0	0.0
87.200	0.13800	0.12600	0.11330	0.08020	0.03850	0.00820	0.0	0.0

ENGINEER HP
DATE 10/12/76

FIGURE 5.3-25
SPEEDBRAKE HINGE MOMENT COEFFICIENT



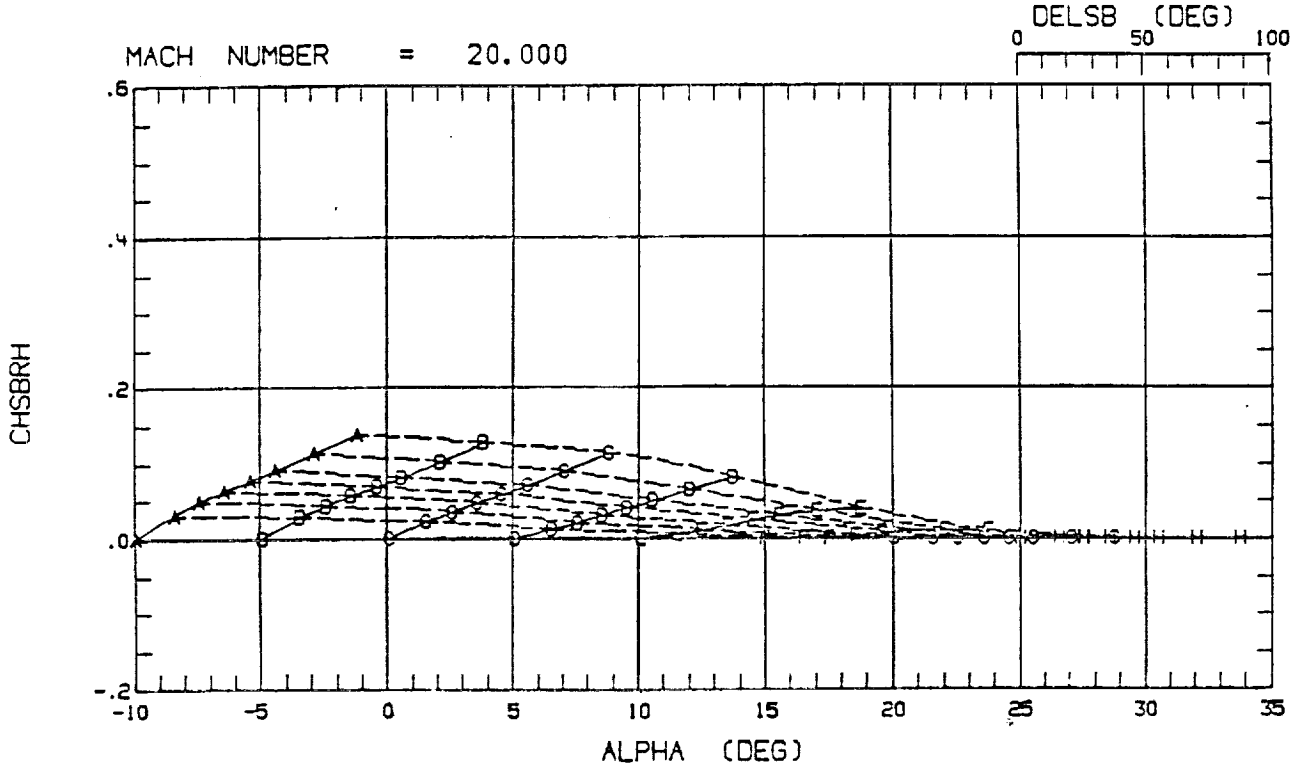
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00270	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00650	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00920	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.01013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.00820	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/2/78

FIGURE 5.3-26
SPEEDBRAKE HINGE MOMENT COEFFICIENT

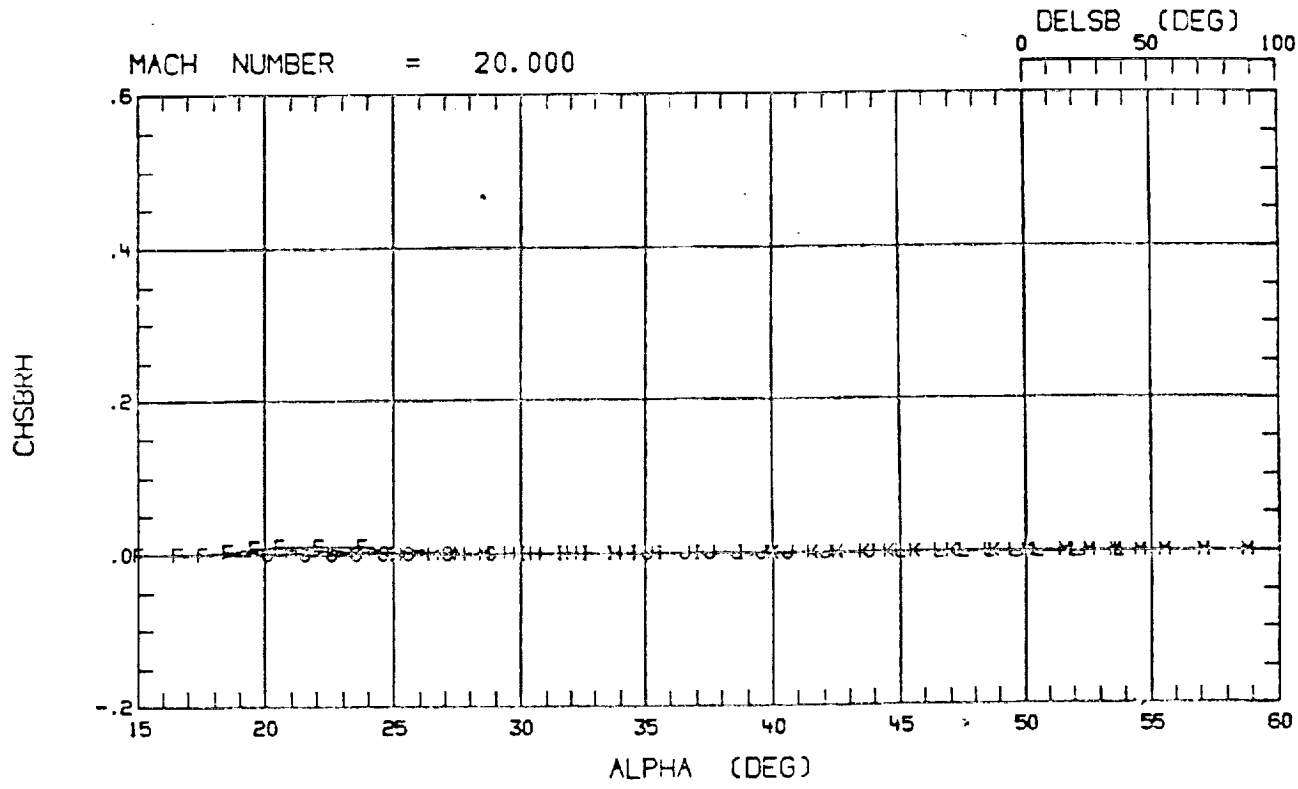


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.03022	0.02649	0.02132	0.01154	0.00534	0.0	0.0	0.0
25.000	0.04800	0.04220	0.03450	0.02000	0.01000	0.0	0.0	0.0
35.000	0.06222	0.05512	0.04629	0.02969	0.01611	0.00270	0.0	0.0
45.000	0.07586	0.06717	0.05732	0.03941	0.02322	0.00650	0.0	0.0
55.000	0.09000	0.08000	0.06910	0.04910	0.02930	0.00920	0.0	0.0
70.000	0.11198	0.10073	0.08878	0.06360	0.03507	0.01013	0.0	0.0
87.200	0.13800	0.12600	0.11330	0.08020	0.03850	0.00820	0.0	0.0

ENGINEER HP
DATE 07/77

FIGURE 5.3-27
SPEEDBRAKE HINGE MOMENT COEFFICIENT

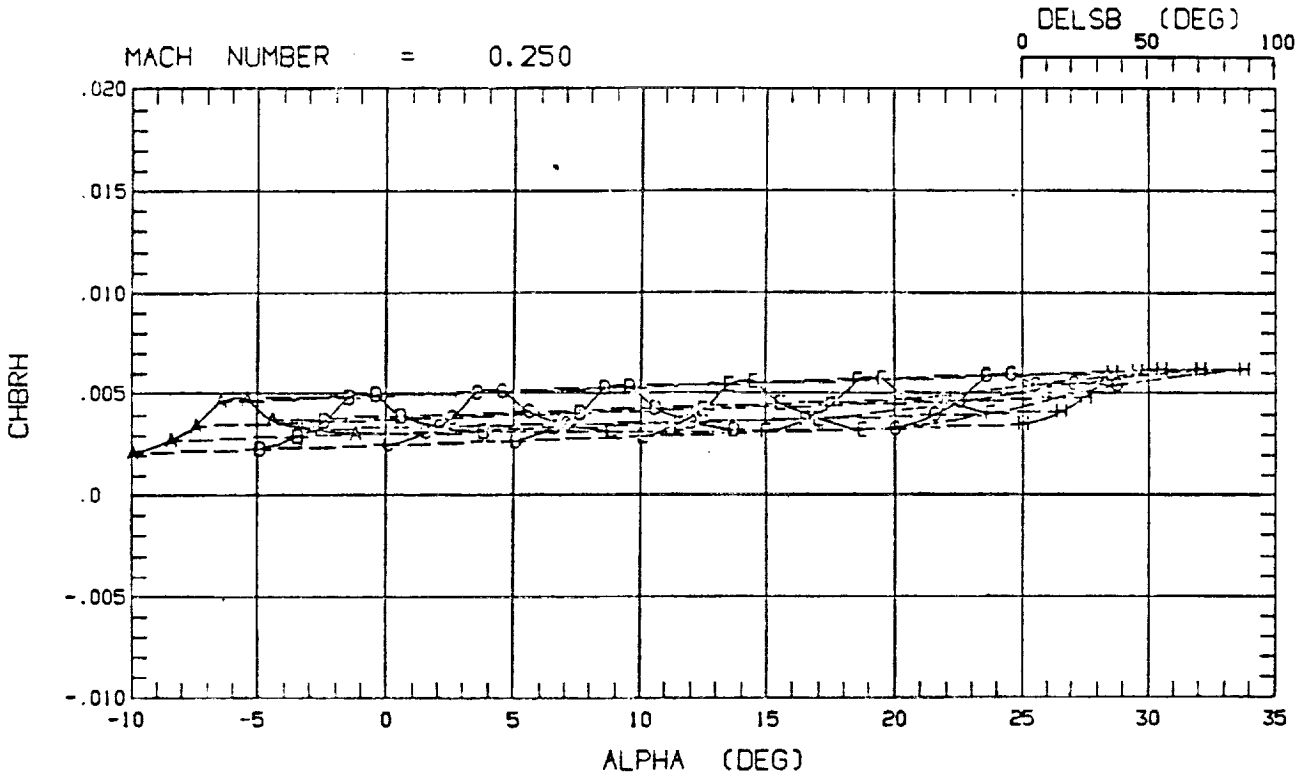


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	SPEEDBRAKE PANEL HINGE MOMENT							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00270	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00650	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00920	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.01013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.00820	0.0	0.0	0.0	.0.0	0.0	0.0	0.0

ENGINEER HP
DATE 12/2/85

FIGURE 5.3-28
SPEEDBRAKE HINGE MOMENT COEFFICIENT



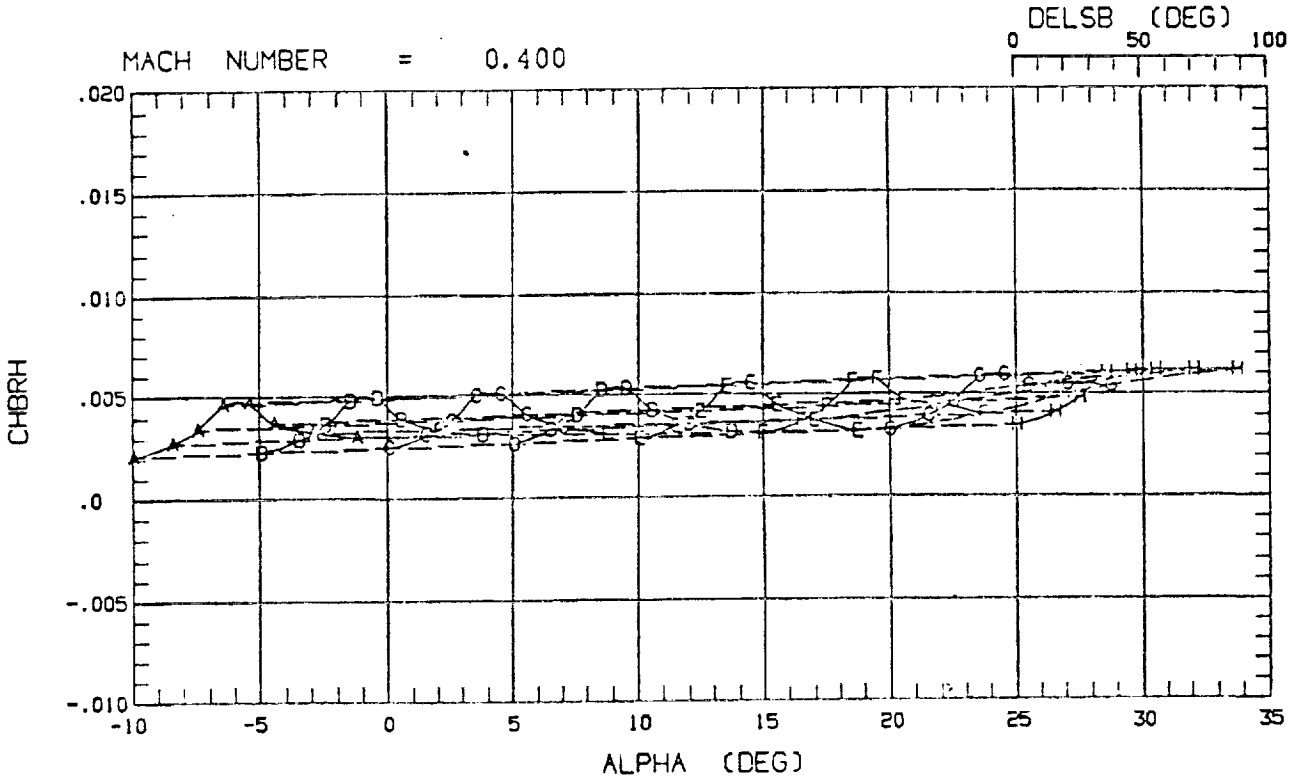
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00207	0.00227	0.00247	0.00267	0.00287	0.00307	0.00327	0.00347
15.000	0.00270	0.00290	0.00310	0.00330	0.00350	0.00370	0.00390	0.00410
25.000	0.00340	0.00360	0.00380	0.00400	0.00420	0.00440	0.00460	0.00480
35.000	0.00460	0.00480	0.00500	0.00520	0.00540	0.00560	0.00580	0.00600
45.000	0.00470	0.00490	0.00510	0.00530	0.00550	0.00570	0.00590	0.00610
55.000	0.00367	0.00387	0.00407	0.00427	0.00447	0.00467	0.00540	0.00613
70.000	0.00325	0.00336	0.00347	0.00358	0.00374	0.00445	0.00544	0.00613
87.200	0.00302	0.00308	0.00310	0.00314	0.00317	0.00398	0.00539	0.00613

ENGINEER HP
DATE 10/3/78

FIGURE 5.3- 29
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



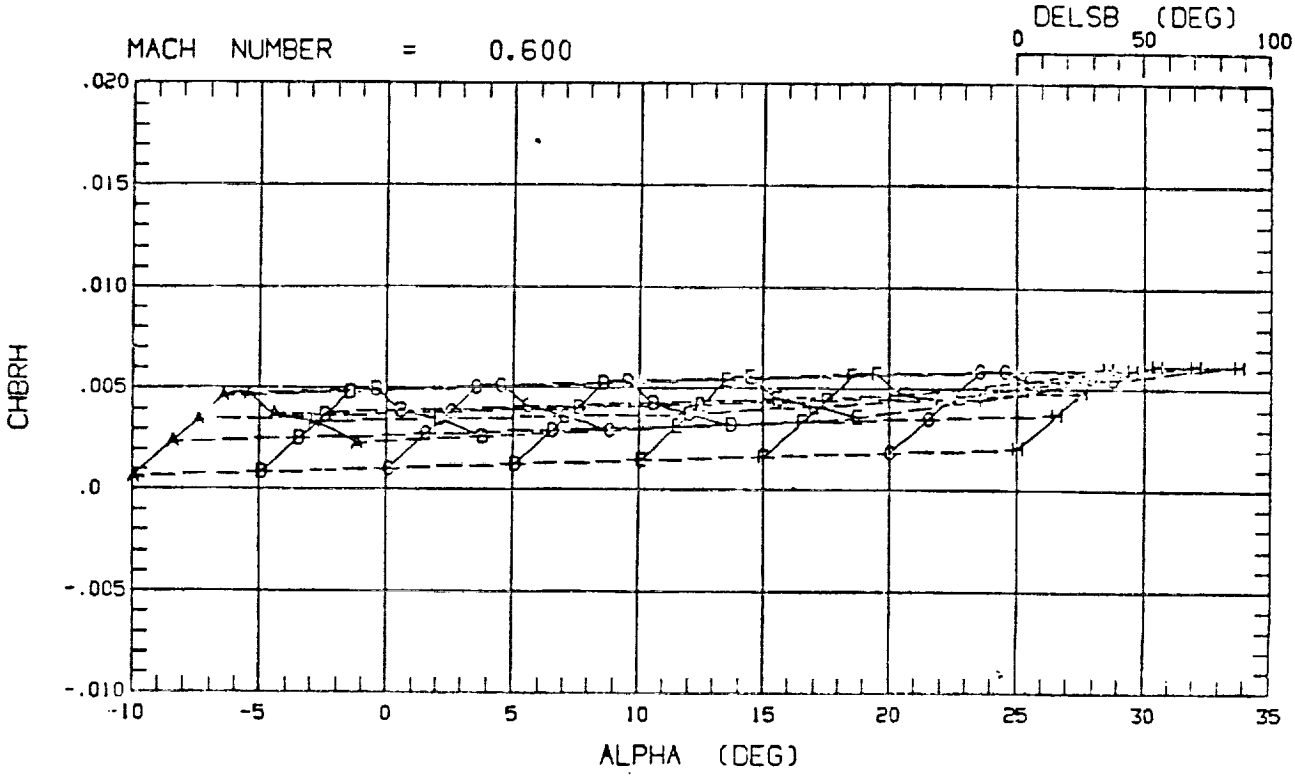
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00207	0.00227	0.00247	0.00267	0.00287	0.00307	0.00327	0.00347
15.000	0.00270	0.00290	0.00310	0.00330	0.00350	0.00370	0.00390	0.00410
25.000	0.00340	0.00360	0.00380	0.00400	0.00420	0.00440	0.00460	0.00480
35.000	0.00460	0.00480	0.00500	0.00520	0.00540	0.00560	0.00580	0.00600
45.000	0.00470	0.00490	0.00510	0.00530	0.00550	0.00570	0.00590	0.00610
55.000	0.00367	0.00387	0.00407	0.00427	0.00447	0.00467	0.00540	0.00613
70.000	0.00325	0.00336	0.00347	0.00358	0.00374	0.00445	0.00544	0.00613
87.200	0.00302	0.00306	0.00310	0.00314	0.00317	0.00398	0.00539	0.00613

ENGINEER HP
DATE 10/2/28

FIGURE 5.3-30
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



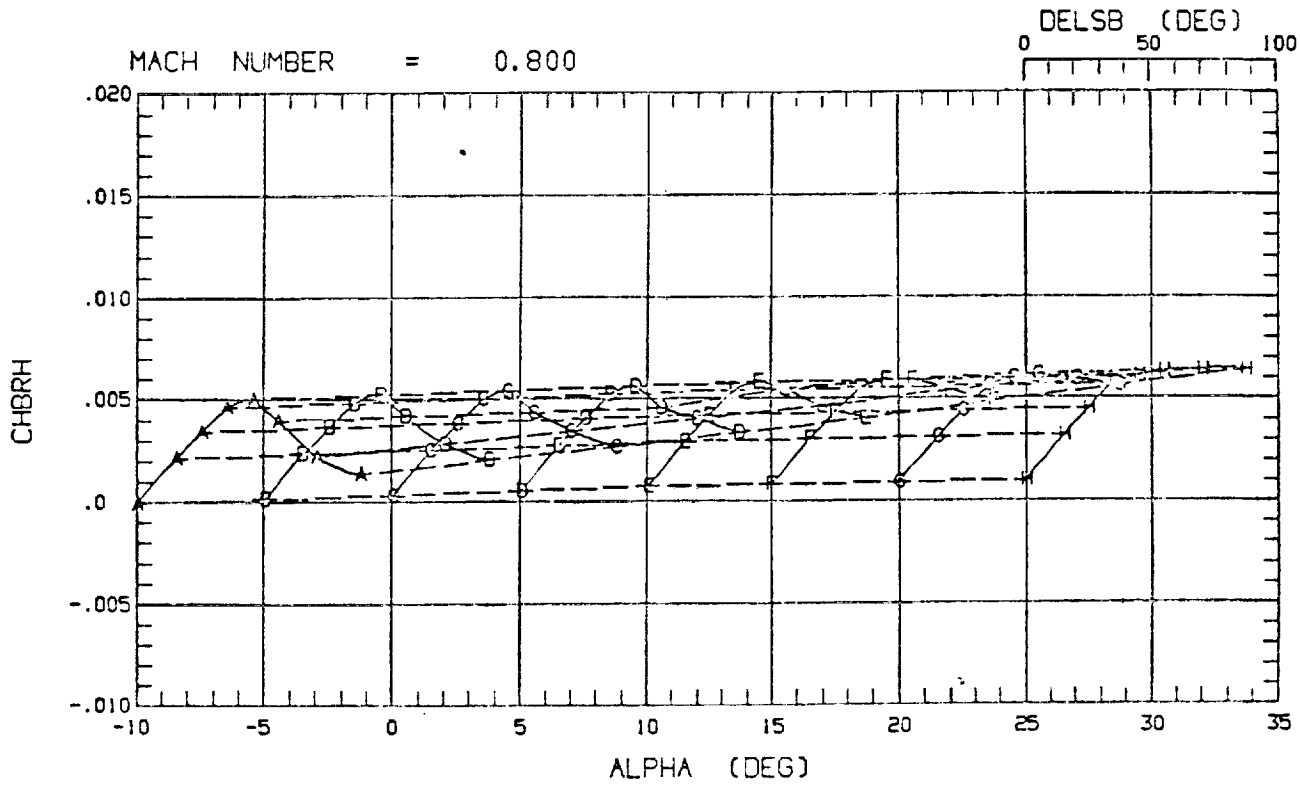
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00060	0.00080	0.00100	0.00120	0.00140	0.00160	0.00180	0.00200
15.000	0.00230	0.00250	0.00270	0.00290	0.00310	0.00330	0.00350	0.00370
25.000	0.00340	0.00360	0.00380	0.00400	0.00420	0.00440	0.00460	0.00480
35.000	0.00460	0.00480	0.00500	0.00520	0.00540	0.00560	0.00580	0.00600
45.000	0.00470	0.00490	0.00510	0.00530	0.00550	0.00570	0.00580	0.00590
55.000	0.00367	0.00387	0.00407	0.00427	0.00447	0.00467	0.00540	0.00513
70.000	0.00231	0.00344	0.00357	0.00370	0.00410	0.00450	0.00540	0.00613
87.200	0.00224	0.00254	0.00284	0.00314	0.00354	0.00448	0.00545	0.00613

ENGINEER HP
DATE 10/2/84

FIGURE 5.3-31
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



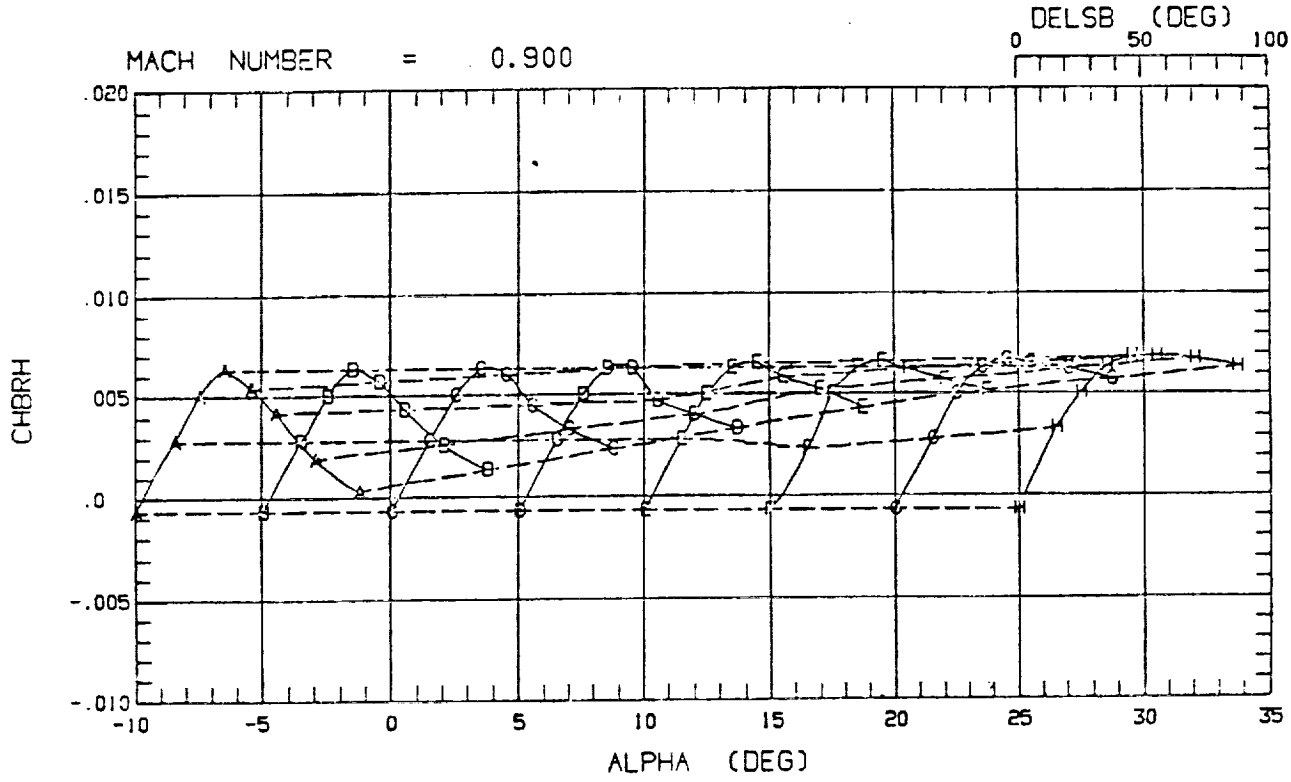
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	-0.00010	0.00010	0.00030	0.00050	0.00070	0.00090	0.00090	0.00100
15.000	0.00210	0.00230	0.00250	0.00270	0.00290	0.00300	0.00310	0.00320
25.000	0.00340	0.00360	0.00380	0.00400	0.00420	0.00430	0.00440	0.00450
35.000	0.00460	0.00480	0.00500	0.00520	0.00540	0.00550	0.00560	0.00570
45.000	0.00500	0.00520	0.00540	0.00560	0.00580	0.00590	0.00600	0.00610
55.000	0.00394	0.00414	0.00434	0.00454	0.00544	0.00590	0.00616	0.00630
70.000	0.00220	0.00280	0.00340	0.00400	0.00460	0.00540	0.00590	0.00640
87.200	0.00135	0.00200	0.00265	0.00330	0.00403	0.00482	0.00561	0.00640

ENGINEER HP
DATE 6/28/78

FIGURE 5.3-32
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



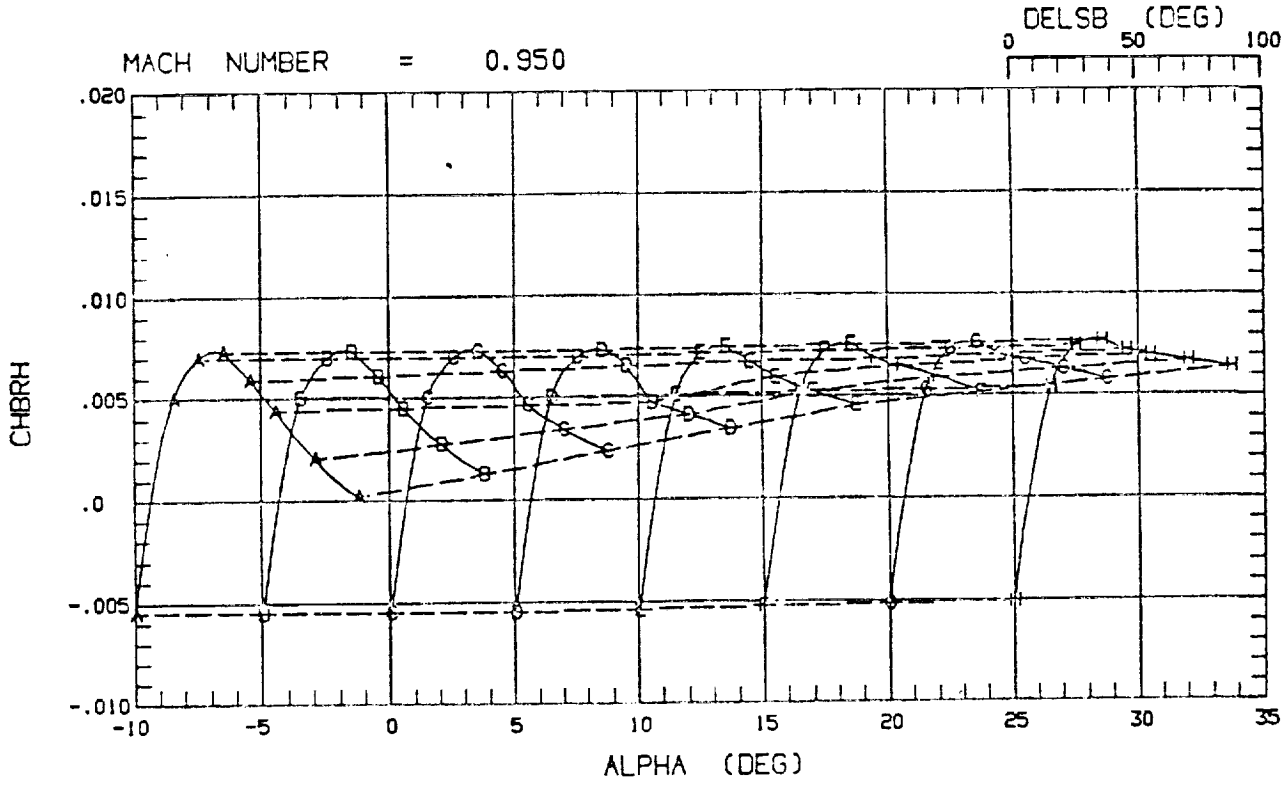
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	-0.00070	-0.00070	-0.00070	-0.00070	-0.00070	-0.00070	-0.00070	-0.00070
15.000	0.00280	0.00280	0.00280	0.00230	0.00280	0.00230	0.00280	0.00330
25.000	0.00500	0.00500	0.00500	0.00500	0.00500	0.00500	0.00500	0.00500
35.000	0.00630	0.00630	0.00630	0.00630	0.00630	0.00630	0.00630	0.00630
45.000	0.00540	0.00570	0.00600	0.00630	0.00650	0.00660	0.00670	0.00680
55.000	0.00418	0.00433	0.00450	0.00467	0.00581	0.00620	0.00652	0.00684
70.000	0.00190	0.00260	0.00330	0.00400	0.00520	0.00570	0.00620	0.00670
87.200	0.00071	0.00132	0.00233	0.00334	0.00435	0.00513	0.00572	0.00631

ENGINEER MD
DATE 12/27/78

FIGURE 5.3-33
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP

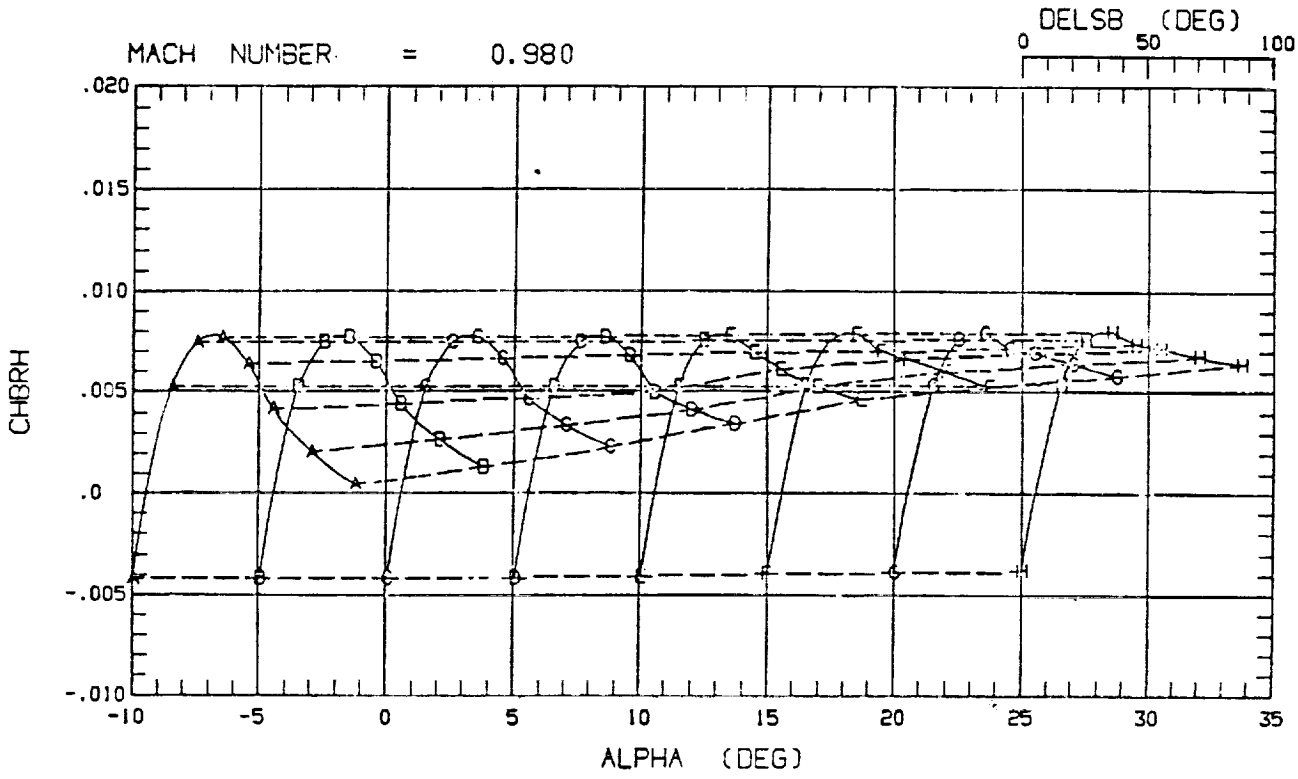


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	-0.00550	-0.00550	-0.00550	-0.00550	-0.00540	-0.00530	-0.00520	-0.00510
15.000	0.00500	0.00500	0.00500	0.00500	0.00510	0.00520	0.00530	0.00540
25.000	0.00700	0.00700	0.00700	0.00700	0.00710	0.00720	0.00730	0.00740
35.000	0.00730	0.00730	0.00730	0.00730	0.00740	0.00750	0.00760	0.00770
45.000	0.00590	0.00610	0.00630	0.00650	0.00670	0.00680	0.00700	0.00720
55.000	0.00440	0.00450	0.00460	0.00470	0.00595	0.00645	0.00673	0.00701
70.000	0.00200	0.00270	0.00340	0.00410	0.00520	0.00590	0.00630	0.00670
87.200	0.00018	0.00126	0.00234	0.00342	0.00451	0.00516	0.00575	0.00634

ENGINEER HP
DATE 10/31/78

FIGURE 5.3-34
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP

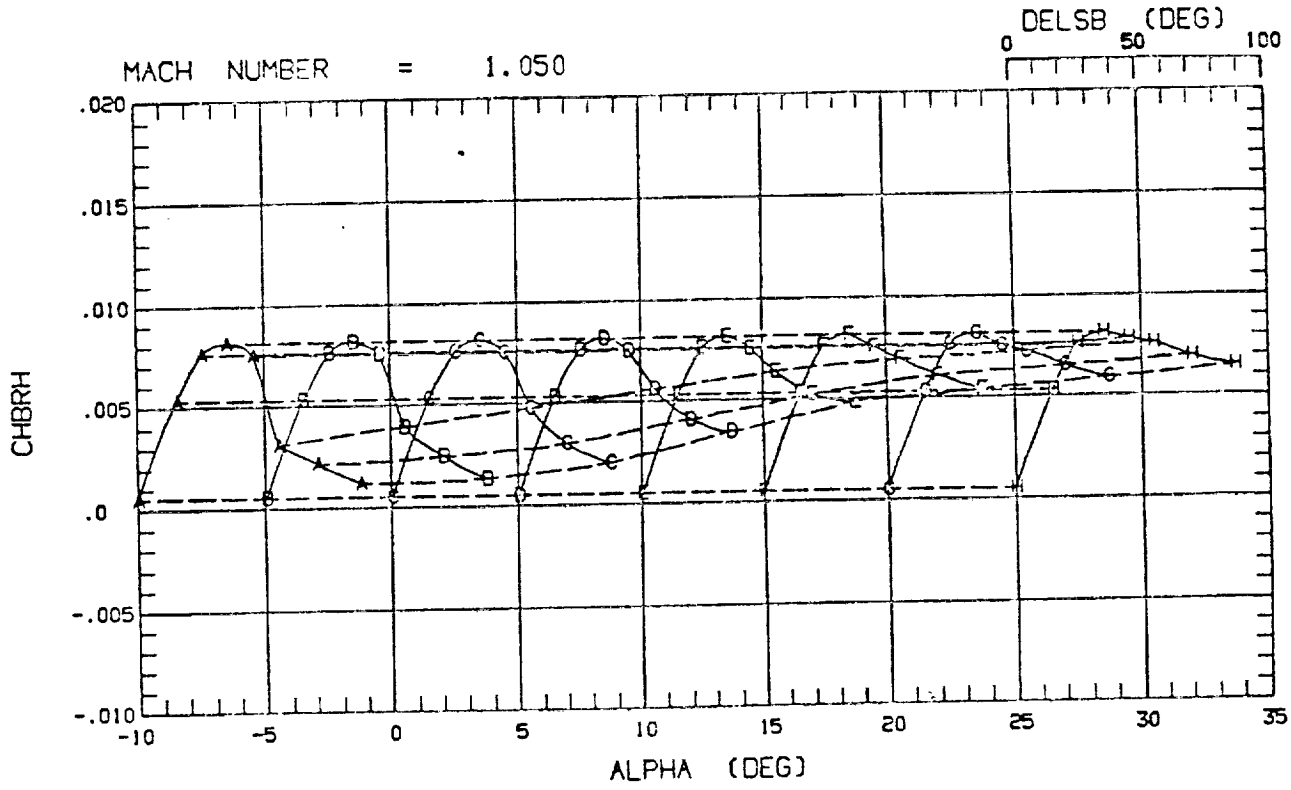


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	-0.00418	-0.00418	-0.00418	-0.00418	-0.00410	-0.00402	-0.00394	-0.00385
15.000	0.00521	0.00521	0.00521	0.00521	0.00524	0.00527	0.00530	0.00539
25.000	0.00742	0.00742	0.00742	0.00742	0.00748	0.00753	0.00757	0.00762
35.000	0.00769	0.00769	0.00769	0.00769	0.00777	0.00784	0.00790	0.00795
45.000	0.00634	0.00648	0.00662	0.00677	0.00692	0.00698	0.00716	0.00738
55.000	0.00413	0.00440	0.00465	0.00496	0.00605	0.00659	0.00687	0.00715
70.000	0.00206	0.00264	0.00332	0.00411	0.00520	0.00595	0.00636	0.00672
87.200	0.00040	0.00127	0.00225	0.00343	0.00461	0.00521	0.00579	0.00636

INEER HP
DATE 10/31/75

FIGURE 5.3-35
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



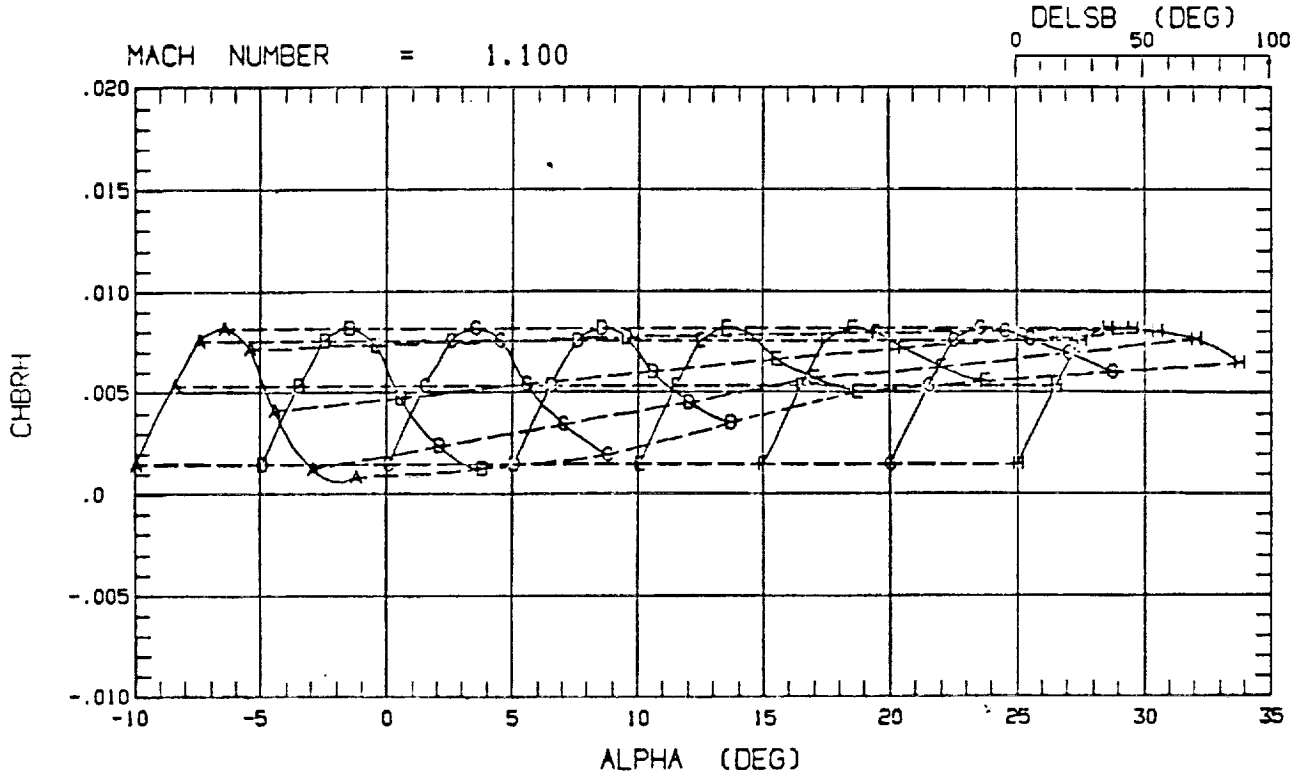
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050
15.000	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530
25.000	0.00760	0.00760	0.00760	0.00760	0.00760	0.00760	0.00760	0.00760
35.000	0.00810	0.00810	0.00810	0.00810	0.00810	0.00810	0.00810	0.00810
45.000	0.00750	0.00750	0.00750	0.00750	0.00750	0.00750	0.00750	0.00780
55.000	0.00313	0.00395	0.00477	0.00559	0.00634	0.00690	0.00724	0.00756
70.000	0.00217	0.00245	0.00300	0.00410	0.00520	0.00610	0.00650	0.00690
87.200	0.00118	0.00135	0.00203	0.00344	0.00485	0.00537	0.00589	0.00641

ENGINEER HP
DATE 10/2/78

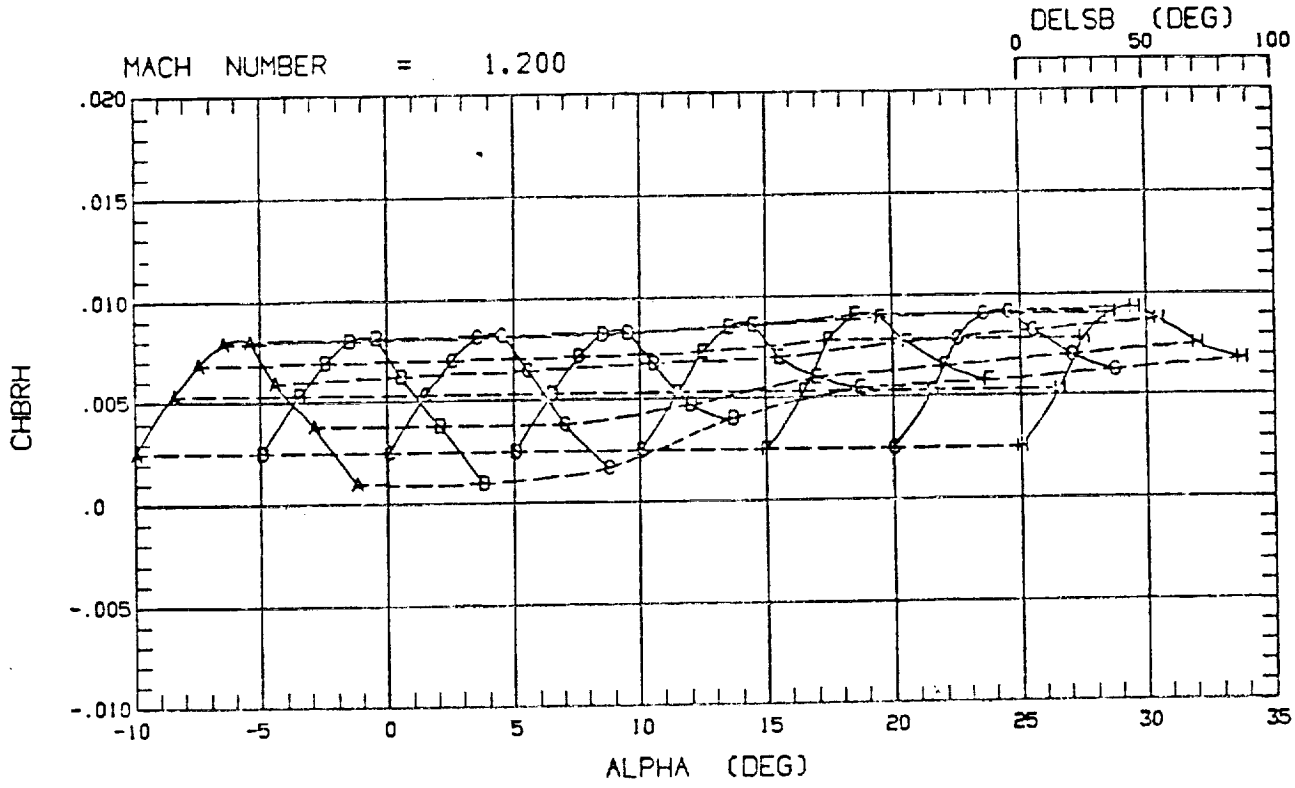
FIGURE 5.3-36
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00140	0.00140	0.00140	0.00140	0.00140	0.00140	0.00140	0.00140
15.000	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530
25.000	0.00750	0.00750	0.00750	0.00750	0.00750	0.00750	0.00750	0.00750
35.000	0.00810	0.00810	0.00810	0.00810	0.00810	0.00810	0.00810	0.00810
45.000	0.00710	0.00730	0.00750	0.00770	0.00780	0.00790	0.00800	0.00810
55.000	0.00409	0.00472	0.00536	0.00600	0.00659	0.00715	0.00756	0.00797
70.000	0.00120	0.00230	0.00340	0.00450	0.00570	0.00620	0.00690	0.00760
87.200	0.00080	0.00119	0.00190	0.00344	0.00498	0.00550	0.00595	0.00643

FIGURE 5.3-37
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



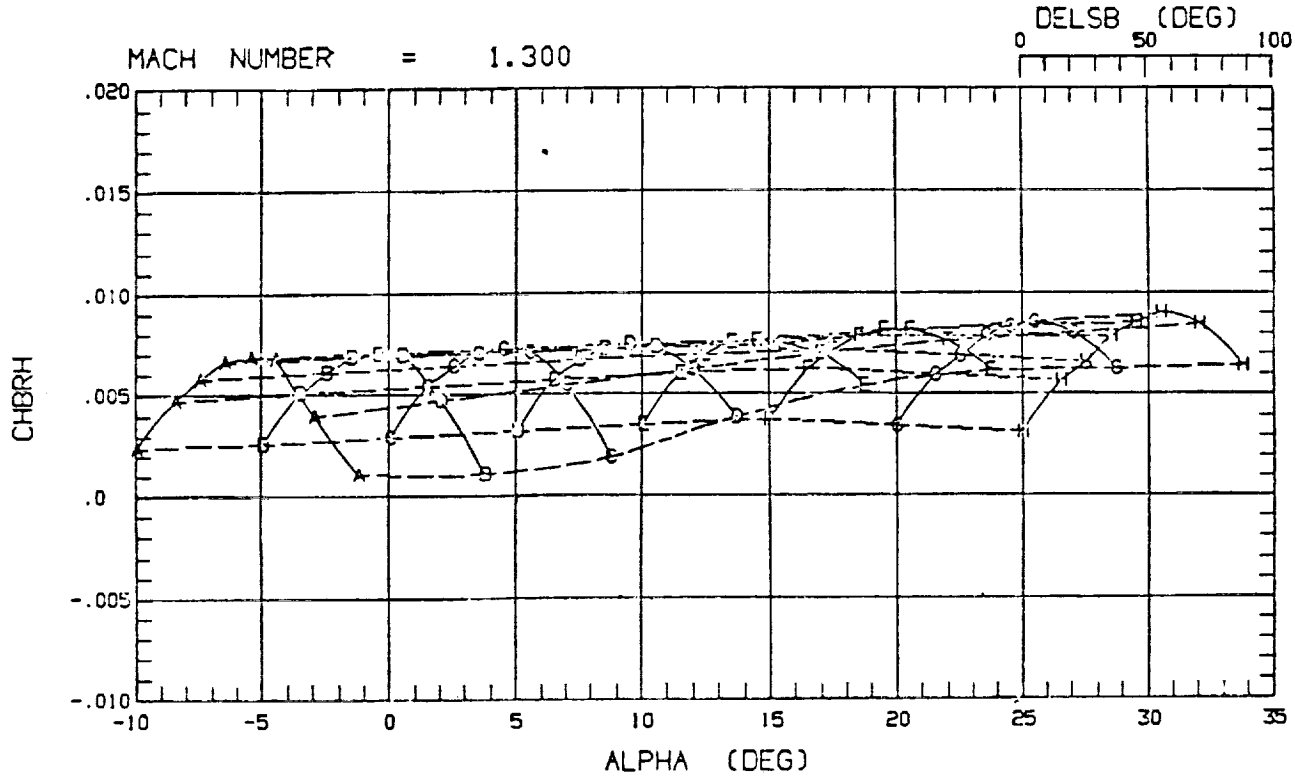
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250
15.000	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530	0.00530
25.000	0.00680	0.00690	0.00700	0.00710	0.00730	0.00780	0.00780	0.00780
35.000	0.00790	0.00800	0.00810	0.00820	0.00850	0.00900	0.00900	0.00900
45.000	0.00800	0.00810	0.00820	0.00830	0.00860	0.00890	0.00910	0.00930
55.000	0.00595	0.00621	0.00647	0.00673	0.00699	0.00770	0.00822	0.00874
70.000	0.00380	0.00380	0.00380	0.00470	0.00600	0.00650	0.00700	0.00750
87.200	0.00100	0.00093	0.00165	0.00400	0.00545	0.00575	0.00625	0.00675

ENGINEER HP
DATE 10/3/78

FIGURE 5.3-38
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



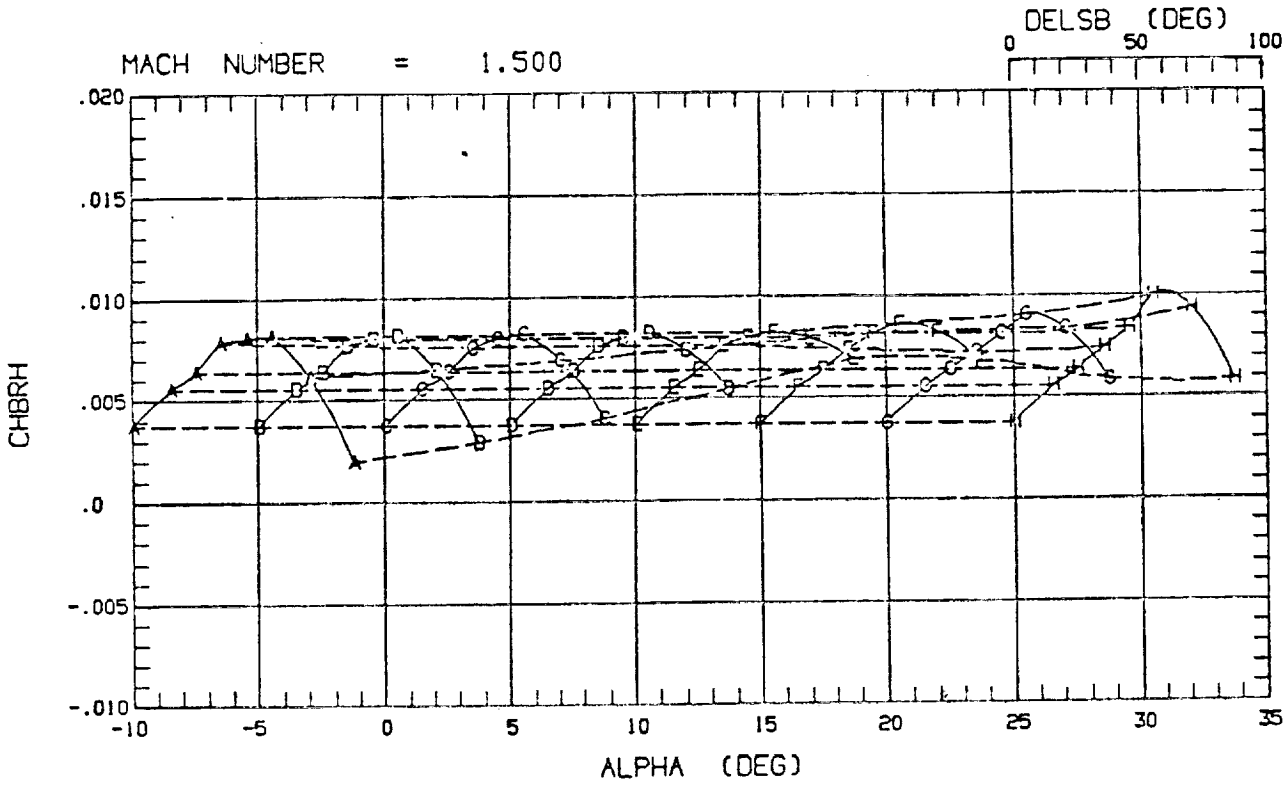
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1070.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00230	0.00260	0.00290	0.00320	0.00350	0.00370	0.00340	0.00310
15.000	0.00470	0.00505	0.00540	0.00570	0.00600	0.00620	0.00590	0.00560
25.000	0.00575	0.00605	0.00635	0.00655	0.00694	0.00710	0.00681	0.00652
35.000	0.00560	0.00680	0.00700	0.00720	0.00750	0.00780	0.00780	0.00780
45.000	0.00580	0.00700	0.00720	0.00740	0.00760	0.00810	0.00830	0.00850
55.000	0.00677	0.00693	0.00709	0.00725	0.00742	0.00810	0.00852	0.00894
70.000	0.00391	0.00467	0.00543	0.00619	0.00696	0.00757	0.00799	0.00841
87.200	0.00107	0.00136	0.00186	0.00386	0.00540	0.00612	0.00685	0.00536

ENGINEER HP
DATE 10/21/71

FIGURE 5.3-39
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



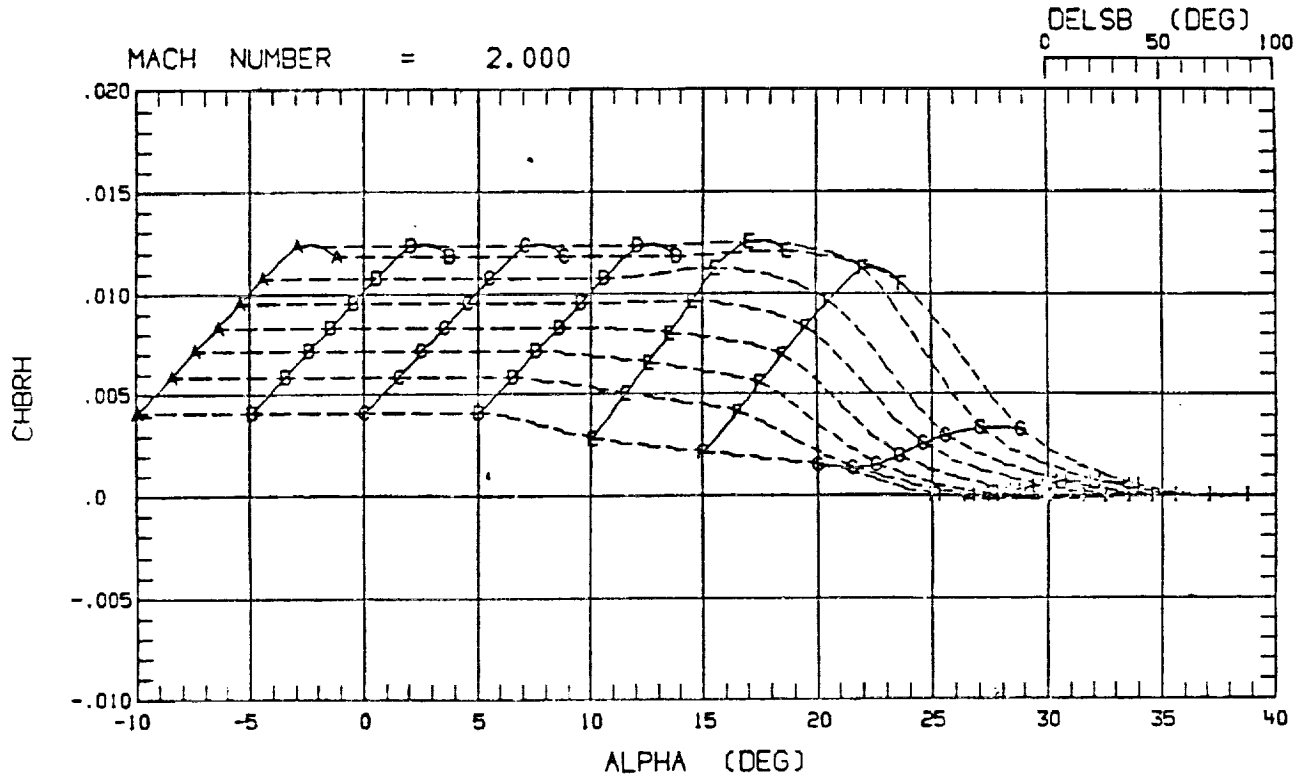
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00370	0.00370	0.00370	0.00370	0.00370	0.00370	0.00370	0.00370
15.000	0.00550	0.00550	0.00550	0.00550	0.00550	0.00550	0.00550	0.00550
25.000	0.00640	0.00640	0.00640	0.00640	0.00640	0.00640	0.00640	0.00640
35.000	0.00782	0.00765	0.00755	0.00756	0.00757	0.00735	0.00720	0.00740
45.000	0.00804	0.00798	0.00795	0.00794	0.00797	0.00812	0.00812	0.00836
55.000	0.00815	0.00815	0.00816	0.00818	0.00821	0.00860	0.00900	0.00996
70.000	0.00612	0.00647	0.00689	0.00739	0.00790	0.00823	0.00837	0.00936
87.200	0.00196	0.00290	0.00404	0.00547	0.00691	0.00676	0.00582	0.00585

ENGINEER HP
DATE 10/27/71

FIGURE 5.3-40
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP

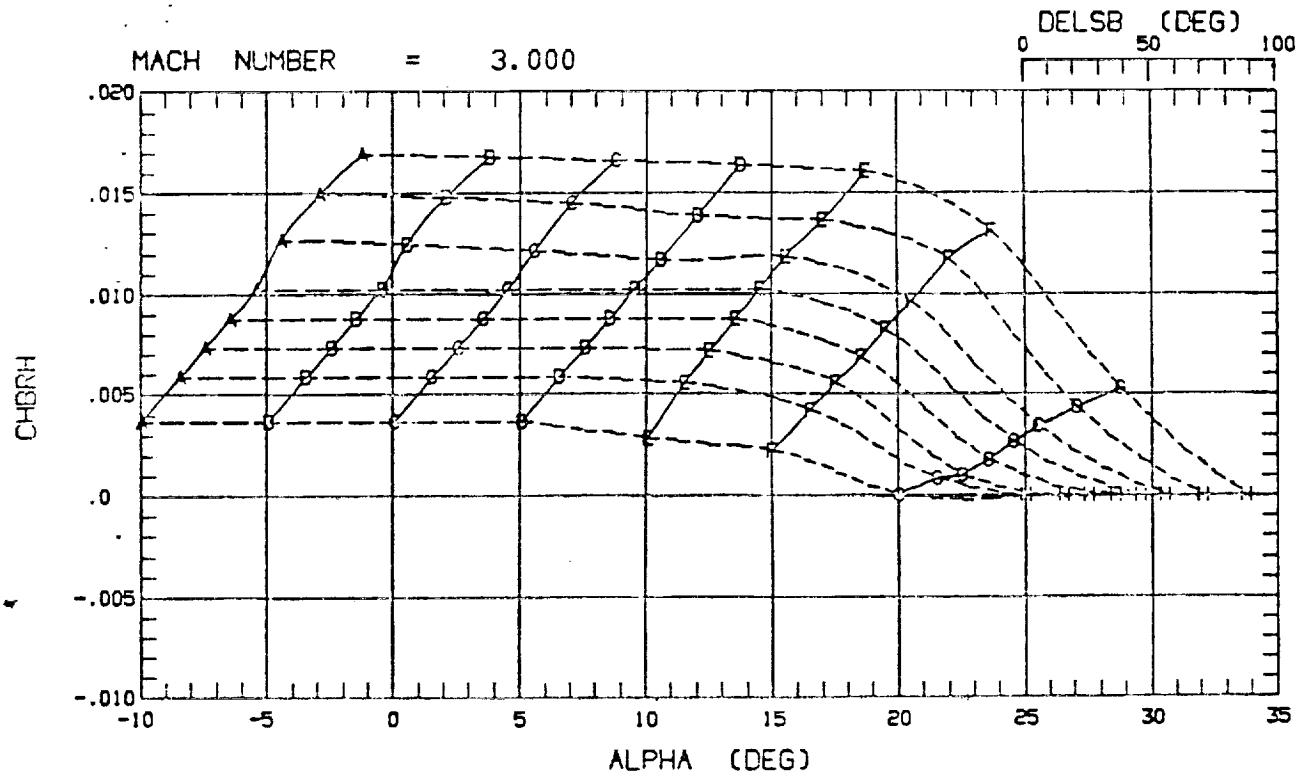


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT								
0.0	0.00410	0.00410	0.00410	0.00410	0.00280	0.00210	0.00151	0.0	0.0
15.000	0.00580	0.00580	0.00580	0.00580	0.00500	0.00410	0.00137	0.0	0.0
25.000	0.00710	0.00710	0.00710	0.00710	0.00650	0.00550	0.00151	0.0	0.0
35.000	0.00830	0.00830	0.00830	0.00830	0.00800	0.00690	0.00195	0.00019	0.0
45.000	0.00950	0.00950	0.00950	0.00950	0.00960	0.00830	0.00254	0.00046	0.0
55.000	0.01070	0.01070	0.01070	0.01070	0.01120	0.00960	0.00298	0.00065	0.0
70.000	0.01230	0.01230	0.01230	0.01230	0.01250	0.01120	0.00329	0.00068	0.0
87.200	0.01180	0.01180	0.01180	0.01180	0.01200	0.01040	0.00333	0.00048	0.0

ENGINEER AP
DATE 10/15/82

FIGURE 5.3-41
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP

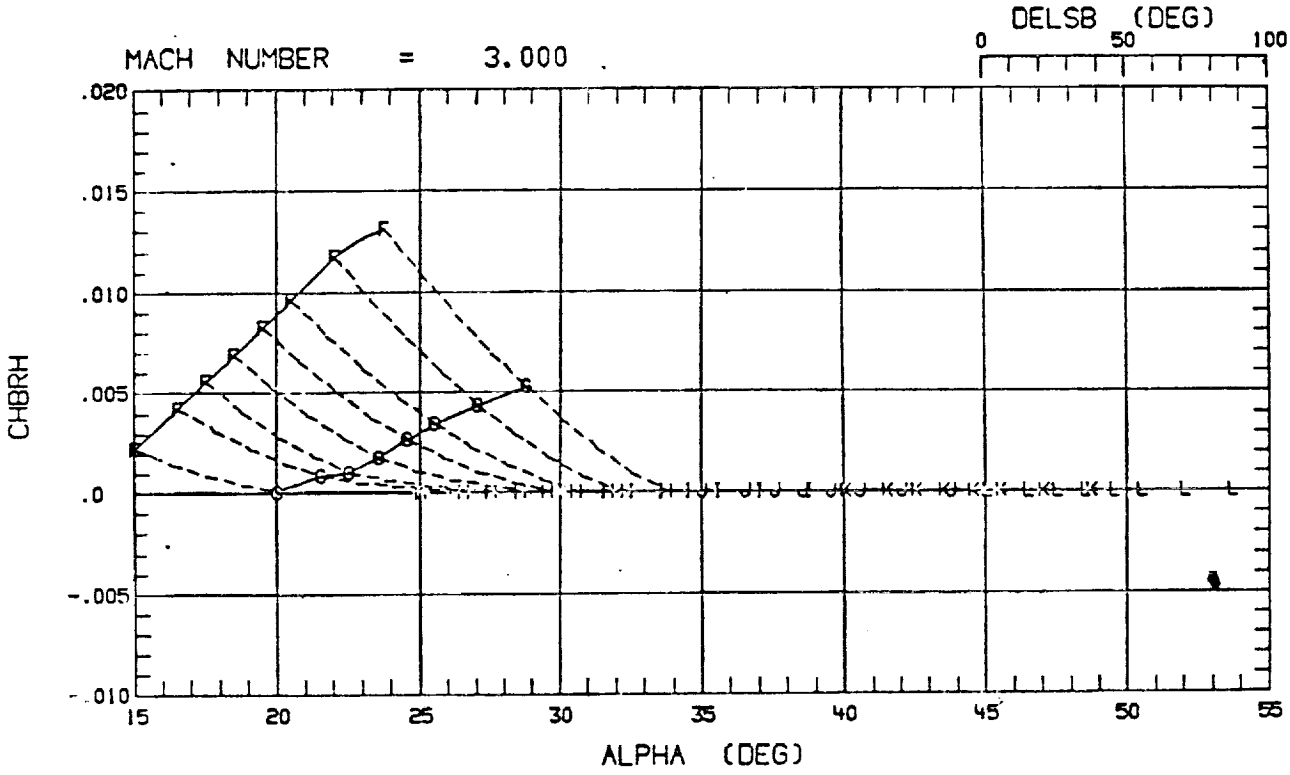


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00360	0.00360	0.00360	0.00360	0.00280	0.00220	0.0	0.0
15.000	0.00580	0.00580	0.00580	0.00580	0.00550	0.00420	0.00079	0.0
25.000	0.00730	0.00730	0.00730	0.00730	0.00710	0.00550	0.00100	0.0
35.000	0.00870	0.00870	0.00870	0.00870	0.00870	0.00680	0.00175	0.0
45.000	0.01020	0.01020	0.01020	0.01020	0.01020	0.00820	0.00262	0.0
55.000	0.01264	0.01242	0.01206	0.01159	0.01180	0.00956	0.00339	0.0
70.000	0.01490	0.01472	0.01443	0.01390	0.01360	0.01168	0.00433	0.0
87.200	0.01687	0.01674	0.01656	0.01635	0.01602	0.01305	0.00522	0.0

ENGINEER HP
DATE 10/31/78

FIGURE 5.3-42
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP

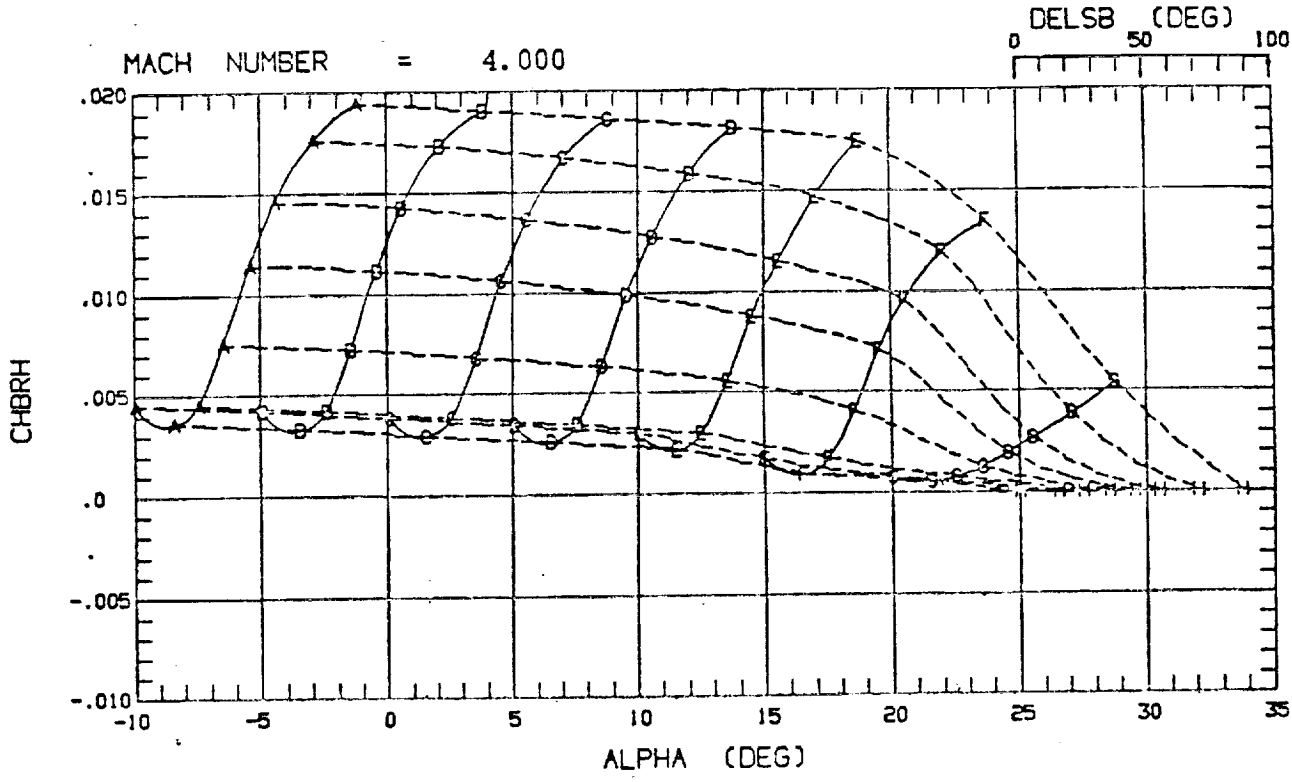


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT						
0.0	0.00220	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.00420	0.00079	0.0	0.0	0.0	0.0	0.0
25.000	0.00550	0.00100	0.0	0.0	0.0	0.0	0.0
35.000	0.00680	0.00175	0.0	0.0	0.0	0.0	0.0
45.000	0.00820	0.00262	0.0	0.0	0.0	0.0	0.0
55.000	0.00956	0.00339	0.0	0.0	0.0	0.0	0.0
70.000	0.01168	0.00433	0.0	0.0	0.0	0.0	0.0
87.200	0.01305	0.00522	0.0	0.0	0.0	0.0	0.0

ENGINEER MP
DATE 10/3/78

FIGURE 5.3-43
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



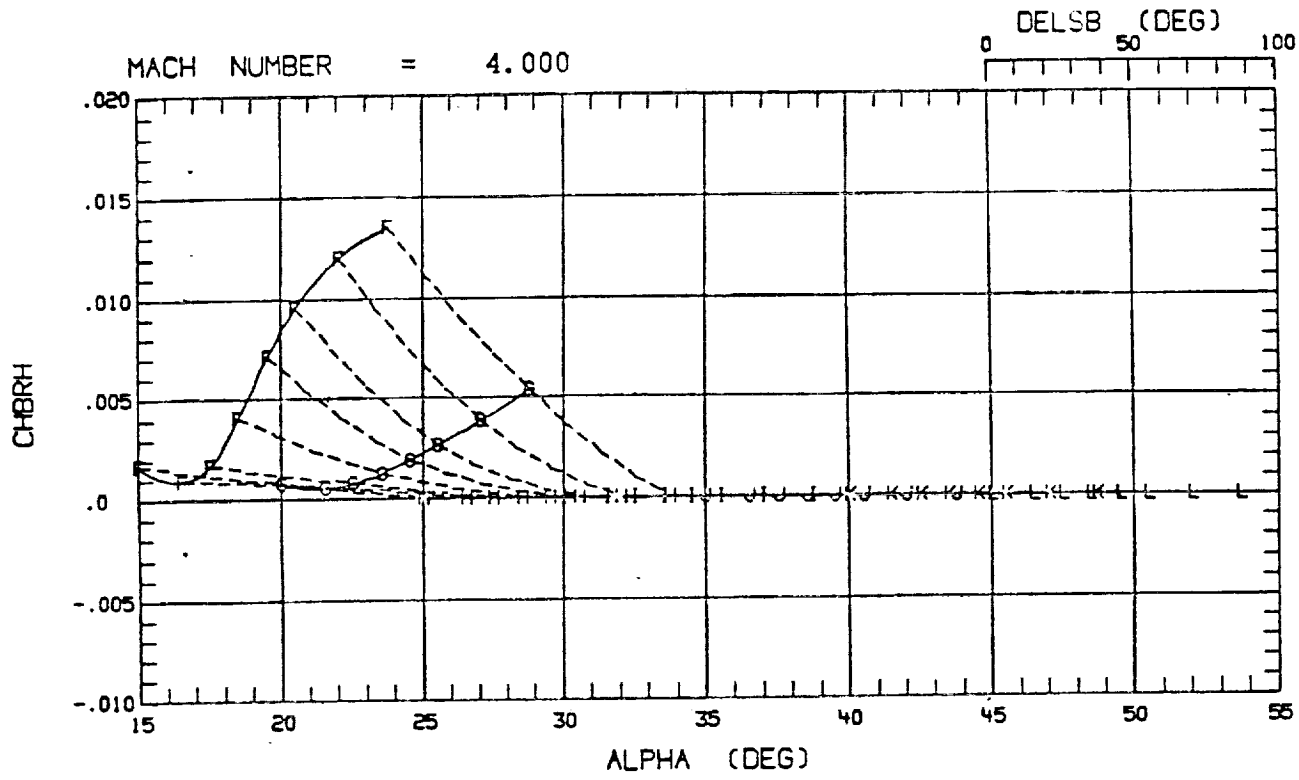
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00446	0.00415	0.00378	0.00339	0.00291	0.00164	0.00070	0.0
15.000	0.00354	0.00323	0.00289	0.00254	0.00213	0.00092	0.00052	0.0
25.000	0.00446	0.00415	0.00378	0.00339	0.00291	0.00164	0.00070	0.0
35.000	0.00751	0.00720	0.00677	0.00626	0.00556	0.00404	0.00122	0.0
45.000	0.01142	0.01110	0.01055	0.00960	0.00874	0.00709	0.00191	0.0
55.000	0.01454	0.01422	0.01359	0.01272	0.01145	0.00953	0.00264	0.0
70.000	0.01757	0.01723	0.01663	0.01585	0.01465	0.01193	0.00382	0.0
87.200	0.01938	0.01902	0.01857	0.01808	0.01743	0.01342	0.00536	0.0

ENGINEER MP
DATE 10/25/78

FIGURE 5.3- 44
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



CONFIGURATION

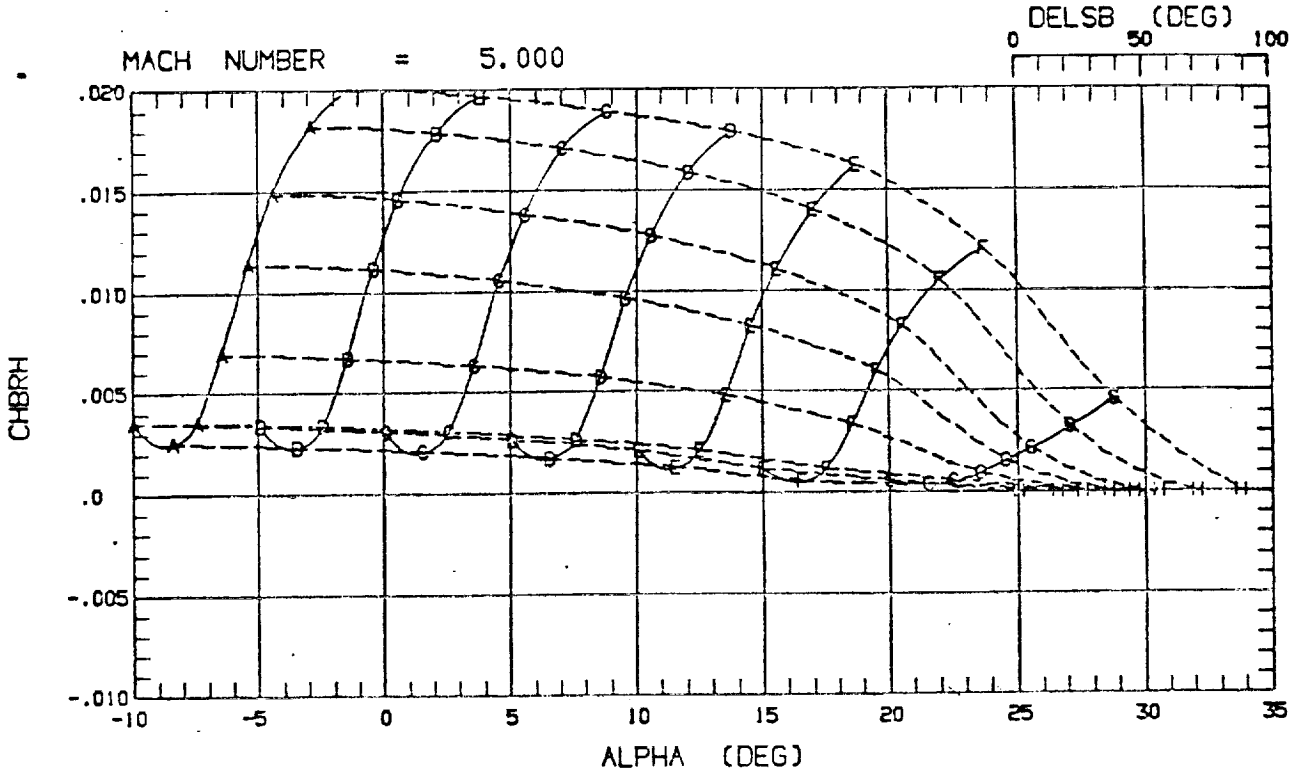
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT						
0.0	0.00164	0.00070	0.0	0.0	0.0	0.0	0.0
15.000	0.00092	0.00052	0.0	0.0	0.0	0.0	0.0
25.000	0.00164	0.00070	0.0	0.0	0.0	0.0	0.0
35.000	0.00404	0.00122	0.0	0.0	0.0	0.0	0.0
45.000	0.00709	0.00191	0.0	0.0	0.0	0.0	0.0
55.000	0.00953	0.00264	0.0	0.0	0.0	0.0	0.0
70.000	0.01193	0.00382	0.0	0.0	0.0	0.0	0.0
87.200	0.01342	0.00536	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/2/78

FIGURE 5.3-45
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



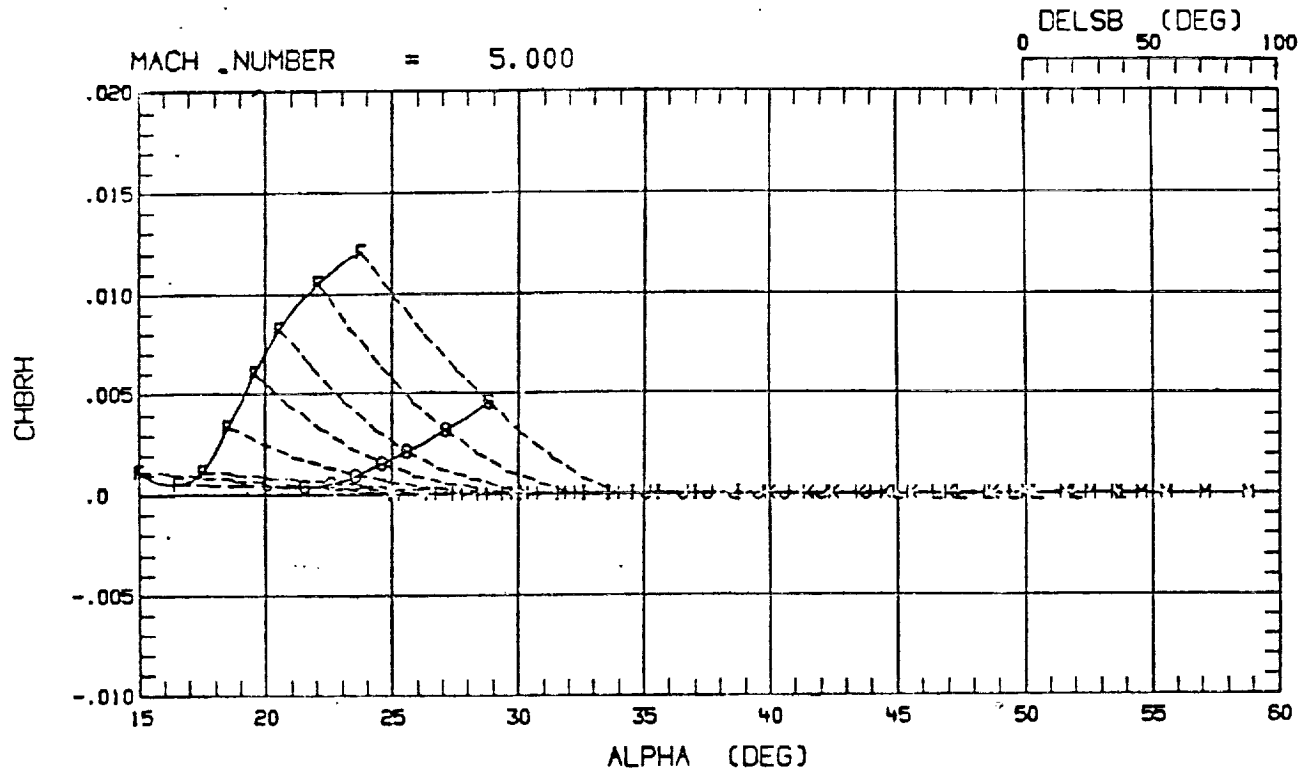
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00350	0.00331	0.00301	0.00259	0.00200	0.00114	0.00048	0.0
15.000	0.00246	0.00229	0.00202	0.00167	0.00118	0.00049	0.00033	0.0
25.000	0.00350	0.00331	0.00301	0.00259	0.00200	0.00114	0.00048	0.0
35.000	0.00694	0.00671	0.00628	0.00566	0.00475	0.00329	0.00089	0.0
45.000	0.01135	0.01108	0.01046	0.00955	0.00817	0.00600	0.00146	0.0
55.000	0.01486	0.01455	0.01379	0.01268	0.01098	0.00820	0.00209	0.0
70.000	0.01819	0.01782	0.01700	0.01582	0.01397	0.01047	0.00314	0.0
87.200	0.02008	0.01965	0.01887	0.01783	0.01618	0.01204	0.00454	0.0

ENGINEER HP
DATE 10/27/78

FIGURE 5.3-46
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



CONFIGURATION

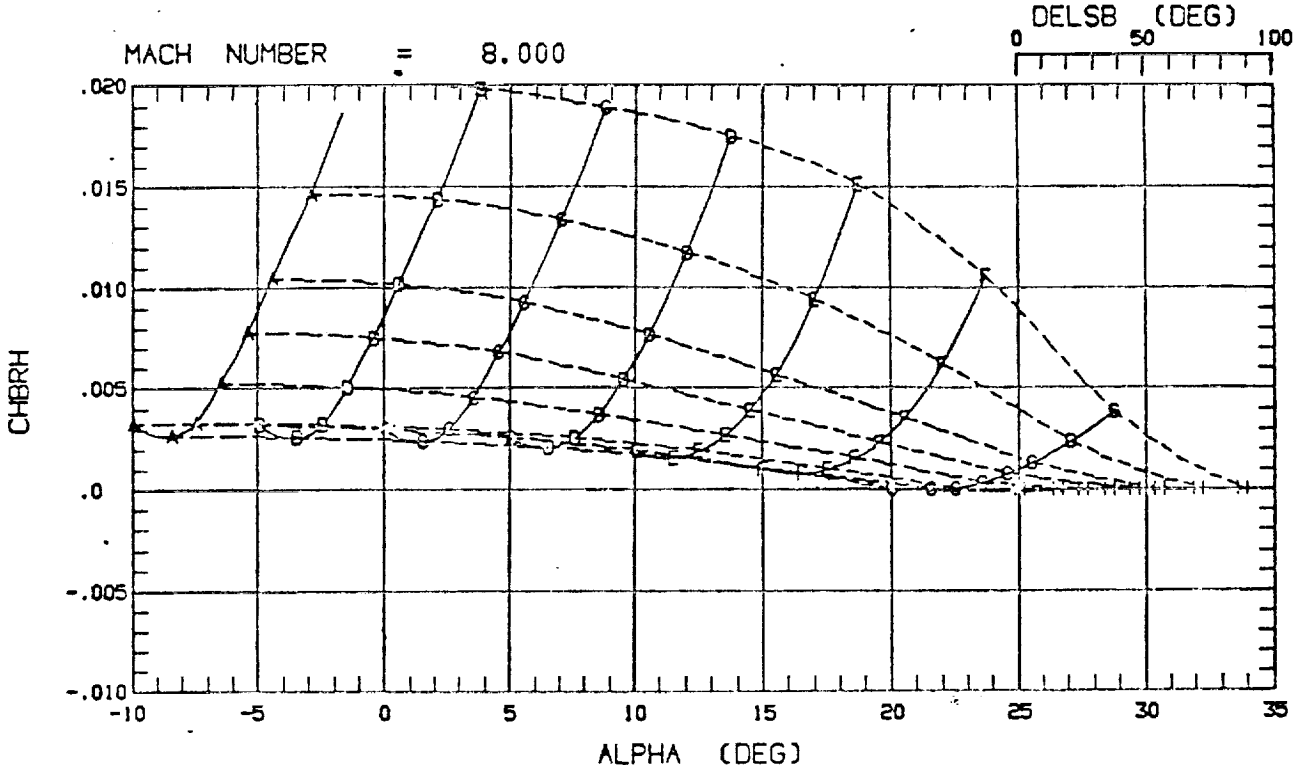
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	REFERENCE DIMENSIONS	
OR	YO = BL 0.0 IN.	WING AREA	SW = 2690.00 SQ.FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	WING SPAN	BW = 78.056 FT.
		M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00114	0.00048	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.00049	0.00033	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.00114	0.00048	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00329	0.00089	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00600	0.00146	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00820	0.00209	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.01047	0.00314	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.01204	0.00454	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/27/78

FIGURE 5.3-47
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



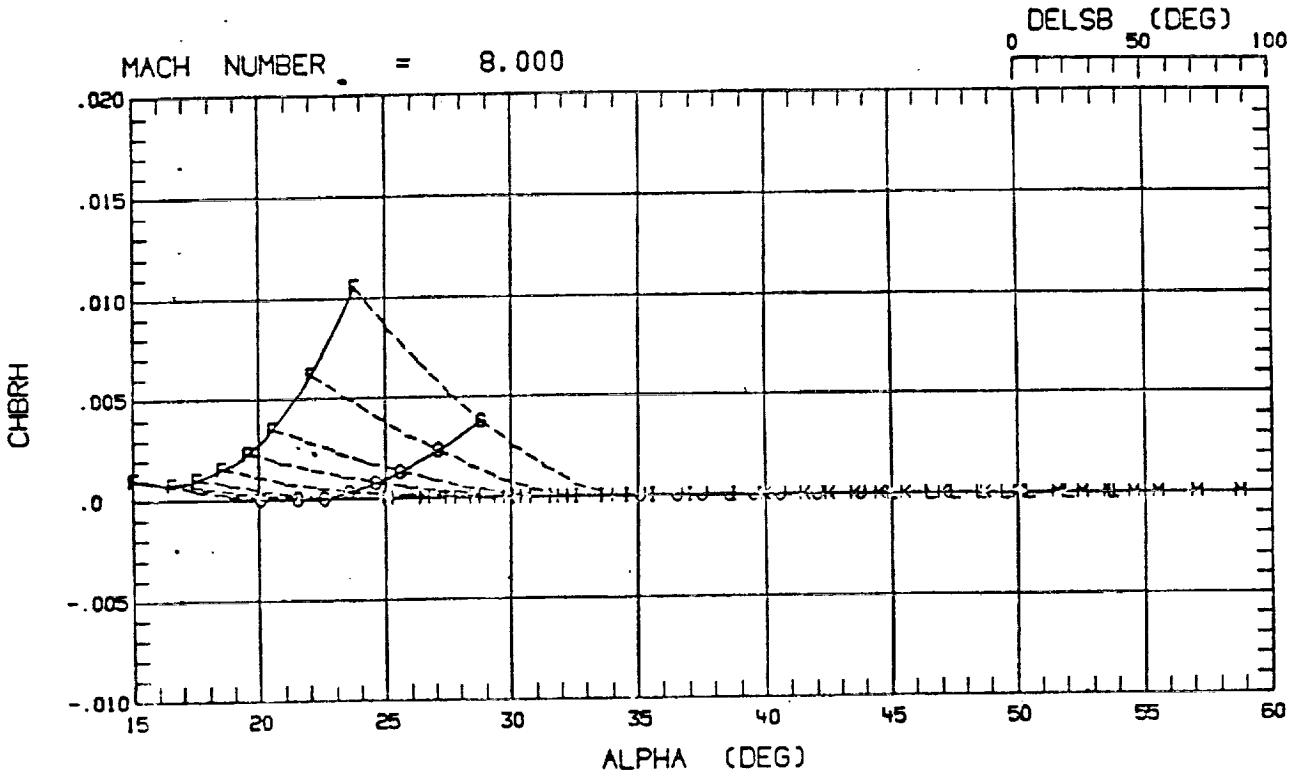
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00328	0.00318	0.00291	0.00248	0.00185	0.00098	0.0	0.0
15.000	0.00284	0.00255	0.00234	0.00201	0.00151	0.00075	0.0	0.0
25.000	0.00328	0.00318	0.00291	0.00248	0.00185	0.00098	0.0	0.0
35.000	0.00522	0.00501	0.00450	0.00366	0.00263	0.00148	0.00029	0.0
45.000	0.00773	0.00746	0.00672	0.00537	0.00385	0.00227	0.00073	0.0
55.000	0.01037	0.01007	0.00918	0.00757	0.00561	0.00347	0.00129	0.0
70.000	0.01461	0.01429	0.01330	0.01166	0.00931	0.00618	0.00231	0.0
87.200	0.02004	0.01976	0.01884	0.01742	0.01504	0.01047	0.00378	0.0

ENGINEER HP
DATE 10-27-78

FIGURE 5.3-48
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

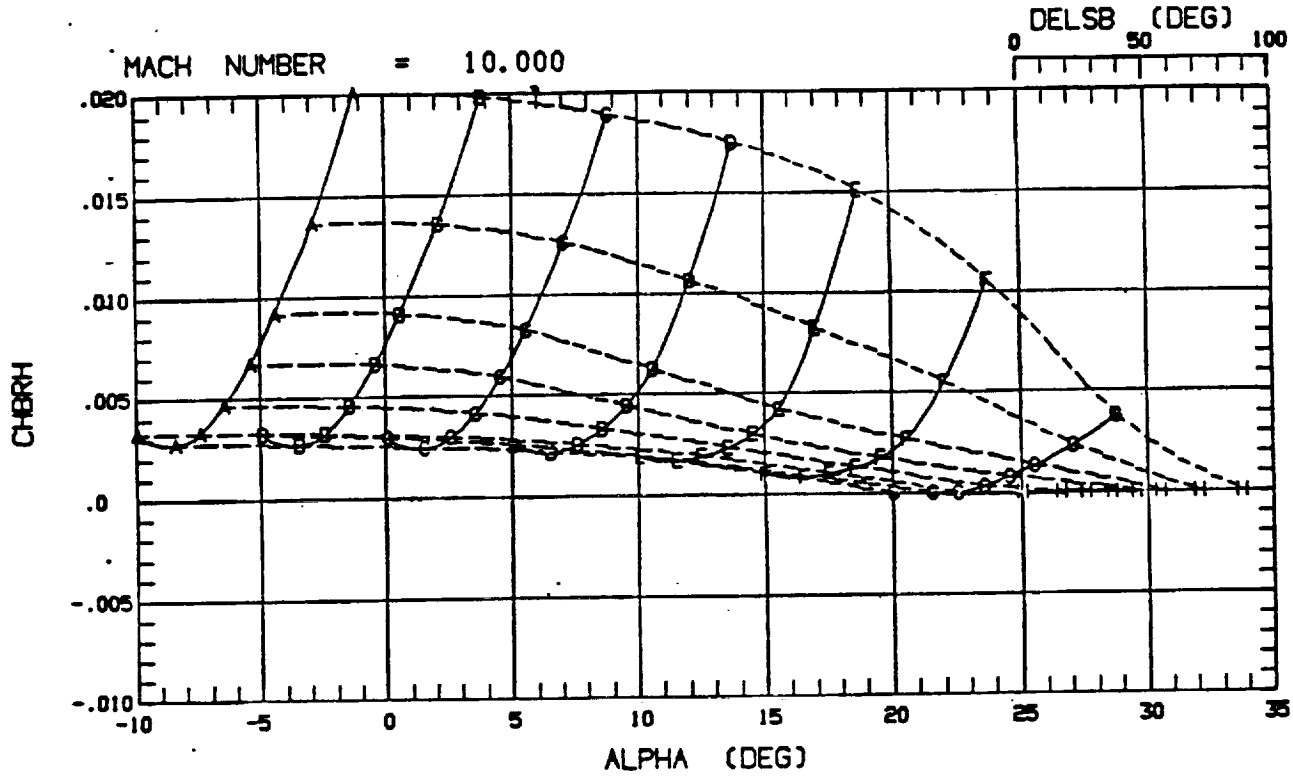
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00098	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.00075	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.00098	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00148	0.00029	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00227	0.00073	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00347	0.00129	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00618	0.00231	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.01047	0.00378	0.0	0.0	0.0	0.0	0.0	0.0

NEER HP
DATE 10/27/78

FIGURE 5.3-49
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



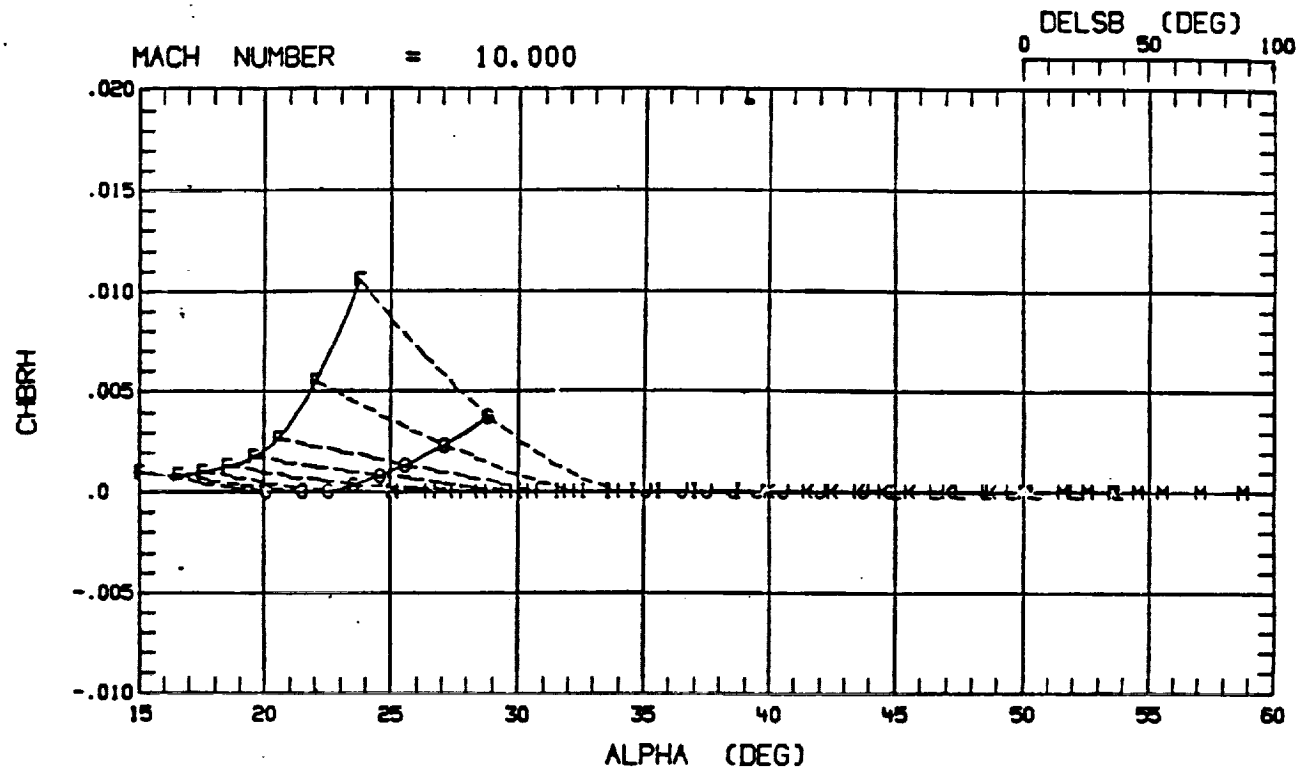
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00326	0.00318	0.00292	0.00250	0.00188	0.00097	0.0	0.0
15.000	0.00272	0.00264	0.00244	0.00214	0.00166	0.00083	0.0	0.0
25.000	0.00326	0.00318	0.00292	0.00250	0.00188	0.00097	0.0	0.0
35.000	0.00462	0.00452	0.00410	0.00326	0.00229	0.00126	0.00030	0.0
45.000	0.00666	0.00657	0.00591	0.00441	0.00291	0.00170	0.00076	0.0
55.000	0.00914	0.00907	0.00821	0.00620	0.00419	0.00261	0.00130	0.0
70.000	0.01363	0.01349	0.01254	0.01059	0.00817	0.00549	0.00229	0.0
87.200	0.02002	0.01978	0.01887	0.01744	0.01505	0.01049	0.00371	0.0

ENGINEER HP
DATE 10/27/78

FIGURE 5.3-50
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP

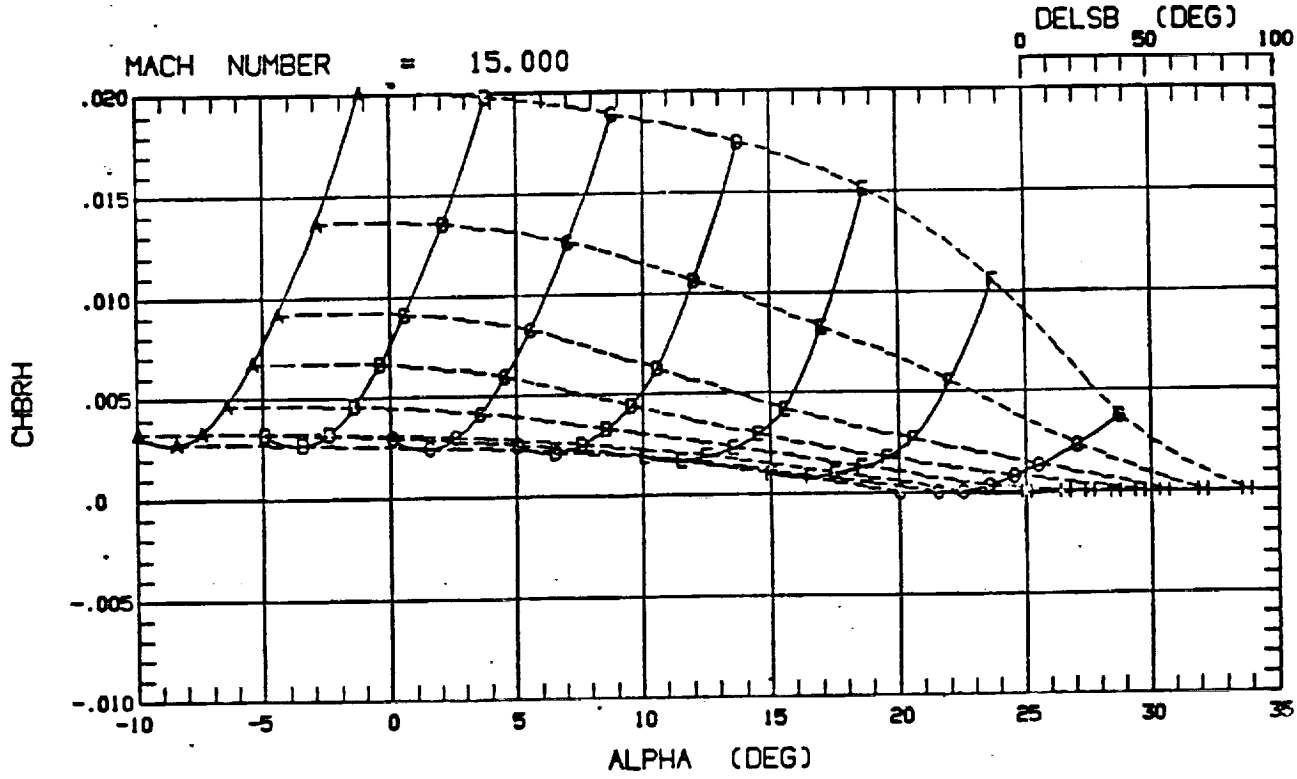


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00097	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.00083	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.00097	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00126	0.00030	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00170	0.00076	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00261	0.00130	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00549	0.00229	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.01049	0.00371	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/5/82

FIGURE 5.3-51
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



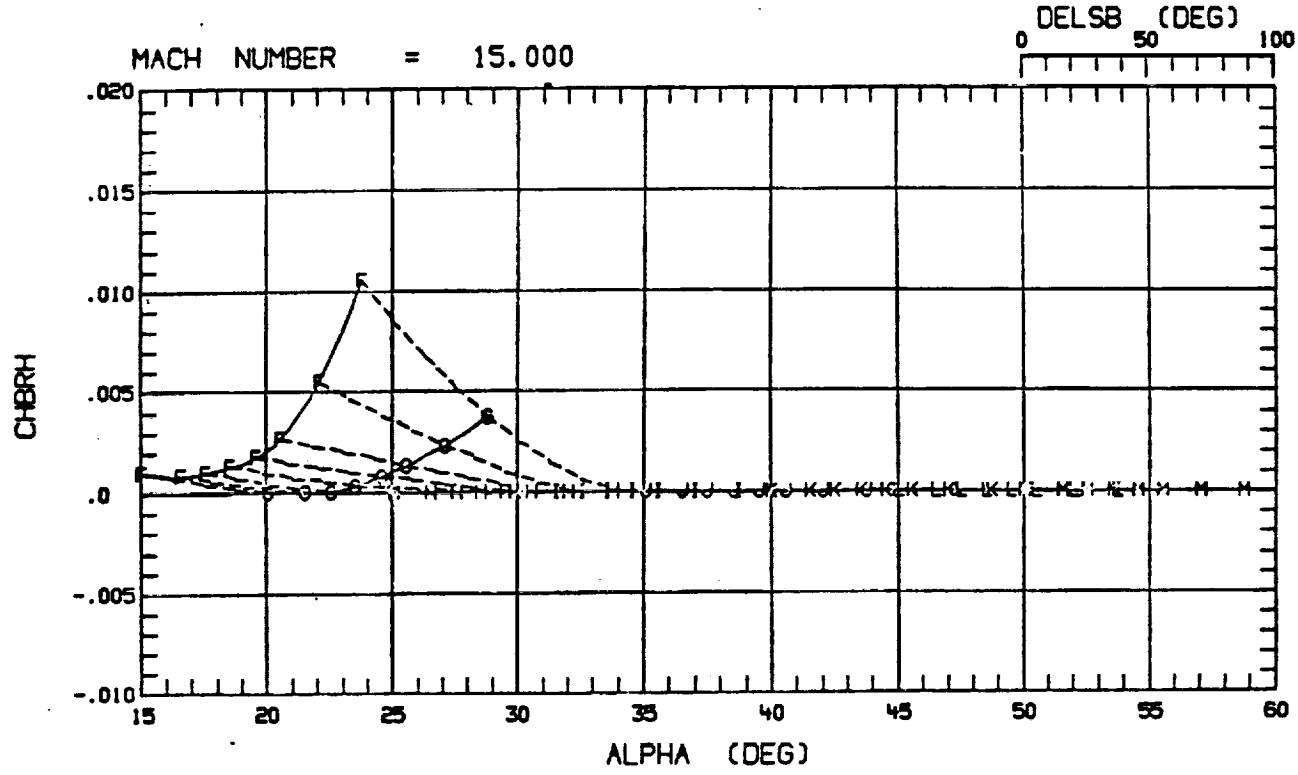
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00326	0.00318	0.00292	0.00250	0.00188	0.00097	0.0	0.0
15.000	0.00272	0.00264	0.00244	0.00214	0.00166	0.00083	0.0	0.0
25.000	0.00326	0.00318	0.00292	0.00250	0.00188	0.00097	0.0	0.0
35.000	0.00462	0.00452	0.00410	0.00326	0.00229	0.00126	0.00030	0.0
45.000	0.00636	0.00657	0.00591	0.00441	0.00291	0.00170	0.00076	0.0
55.000	0.00914	0.00907	0.00821	0.00620	0.00419	0.00261	0.00130	0.0
70.000	0.01363	0.01349	0.01254	0.01059	0.00817	0.00549	0.00229	0.0
87.200	0.02002	0.01978	0.01887	0.01744	0.01505	0.01049	0.00371	0.0

ENGINEER HP
DATE 10/23/73

FIGURE 5.3-52
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP

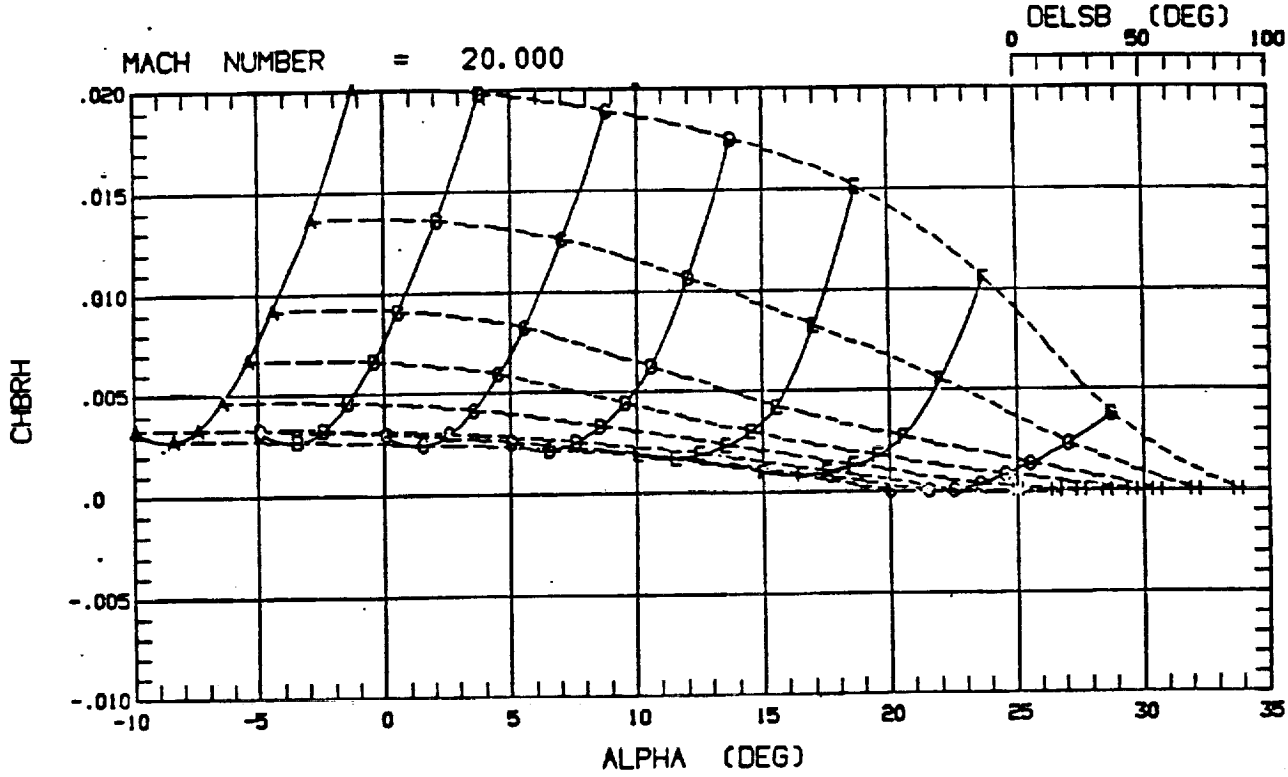


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00097	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.00083	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.00097	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00126	0.00030	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00170	0.00076	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00261	0.00130	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00549	0.00229	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.01049	0.00371	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/31/78

FIGURE 5.3-53
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



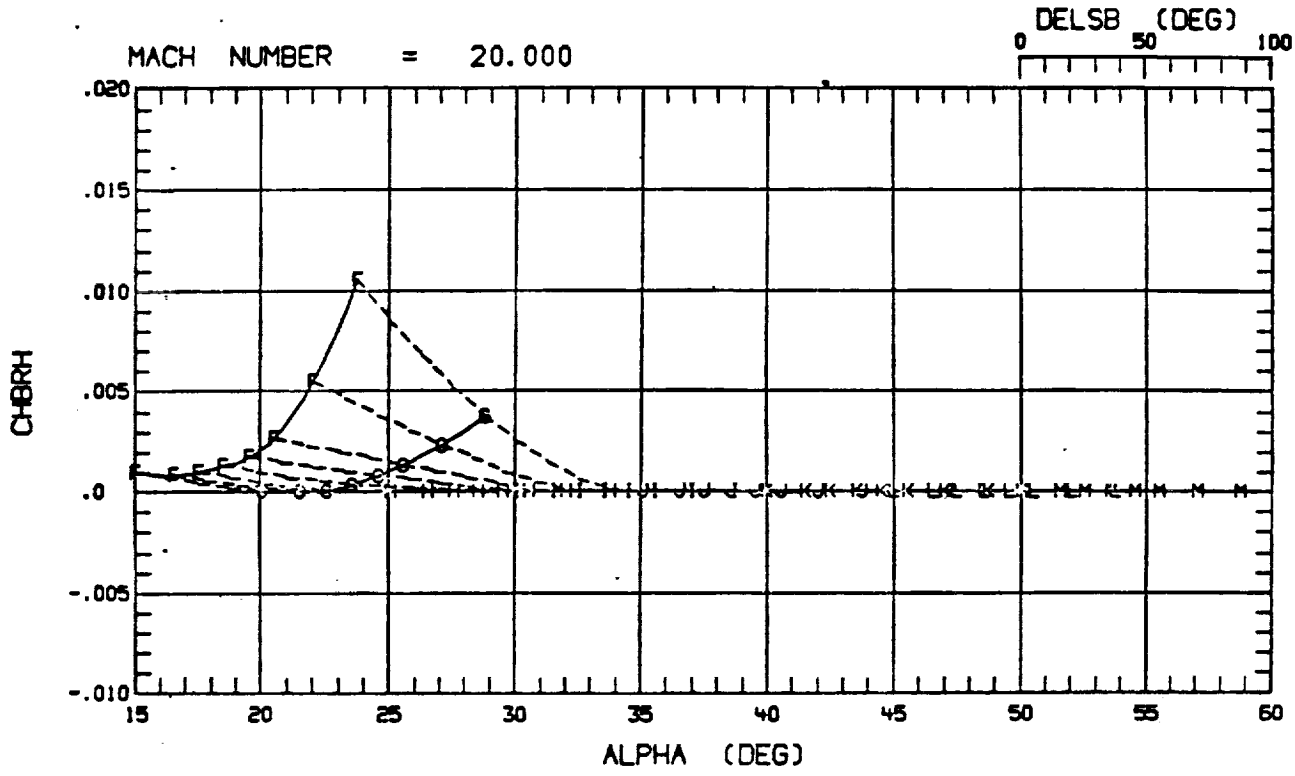
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00326	0.00318	0.00292	0.00250	0.00188	0.00097	0.0	0.0
15.000	0.00272	0.00264	0.00244	0.00214	0.00166	0.00083	0.0	0.0
25.000	0.00326	0.00318	0.00292	0.00250	0.00188	0.00097	0.0	0.0
35.000	0.00462	0.00452	0.00410	0.00326	0.00229	0.00126	0.00030	0.0
45.000	0.00666	0.00657	0.00591	0.00441	0.00291	0.00170	0.00076	0.0
55.000	0.00914	0.00907	0.00821	0.00620	0.00419	0.00261	0.00130	0.0
70.000	0.01363	0.01349	0.01254	0.01059	0.00817	0.00549	0.00229	0.0
87.200	0.02002	0.01978	0.01887	0.01744	0.01505	0.01049	0.00371	0.0

ENGINEER HP
DATE 10/2/78

FIGURE 5.3-54
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP



CONFIGURATION

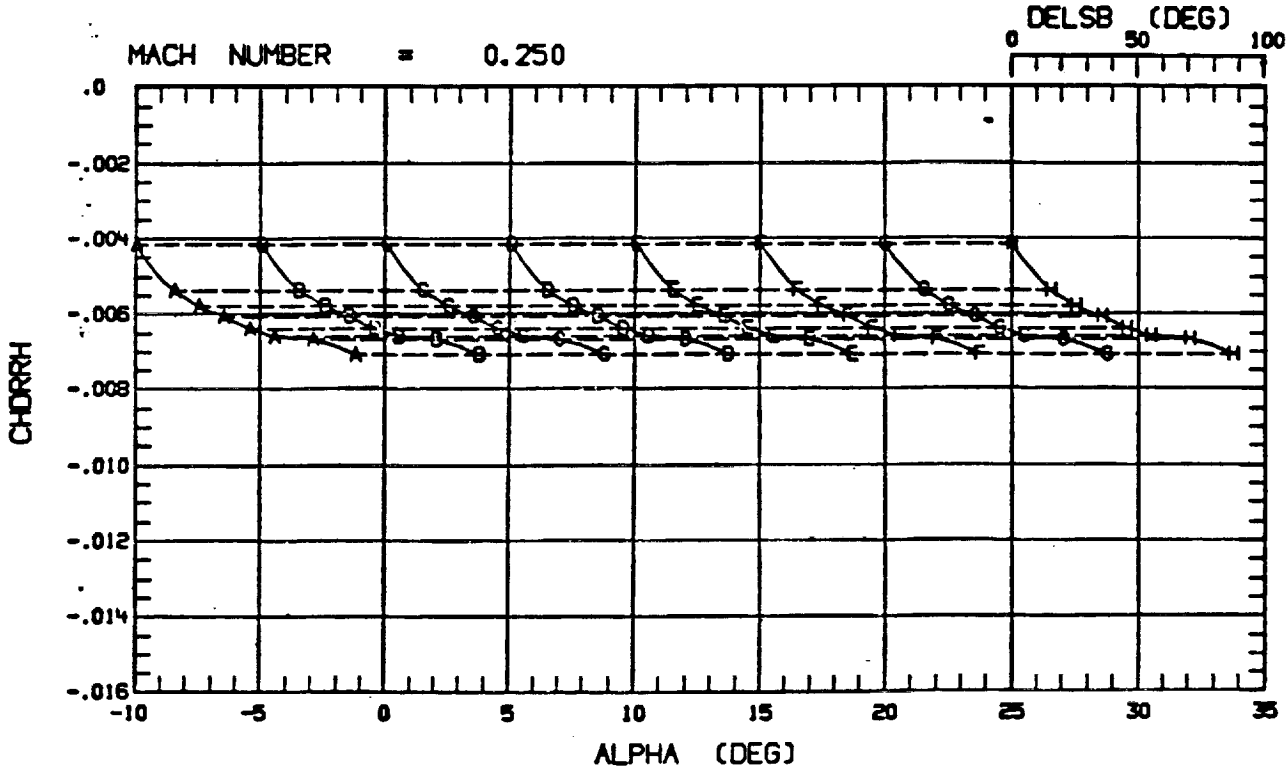
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER SPEEDBRAKE HINGE MOMENT							
0.0	0.00097	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	0.00083	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	0.00097	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	0.00126	0.00030	0.0	0.0	0.0	0.0	0.0	0.0
45.000	0.00170	0.00076	0.0	0.0	0.0	0.0	0.0	0.0
55.000	0.00261	0.00130	0.0	0.0	0.0	0.0	0.0	0.0
70.000	0.00549	0.00229	0.0	0.0	0.0	0.0	0.0	0.0
87.200	0.01049	0.00371	0.0	0.0	0.0	0.0	0.0	0.0

GINEER HP
ATE 10/5/78

FIGURE 5.3-55
RUDDER SPEEDBRAKE HINGE MOMENT DUE TO SIDESLIP

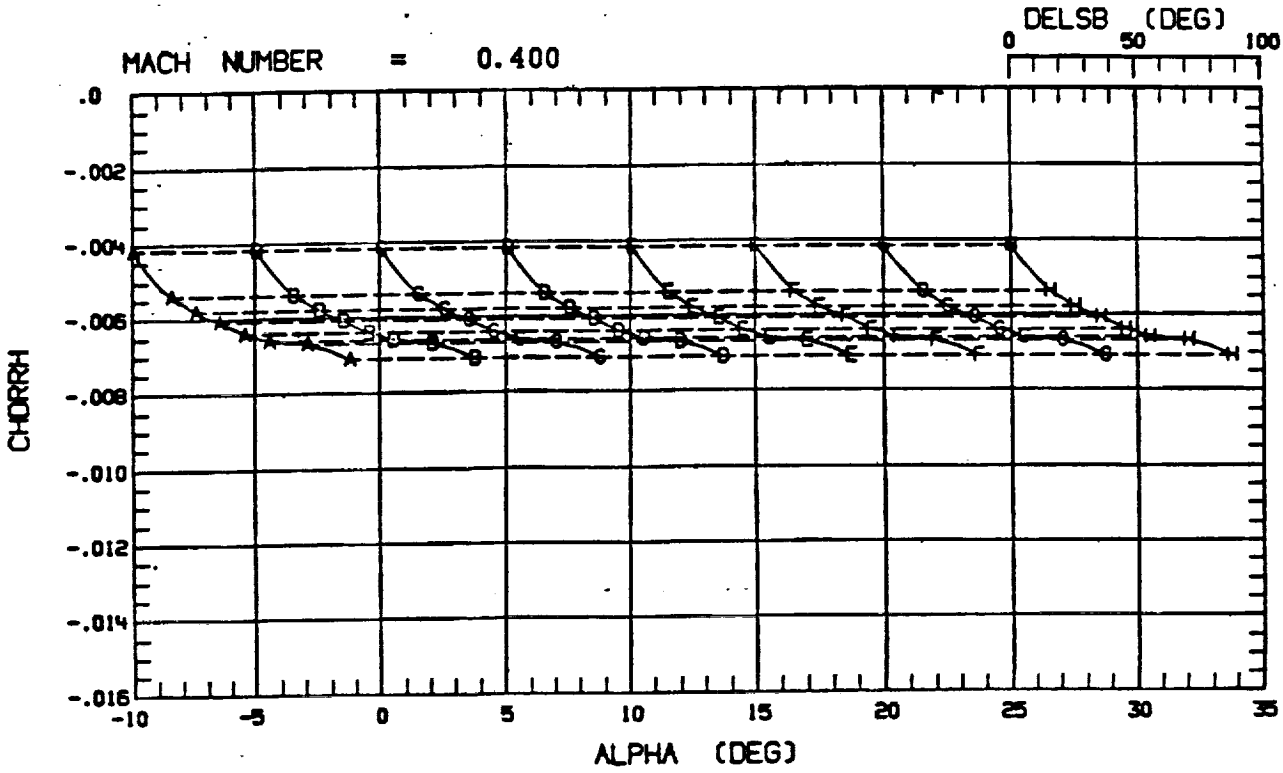


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420
15.000	-0.00540	-0.00540	-0.00540	-0.00540	-0.00540	-0.00540	-0.00540	-0.00540
25.000	-0.00580	-0.00580	-0.00580	-0.00580	-0.00580	-0.00580	-0.00580	-0.00580
35.000	-0.00610	-0.00610	-0.00610	-0.00610	-0.00610	-0.00610	-0.00610	-0.00610
45.000	-0.00640	-0.00640	-0.00640	-0.00640	-0.00640	-0.00640	-0.00640	-0.00640
55.000	-0.00660	-0.00660	-0.00660	-0.00660	-0.00660	-0.00660	-0.00660	-0.00660
70.000	-0.00670	-0.00670	-0.00670	-0.00670	-0.00670	-0.00670	-0.00670	-0.00670
87.200	-0.00710	-0.00710	-0.00710	-0.00710	-0.00710	-0.00710	-0.00710	-0.00710

ENGINEER HP
DATE 8/3/28

FIGURE 5.3-56
HINGE MOMENT COEFFICIENT DUE TO RUDDER



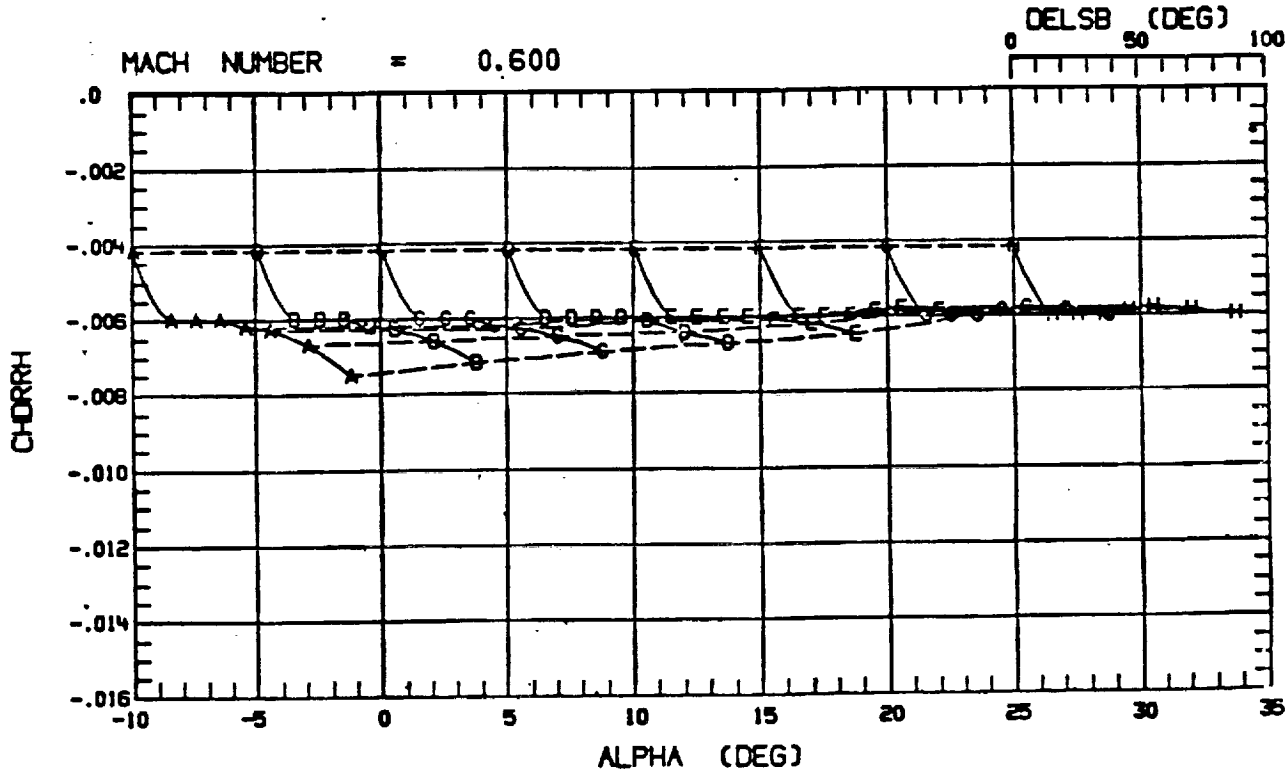
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420
15.000	-0.00540	-0.00540	-0.00540	-0.00540	-0.00540	-0.00540	-0.00540	-0.00540
25.000	-0.00580	-0.00580	-0.00580	-0.00580	-0.00580	-0.00580	-0.00580	-0.00580
35.000	-0.00610	-0.00610	-0.00610	-0.00610	-0.00610	-0.00610	-0.00610	-0.00610
45.000	-0.00640	-0.00640	-0.00640	-0.00640	-0.00640	-0.00640	-0.00640	-0.00640
55.000	-0.00660	-0.00660	-0.00660	-0.00660	-0.00660	-0.00660	-0.00660	-0.00660
70.000	-0.00670	-0.00670	-0.00670	-0.00670	-0.00670	-0.00670	-0.00670	-0.00670
87.200	-0.00710	-0.00710	-0.00710	-0.00710	-0.00710	-0.00710	-0.00710	-0.00710

ENGINEER NP
DATE 10/2/78

FIGURE 5.3-57
HINGE MOMENT COEFFICIENT DUE TO RUDDER



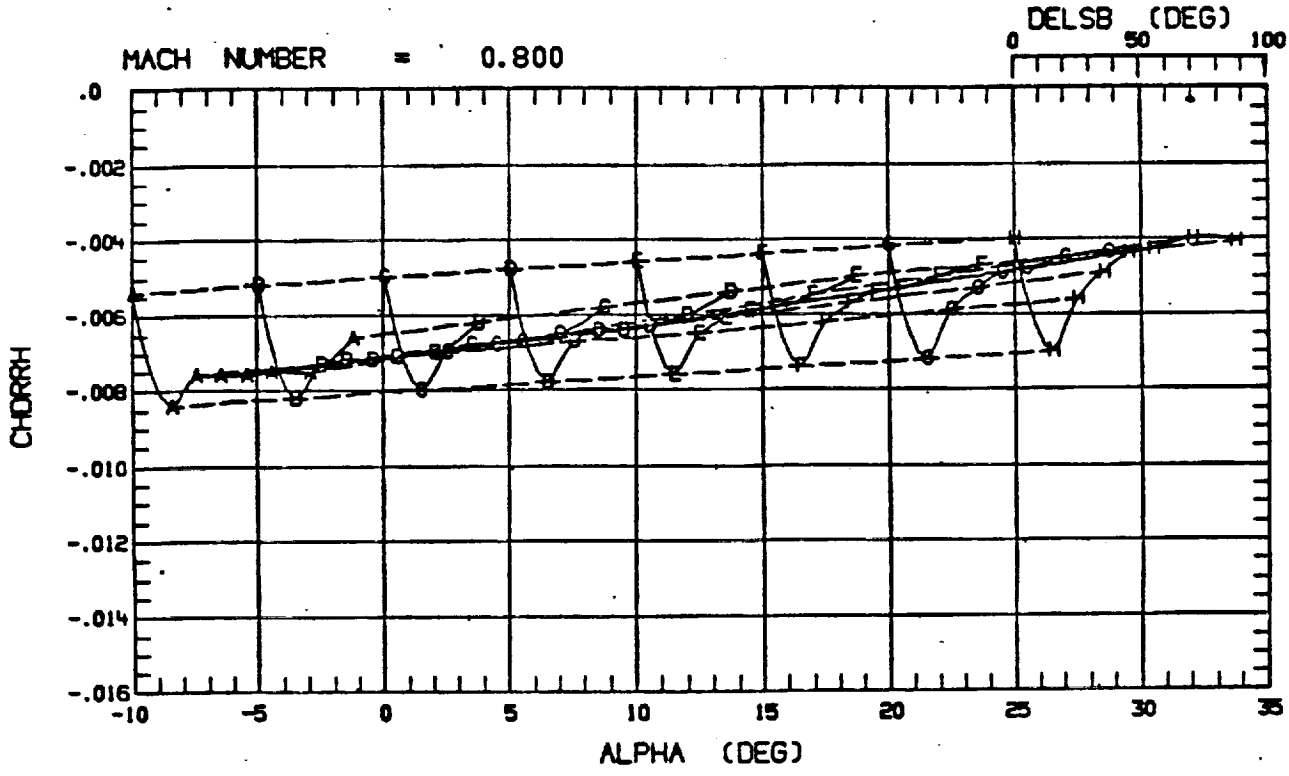
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420	-0.00420
15.000	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600
25.000	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600
35.000	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600
45.000	-0.00620	-0.00620	-0.00620	-0.00600	-0.00600	-0.00590	-0.00590	-0.00590
55.000	-0.00630	-0.00630	-0.00630	-0.00610	-0.00610	-0.00580	-0.00580	-0.00580
70.000	-0.00670	-0.00660	-0.00650	-0.00640	-0.00620	-0.00590	-0.00590	-0.00590
87.200	-0.00750	-0.00720	-0.00690	-0.00670	-0.00650	-0.00600	-0.00600	-0.00600

ENGINEER HP
DATE 10/2/78

FIGURE 5.3-58
HINGE MOMENT COEFFICIENT DUE TO RUDDER

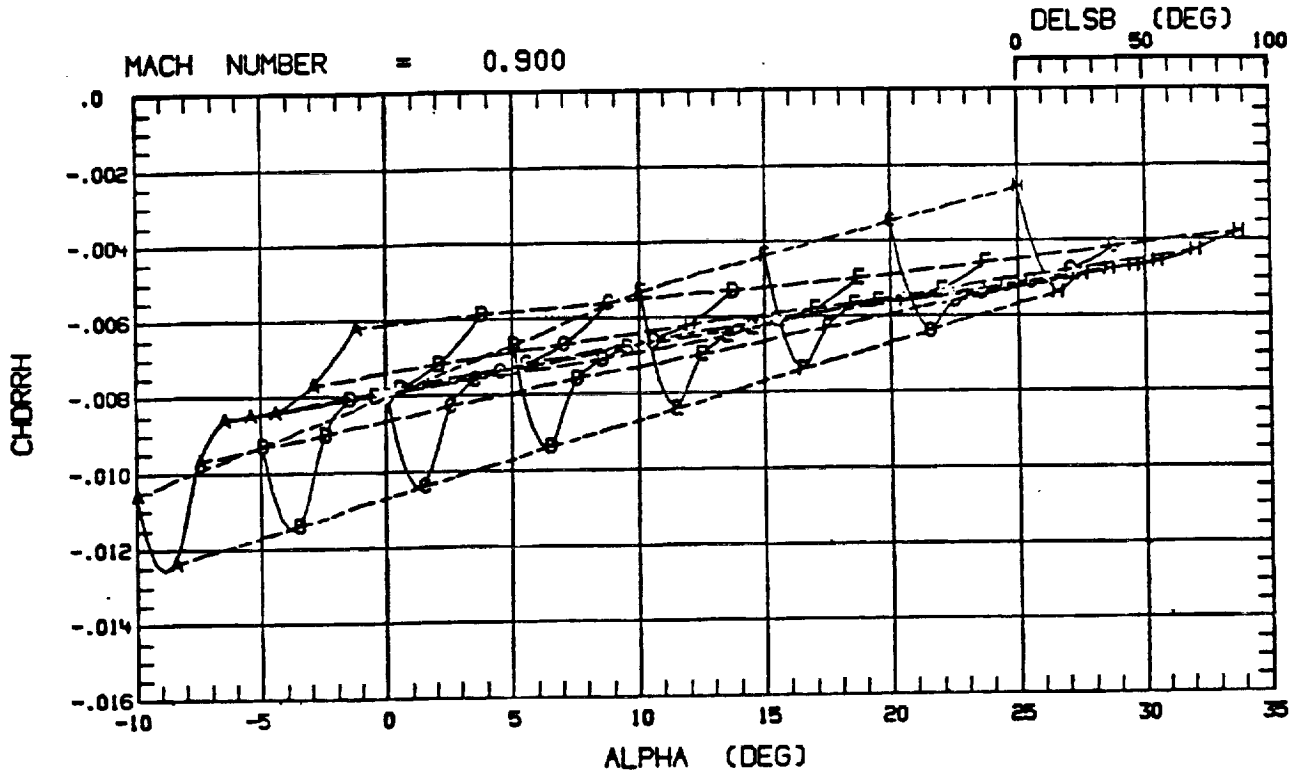


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00540	-0.00520	-0.00500	-0.00480	-0.00460	-0.00440	-0.00420	-0.00400
15.000	-0.00840	-0.00820	-0.00800	-0.00780	-0.00760	-0.00740	-0.00720	-0.00700
25.000	-0.00760	-0.00730	-0.00700	-0.00670	-0.00650	-0.00620	-0.00590	-0.00560
35.000	-0.00760	-0.00720	-0.00680	-0.00640	-0.00610	-0.00570	-0.00530	-0.00490
45.000	-0.00760	-0.00720	-0.00680	-0.00640	-0.00590	-0.00540	-0.00490	-0.00440
55.000	-0.00750	-0.00710	-0.00670	-0.00630	-0.00580	-0.00530	-0.00480	-0.00430
70.000	-0.00750	-0.00700	-0.00650	-0.00600	-0.00550	-0.00500	-0.00450	-0.00400
87.200	-0.00660	-0.00620	-0.00580	-0.00540	-0.00500	-0.00470	-0.00440	-0.00410

NGINEER HP
ATE 10/27/72

FIGURE 5.3- 59
HINGE MOMENT COEFFICIENT DUE TO RUDDER

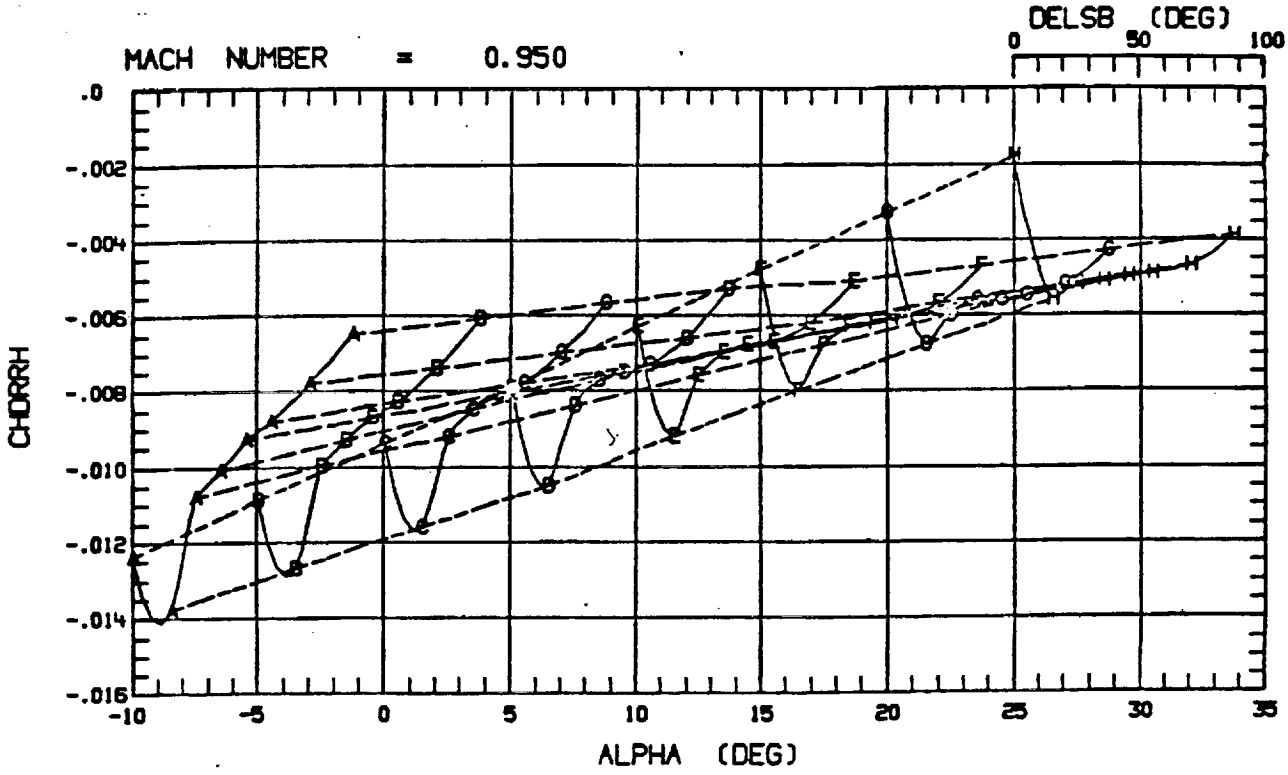


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.01060	-0.00930	-0.00800	-0.00670	-0.00530	-0.00440	-0.00350	-0.00260
15.000	-0.01240	-0.01140	-0.01040	-0.00940	-0.00840	-0.00740	-0.00640	-0.00540
25.000	-0.00970	-0.00900	-0.00830	-0.00760	-0.00700	-0.00630	-0.00560	-0.00490
35.000	-0.00860	-0.00810	-0.00760	-0.00710	-0.00650	-0.00570	-0.00540	-0.00480
45.000	-0.00850	-0.00800	-0.00740	-0.00680	-0.00630	-0.00560	-0.00520	-0.00470
55.000	-0.00840	-0.00780	-0.00720	-0.00660	-0.00610	-0.00560	-0.00510	-0.00460
70.000	-0.00770	-0.00720	-0.00670	-0.00620	-0.00580	-0.00530	-0.00480	-0.00430
87.200	-0.00620	-0.00590	-0.00560	-0.00530	-0.00500	-0.00460	-0.00420	-0.00380

ENGINEER HP
DATE 10-15-78

FIGURE 5.3-60
HINGE MOMENT COEFFICIENT DUE TO RUDDER



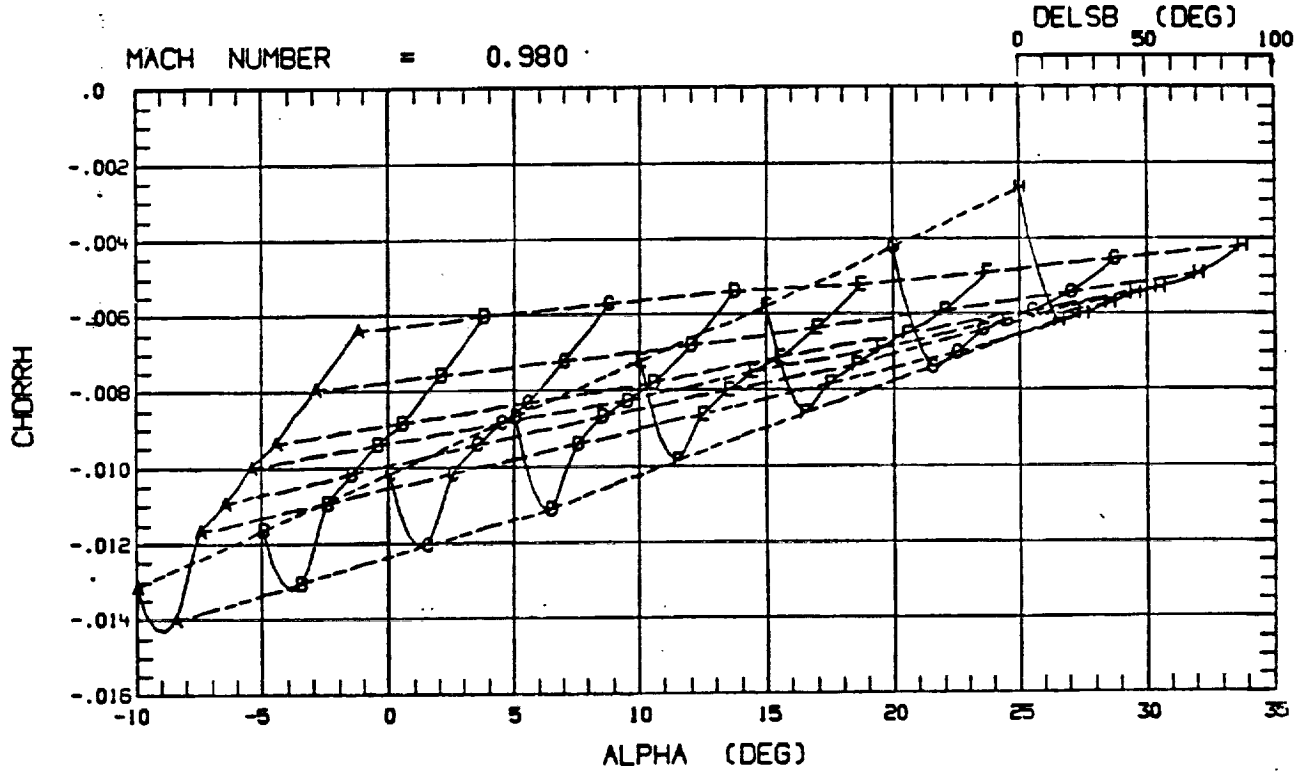
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.01240	-0.01090	-0.00940	-0.00790	-0.00630	-0.00480	-0.00330	-0.00180
15.000	-0.01390	-0.01270	-0.01160	-0.01050	-0.00920	-0.00800	-0.00680	-0.00560
25.000	-0.01080	-0.01000	-0.00920	-0.00840	-0.00760	-0.00680	-0.00600	-0.00520
35.000	-0.01010	-0.00930	-0.00850	-0.00770	-0.00700	-0.00630	-0.00560	-0.00510
45.000	-0.00930	-0.00870	-0.00810	-0.00750	-0.00680	-0.00620	-0.00560	-0.00500
55.000	-0.00880	-0.00830	-0.00780	-0.00730	-0.00670	-0.00610	-0.00550	-0.00490
70.000	-0.00780	-0.00740	-0.00700	-0.00660	-0.00620	-0.00570	-0.00520	-0.00470
87.200	-0.00650	-0.00610	-0.00570	-0.00530	-0.00510	-0.00470	-0.00430	-0.00390

ENGINEER HP
DATE 10/27/78

FIGURE 5.3-61
HINGE MOMENT COEFFICIENT DUE TO RUDDER

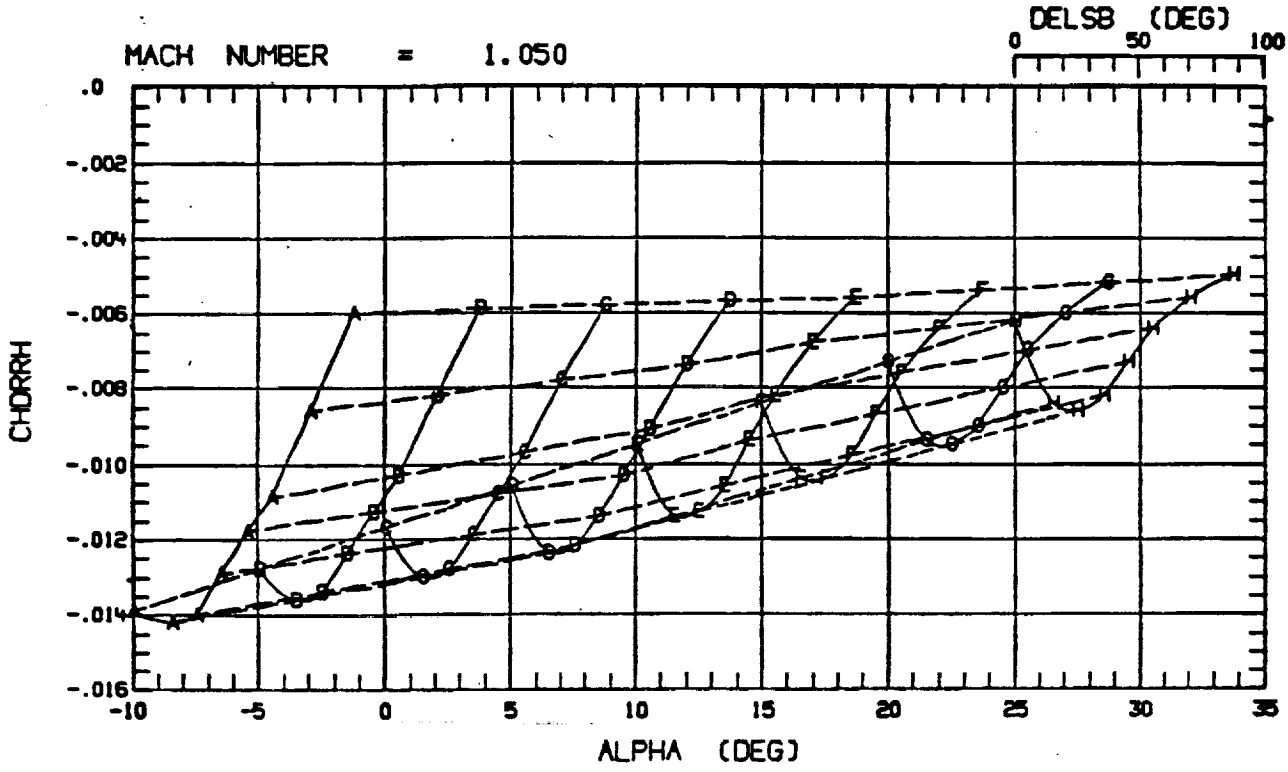


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.01316	-0.01167	-0.01018	-0.00869	-0.00722	-0.00580	-0.00424	-0.00270
15.000	-0.01405	-0.01306	-0.01206	-0.01112	-0.00986	-0.00861	-0.00740	-0.00618
25.000	-0.01170	-0.01095	-0.01019	-0.00944	-0.00863	-0.00783	-0.00703	-0.00603
35.000	-0.01098	-0.01019	-0.00944	-0.00871	-0.00799	-0.00733	-0.00643	-0.00574
45.000	-0.01002	-0.00943	-0.00885	-0.00827	-0.00753	-0.00691	-0.00617	-0.00549
55.000	-0.00937	-0.00895	-0.00833	-0.00781	-0.00714	-0.00653	-0.00591	-0.00530
70.000	-0.00796	-0.00760	-0.00723	-0.00684	-0.00639	-0.00592	-0.00544	-0.00496
87.200	-0.00640	-0.00607	-0.00574	-0.00540	-0.00524	-0.00490	-0.00456	-0.00422

ENGINEER HP
DATE 10/27/78

FIGURE 5.3-62
HINGE MOMENT COEFFICIENT DUE TO RUDDER

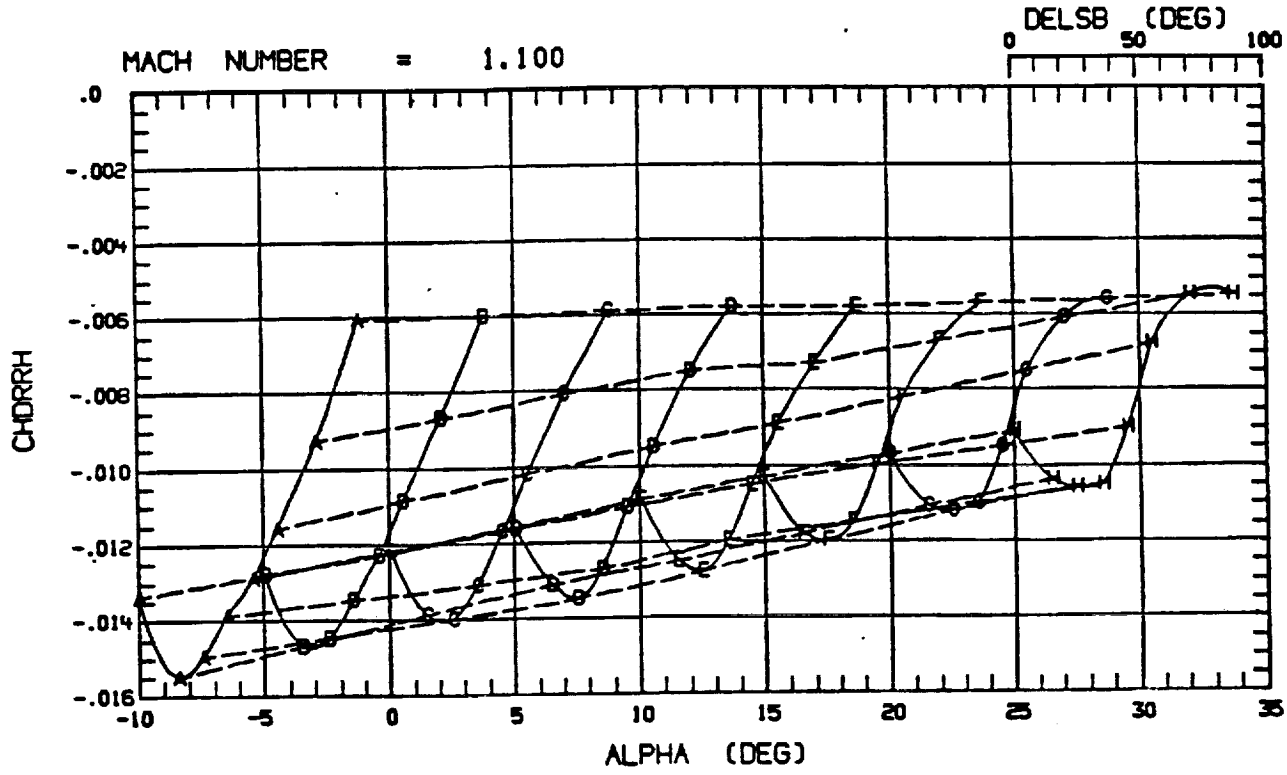


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.01390	-0.01280	-0.01170	-0.01060	-0.00950	-0.00840	-0.00730	-0.00620
15.000	-0.01420	-0.01360	-0.01300	-0.01240	-0.01140	-0.01040	-0.00940	-0.00840
25.000	-0.01400	-0.01340	-0.01280	-0.01220	-0.01130	-0.01040	-0.00950	-0.00860
35.000	-0.01290	-0.01240	-0.01190	-0.01140	-0.01060	-0.00980	-0.00900	-0.00820
45.000	-0.01180	-0.01130	-0.01080	-0.01030	-0.00940	-0.00870	-0.00800	-0.00730
55.000	-0.01090	-0.01030	-0.00970	-0.00910	-0.00820	-0.00760	-0.00700	-0.00640
70.000	-0.00860	-0.00820	-0.00780	-0.00740	-0.00680	-0.00640	-0.00600	-0.00560
87.200	-0.00600	-0.00590	-0.00580	-0.00570	-0.00560	-0.00540	-0.00520	-0.00500

ENGINEER HP
DATE 8/27/78

FIGURE 5.3- 63
HINGE MOMENT COEFFICIENT DUE TO RUDDER



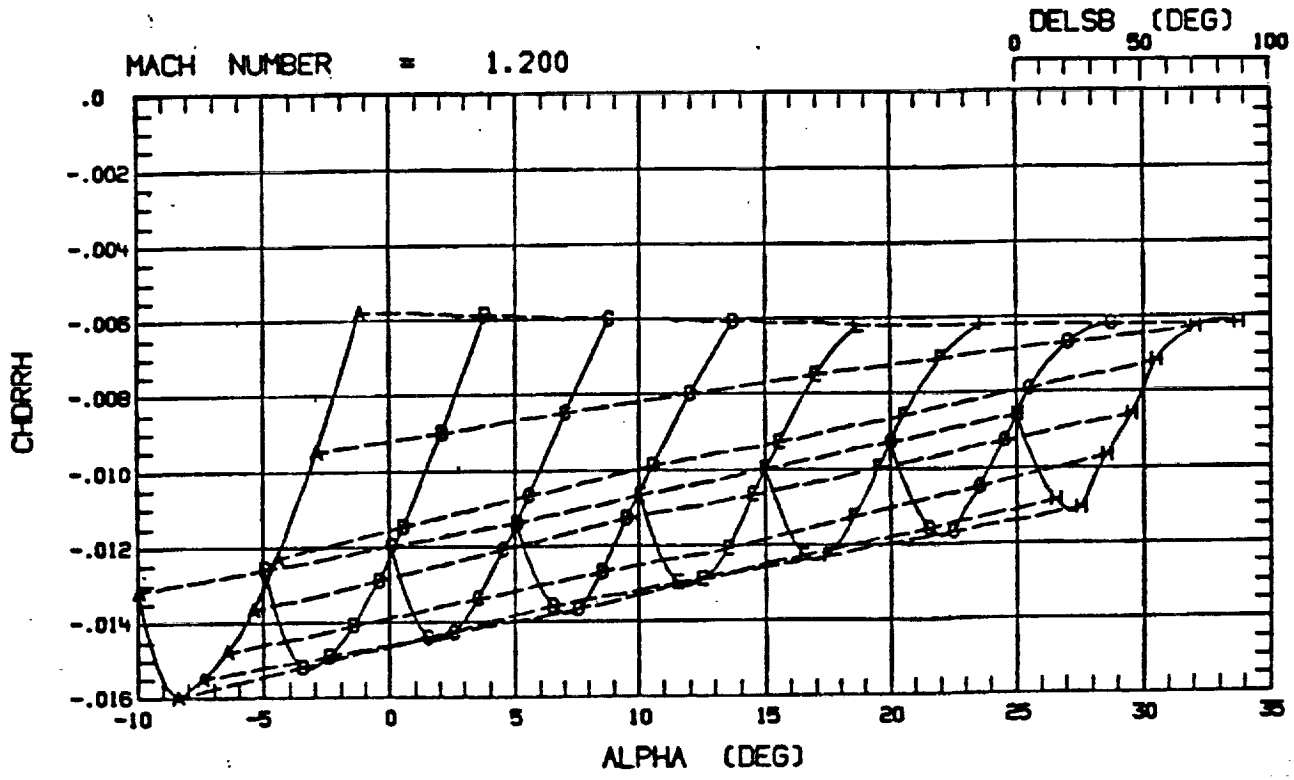
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.01340	-0.01280	-0.01220	-0.01160	-0.01090	-0.01030	-0.00970	-0.00910
15.000	-0.01550	-0.01470	-0.01390	-0.01310	-0.01250	-0.01180	-0.01110	-0.01040
25.000	-0.01500	-0.01450	-0.01400	-0.01350	-0.01280	-0.01200	-0.01120	-0.01060
35.000	-0.01390	-0.01350	-0.01310	-0.01270	-0.01200	-0.01150	-0.01100	-0.01050
45.000	-0.01290	-0.01230	-0.01170	-0.01110	-0.01050	-0.01000	-0.00950	-0.00900
55.000	-0.01160	-0.01090	-0.01020	-0.00950	-0.00890	-0.00820	-0.00750	-0.00680
70.000	-0.00930	-0.00870	-0.00810	-0.00750	-0.00730	-0.00670	-0.00610	-0.00550
87.200	-0.00610	-0.00600	-0.00590	-0.00580	-0.00580	-0.00570	-0.00560	-0.00550

ENGINEER HP
DATE 10-2-78

FIGURE 5.3- 64
HINGE MOMENT COEFFICIENT DUE TO RUDDER



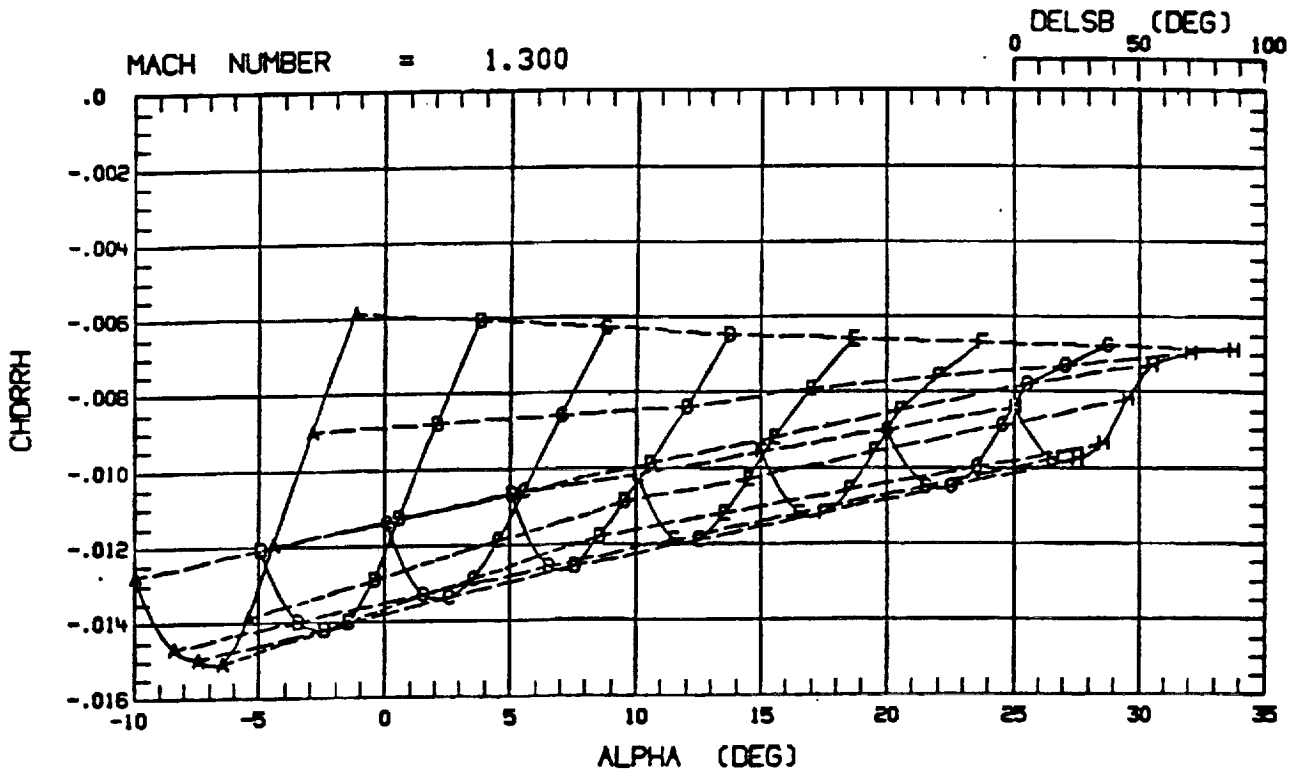
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.01320	-0.01260	-0.01200	-0.01140	-0.01070	-0.01000	-0.00930	-0.00860
15.000	-0.01600	-0.01520	-0.01440	-0.01360	-0.01300	-0.01230	-0.01160	-0.01090
25.000	-0.01550	-0.01490	-0.01430	-0.01370	-0.01290	-0.01230	-0.01170	-0.01110
35.000	-0.01480	-0.01410	-0.01340	-0.01270	-0.01210	-0.01130	-0.01050	-0.00970
45.000	-0.01370	-0.01290	-0.01210	-0.01130	-0.01070	-0.01000	-0.00930	-0.00860
55.000	-0.01230	-0.01150	-0.01070	-0.00990	-0.00930	-0.00860	-0.00790	-0.00720
70.000	-0.00950	-0.00900	-0.00850	-0.00800	-0.00750	-0.00710	-0.00670	-0.00630
87.200	-0.00580	-0.00590	-0.00600	-0.00610	-0.00620	-0.00620	-0.00620	-0.00620

ENGINEER AP
DATE 10/2/72

FIGURE 5.3-65
HINGE MOMENT COEFFICIENT DUE TO RUDDER

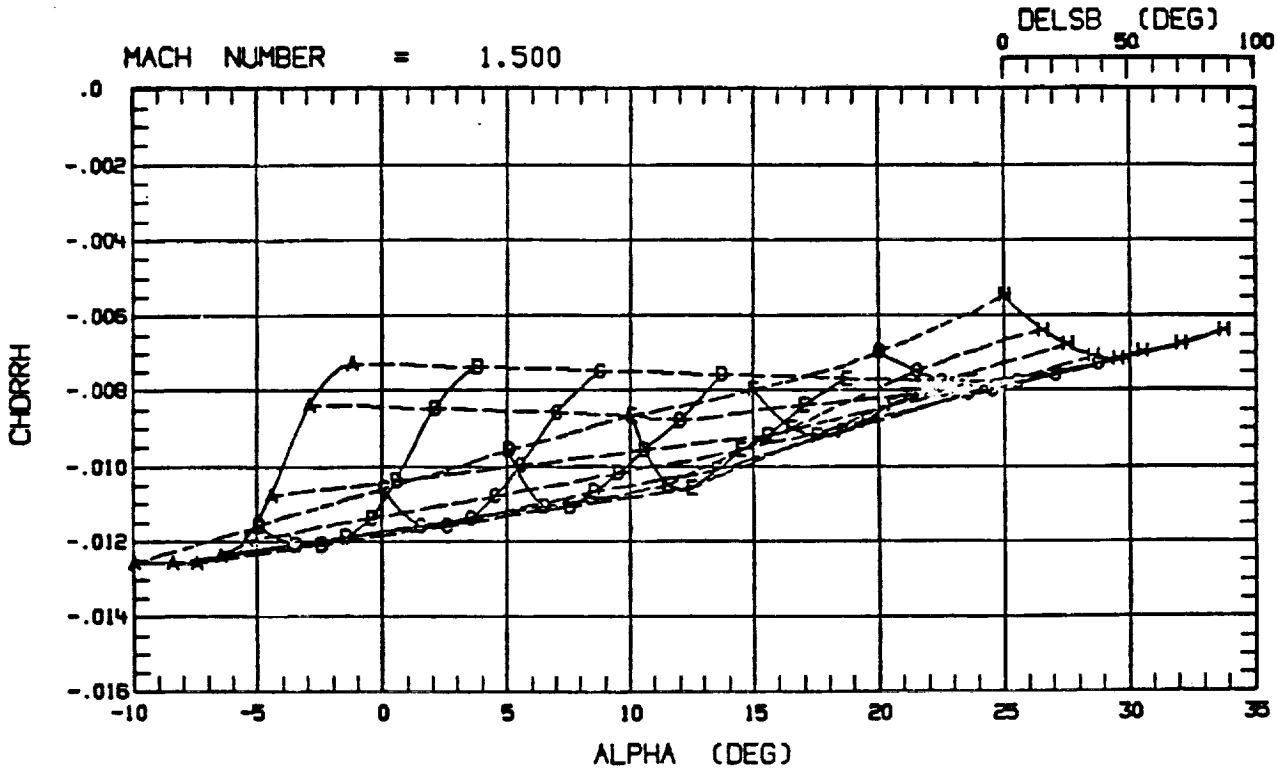


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.01280	-0.01210	-0.01140	-0.01070	-0.01020	-0.00960	-0.00900	-0.00840
15.000	-0.01470	-0.01400	-0.01330	-0.01260	-0.01190	-0.01120	-0.01050	-0.00980
25.000	-0.01500	-0.01420	-0.01340	-0.01260	-0.01190	-0.01120	-0.01050	-0.00980
35.000	-0.01510	-0.01400	-0.01290	-0.01180	-0.01120	-0.01060	-0.01000	-0.00940
45.000	-0.01390	-0.01290	-0.01190	-0.01090	-0.01030	-0.00960	-0.00890	-0.00820
55.000	-0.01200	-0.01130	-0.01060	-0.00990	-0.00920	-0.00850	-0.00780	-0.00730
70.000	-0.00900	-0.00880	-0.00860	-0.00840	-0.00790	-0.00760	-0.00730	-0.00700
87.200	-0.00590	-0.00610	-0.00630	-0.00650	-0.00660	-0.00670	-0.00680	-0.00690

ENGINEER MP
DATE 10/3/73

FIGURE 5.3-66
HINGE MOMENT COEFFICIENT DUE TO RUDDER

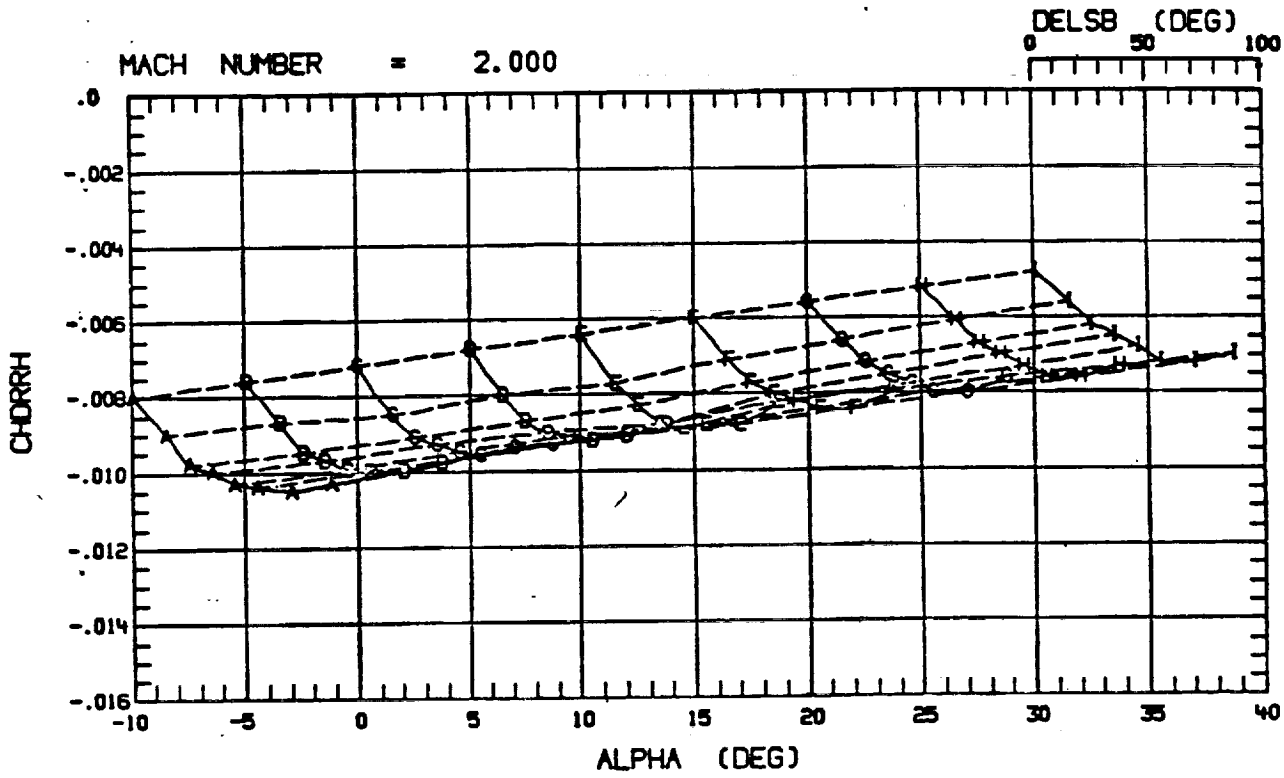


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.01260	-0.01160	-0.01060	-0.00960	-0.00870	-0.00800	-0.00700	-0.00550
15.000	-0.01260	-0.01210	-0.01160	-0.01110	-0.01050	-0.00900	-0.00750	-0.00640
25.000	-0.01260	-0.01210	-0.01160	-0.01110	-0.01060	-0.00920	-0.00780	-0.00680
35.000	-0.01240	-0.01190	-0.01140	-0.01070	-0.01010	-0.00910	-0.00810	-0.00710
45.000	-0.01200	-0.01140	-0.01080	-0.01020	-0.00960	-0.00880	-0.00800	-0.00720
55.000	-0.01080	-0.01040	-0.01000	-0.00960	-0.00920	-0.00840	-0.00780	-0.00700
70.000	-0.00840	-0.00850	-0.00860	-0.00880	-0.00840	-0.00810	-0.00760	-0.00680
87.200	-0.00730	-0.00740	-0.00750	-0.00760	-0.00770	-0.00780	-0.00730	-0.00640

ENGINEER HP
DATE 10/27/78

FIGURE 5.3- 67
HINGE MOMENT COEFFICIENT DUE TO RUDDER



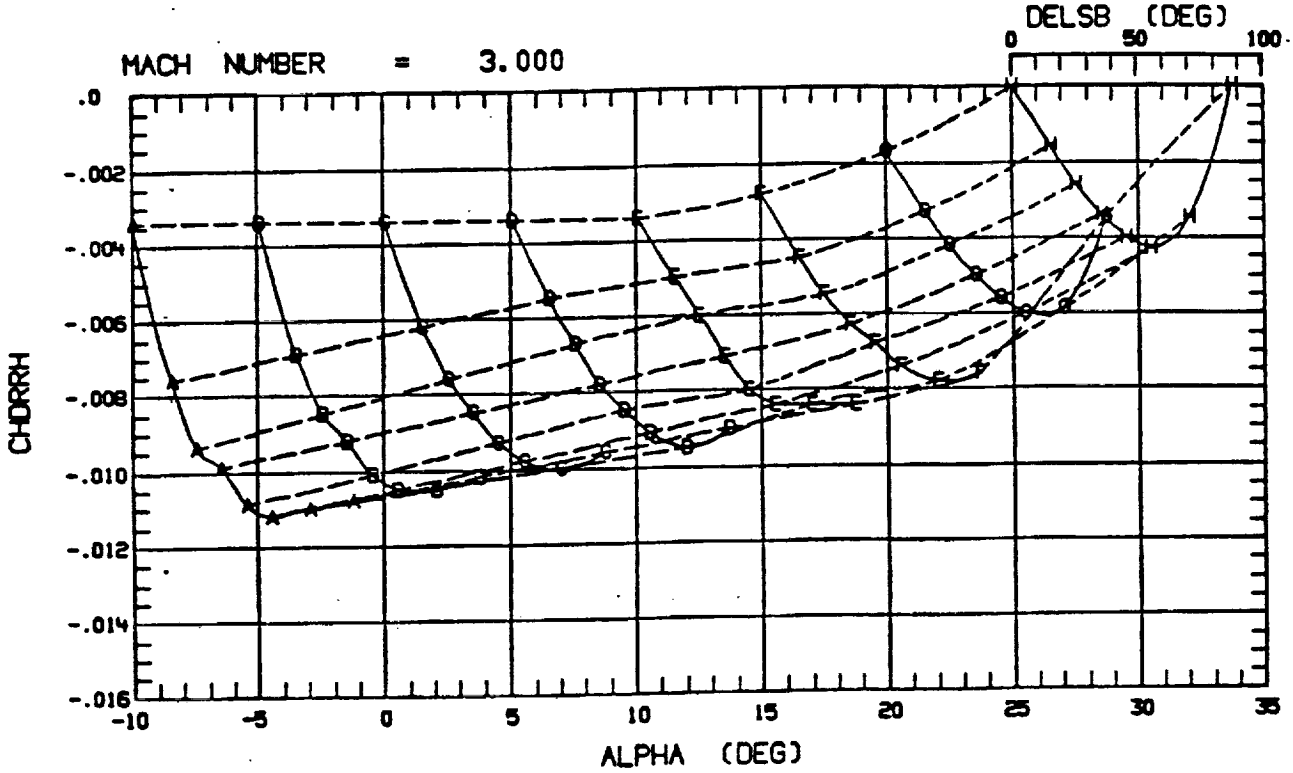
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELSB (DEG)	RUDDER HINGE MOMENT								
0.0	-0.00800	-0.00760	-0.00720	-0.00680	-0.00640	-0.00600	-0.00560	-0.00520	-0.00480
15.000	-0.00900	-0.00870	-0.00850	-0.00800	-0.00770	-0.00710	-0.00660	-0.00610	-0.00560
25.000	-0.00980	-0.00950	-0.00910	-0.00870	-0.00830	-0.00770	-0.00720	-0.00670	-0.00620
35.000	-0.01000	-0.00970	-0.00930	-0.00900	-0.00880	-0.00800	-0.00750	-0.00700	-0.00650
45.000	-0.01030	-0.00995	-0.00950	-0.00910	-0.00890	-0.00820	-0.00775	-0.00730	-0.00680
55.000	-0.01040	-0.01000	-0.00960	-0.00920	-0.00880	-0.00840	-0.00800	-0.00760	-0.00720
70.000	-0.01050	-0.01000	-0.00940	-0.00910	-0.00880	-0.00840	-0.00800	-0.00760	-0.00720
87.200	-0.01030	-0.00980	-0.00930	-0.00880	-0.00820	-0.00790	-0.00760	-0.00730	-0.00700

ENGINEER HP
DATE 10/21/76

FIGURE 5.3-68
HINGE MOMENT COEFFICIENT DUE TO RUDDER



CONFIGURATION

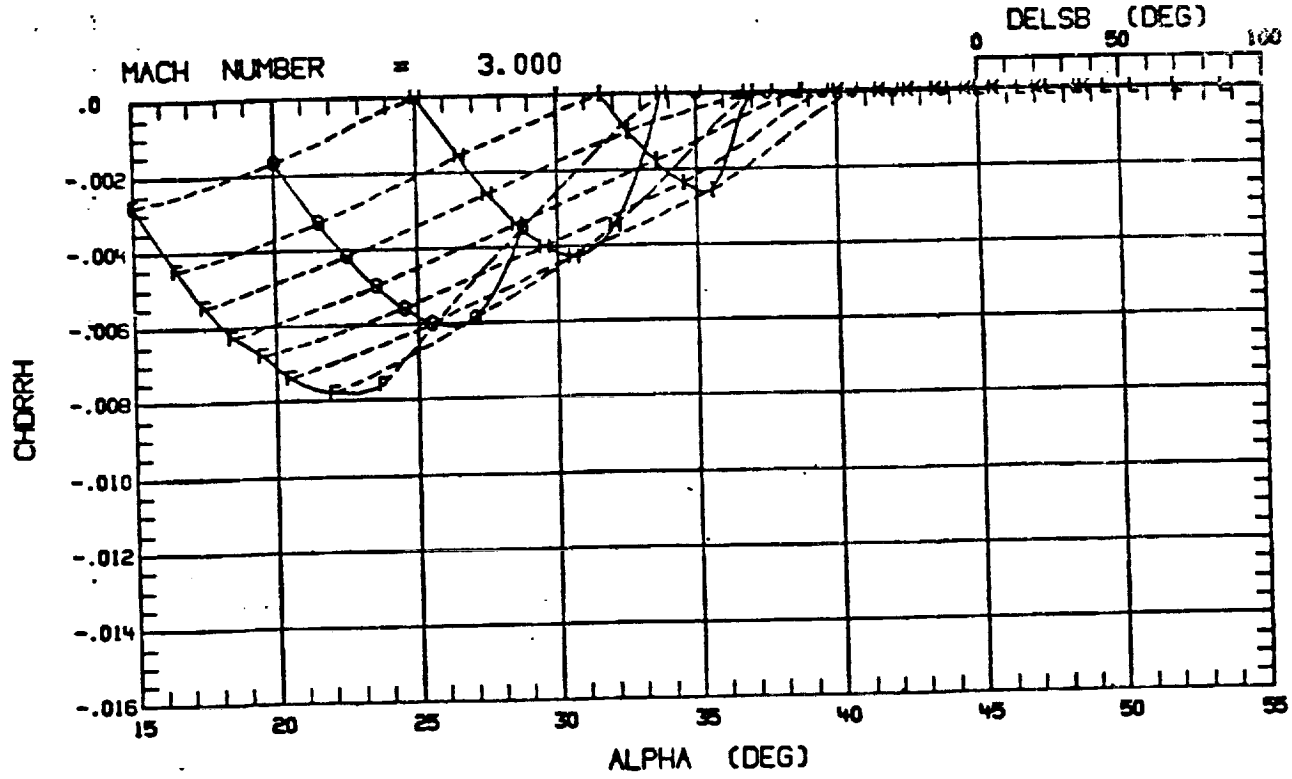
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00340	-0.00340	-0.00340	-0.00340	-0.00340	-0.00280	-0.00170	0.0
15.000	-0.00760	-0.00690	-0.00620	-0.00550	-0.00500	-0.00450	-0.00330	-0.00160
25.000	-0.00940	-0.00850	-0.00760	-0.00670	-0.00600	-0.00550	-0.00420	-0.00260
35.000	-0.00990	-0.00920	-0.00850	-0.00780	-0.00710	-0.00630	-0.00500	-0.00340
45.000	-0.01090	-0.01010	-0.00930	-0.00850	-0.00800	-0.00680	-0.00560	-0.00400
55.000	-0.01120	-0.01050	-0.00980	-0.00910	-0.00840	-0.00740	-0.00600	-0.00430
70.000	-0.01100	-0.01050	-0.01000	-0.00950	-0.00840	-0.00780	-0.00590	-0.00350
87.200	-0.01080	-0.01020	-0.00960	-0.00900	-0.00840	-0.00760	-0.00350	0.0

GINEER MP
TE 01/21/78

FIGURE 5.3-69
HINGE MOMENT COEFFICIENT DUE TO RUDDER



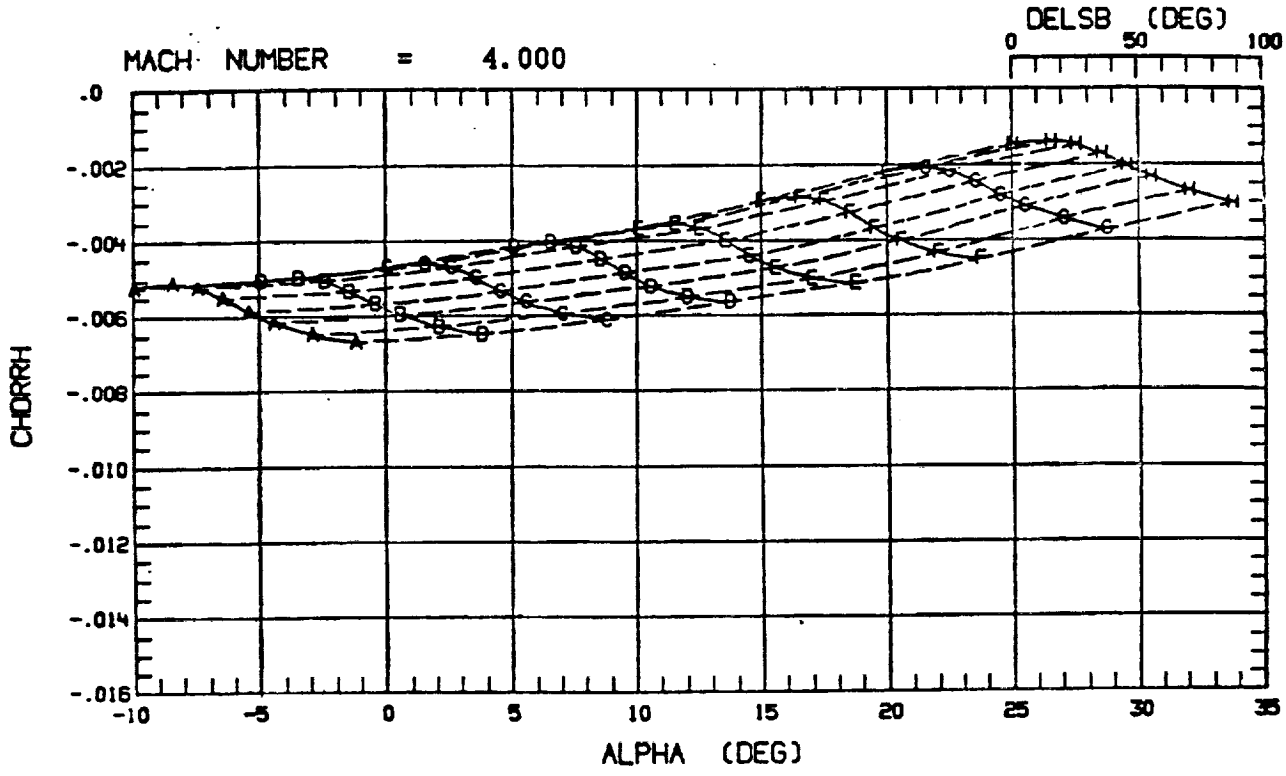
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER HINGE MOMENT						
0.0	-0.00280	-0.00170	0.0	0.0	0.0	0.0	0.0
15.000	-0.00450	-0.00330	-0.00160	0.0	0.0	0.0	0.0
25.000	-0.00550	-0.00420	-0.00260	-0.00100	0.0	0.0	0.0
35.000	-0.00630	-0.00500	-0.00340	-0.00180	0.0	0.0	0.0
45.000	-0.00680	-0.00560	-0.00400	-0.00240	0.0	0.0	0.0
55.000	-0.00740	-0.00600	-0.00430	-0.00260	0.0	0.0	0.0
70.000	-0.00780	-0.00590	-0.00350	0.0	0.0	0.0	0.0
87.200	-0.00760	-0.00350	0.0	0.0	0.0	0.0	0.0

ENGINEER HC
DATE 10/3/77

FIGURE 5.3-70
HINGE MOMENT COEFFICIENT DUE TO RUDDER



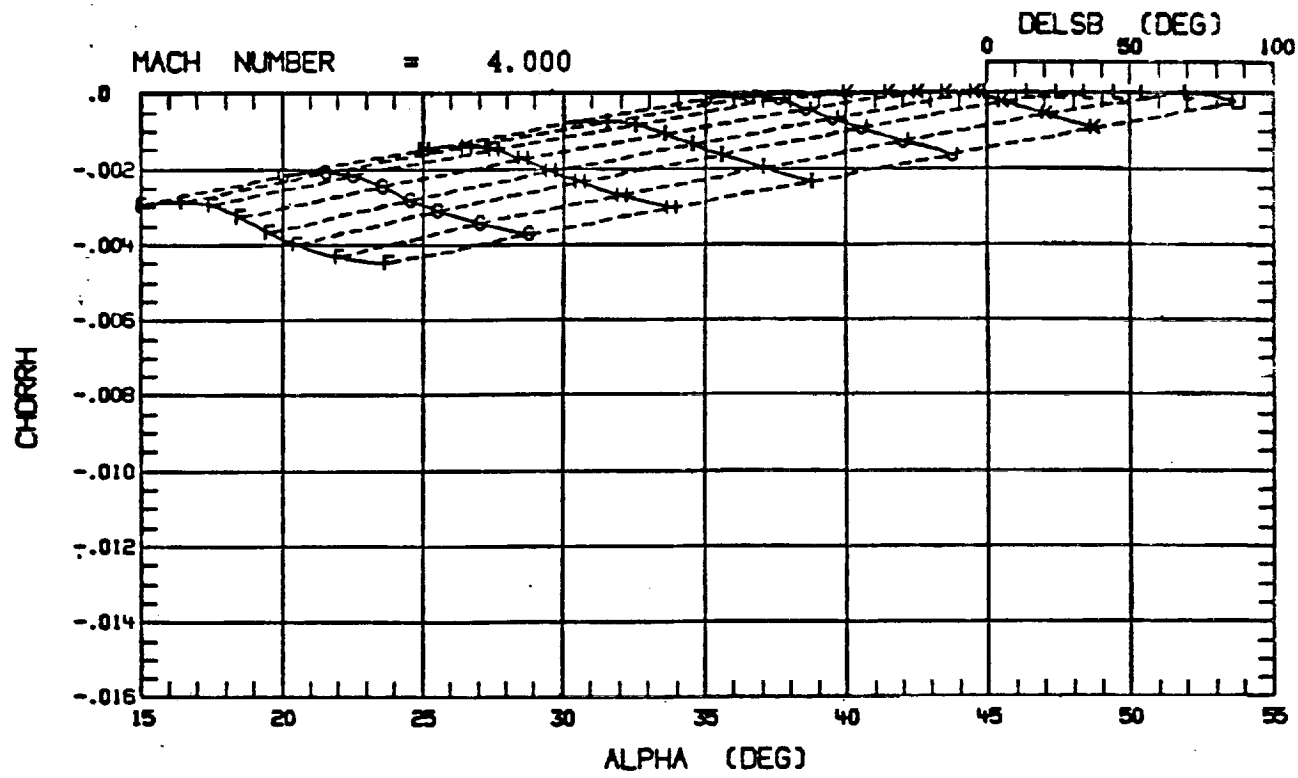
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00522	-0.00507	-0.00472	-0.00417	-0.00368	-0.00297	-0.00219	-0.00149
15.000	-0.00513	-0.00498	-0.00463	-0.00408	-0.00358	-0.00288	-0.00211	-0.00141
25.000	-0.00522	-0.00507	-0.00472	-0.00417	-0.00368	-0.00298	-0.00219	-0.00149
35.000	-0.00551	-0.00535	-0.00501	-0.00449	-0.00400	-0.00330	-0.00248	-0.00176
45.000	-0.00588	-0.00570	-0.00537	-0.00489	-0.00441	-0.00371	-0.00283	-0.00208
55.000	-0.00618	-0.00598	-0.00566	-0.00522	-0.00474	-0.00403	-0.00312	-0.00236
70.000	-0.00649	-0.00628	-0.00595	-0.00551	-0.00503	-0.00435	-0.00346	-0.00271
87.200	-0.00671	-0.00648	-0.00613	-0.00566	-0.00517	-0.00452	-0.00375	-0.00305

ENGINEER HP
DATE 10/2/78

FIGURE 5.3-71
HINGE MOMENT COEFFICIENT DUE TO RUDDER

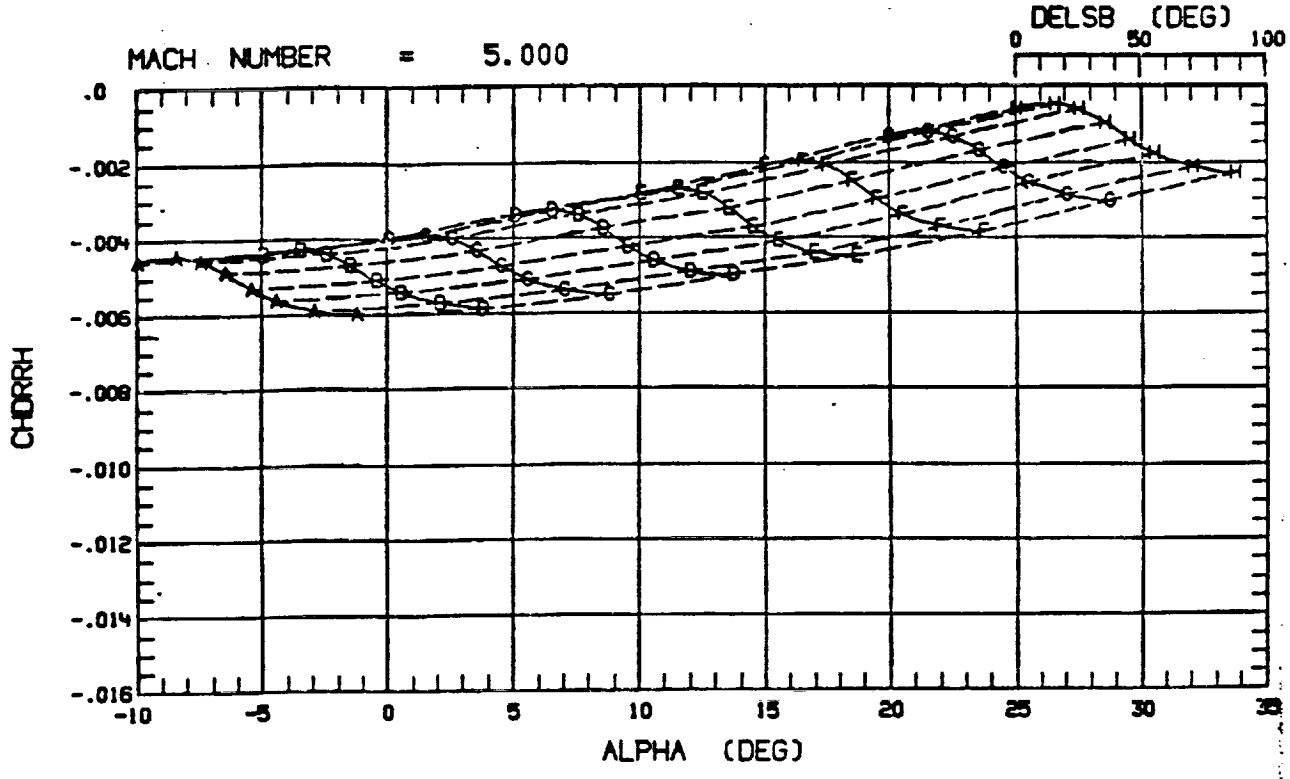


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELSB (DEG)	RUDDER HINGE MOMENT						
0.0	-0.00297	-0.00219	-0.00149	-0.00083	-0.00017	0.0	0.0
15.000	-0.00288	-0.00211	-0.00141	-0.00076	-0.00011	0.0	0.0
25.000	-0.00298	-0.00219	-0.00149	-0.00084	-0.00018	0.0	0.0
35.000	-0.00330	-0.00248	-0.00176	-0.00109	-0.00043	0.0	0.0
45.000	-0.00371	-0.00283	-0.00208	-0.00139	-0.00070	0.0	0.0
55.000	-0.00403	-0.00312	-0.00236	-0.00165	-0.00095	-0.00024	0.0
70.000	-0.00435	-0.00346	-0.00271	-0.00200	-0.00129	-0.00058	0.0
87.200	-0.00452	-0.00375	-0.00305	-0.00235	-0.00165	-0.00095	-0.00025

ENGINEER HP
DATE 10/31/78

FIGURE 5.3-72
HINGE MOMENT COEFFICIENT DUE TO RUDDER



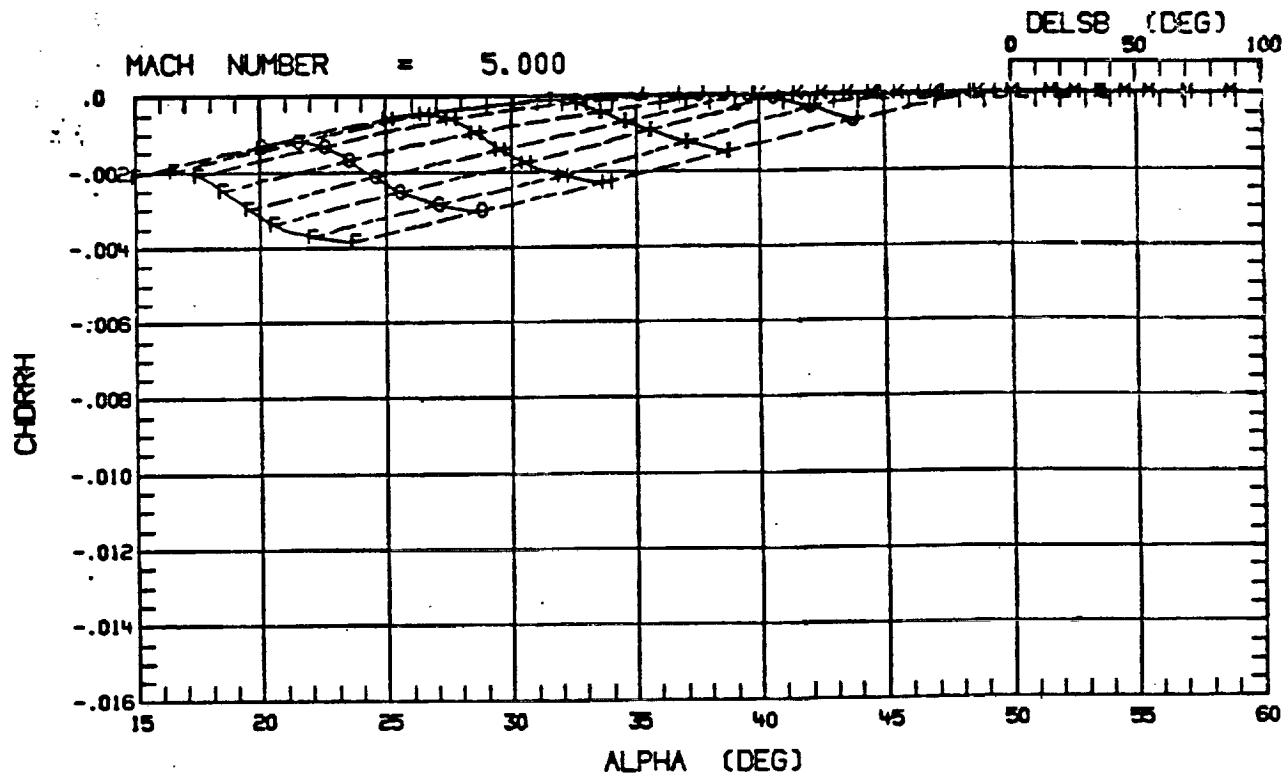
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00457	-0.00441	-0.00402	-0.00340	-0.00285	-0.00211	-0.00133	-0.00060
15.000	-0.00447	-0.00432	-0.00392	-0.00329	-0.00273	-0.00200	-0.00122	-0.00049
25.000	-0.00457	-0.00441	-0.00402	-0.00340	-0.00285	-0.00212	-0.00133	-0.00060
35.000	-0.00489	-0.00472	-0.00435	-0.00377	-0.00323	-0.00250	-0.00170	-0.00096
45.000	-0.00531	-0.00512	-0.00477	-0.00426	-0.00373	-0.00301	-0.00217	-0.00143
55.000	-0.00564	-0.00543	-0.00510	-0.00463	-0.00412	-0.00341	-0.00254	-0.00180
70.000	-0.00592	-0.00572	-0.00539	-0.00493	-0.00443	-0.00373	-0.00288	-0.00214
87.200	-0.00603	-0.00587	-0.00553	-0.00501	-0.00452	-0.00384	-0.00305	-0.00232

ENGINEER HP
DATE 10/3/78

FIGURE 5.3-73
HINGE MOMENT COEFFICIENT DUE TO RUDDER



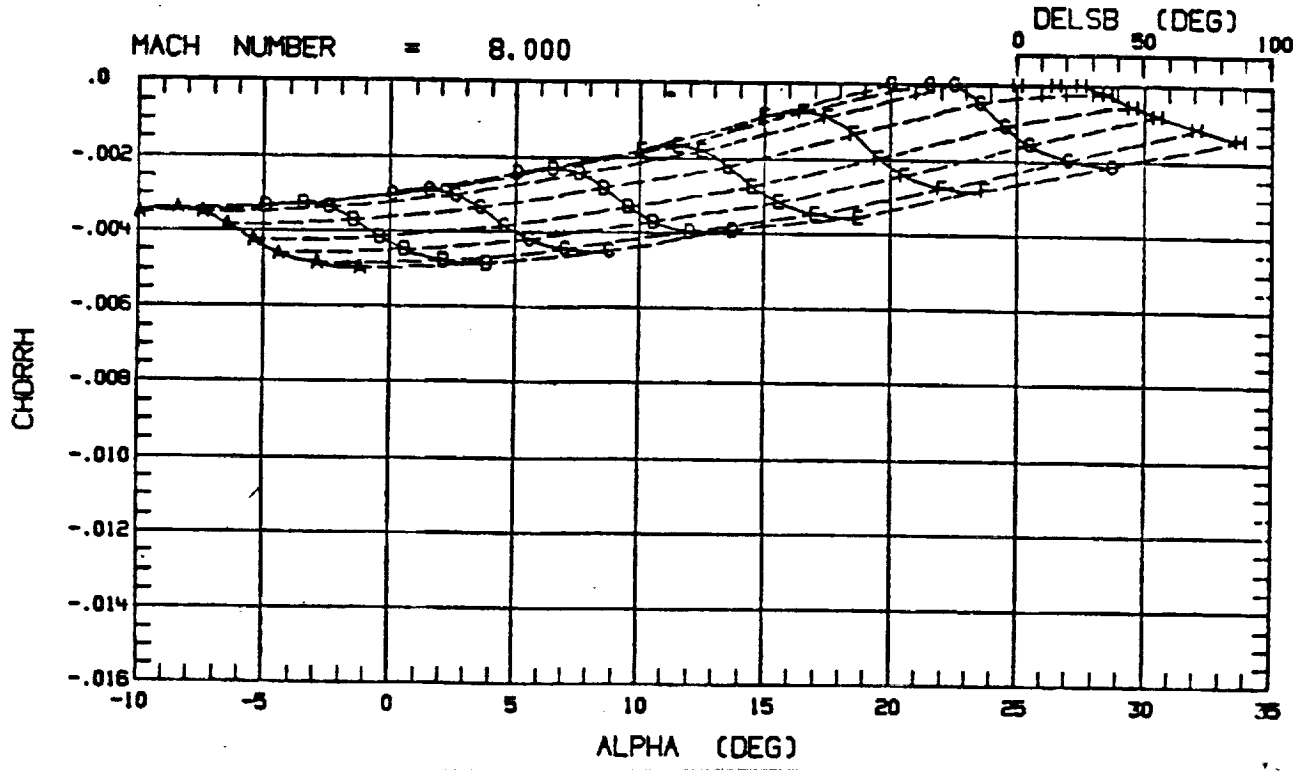
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00211	-0.00133	-0.00060	-0.00020	0.0	0.0	0.0	0.0
15.000	-0.00200	-0.00122	-0.00049	-0.00013	0.0	0.0	0.0	0.0
25.000	-0.00212	-0.00133	-0.00060	-0.00020	0.0	0.0	0.0	0.0
35.000	-0.00250	-0.00170	-0.00096	-0.00043	0.0	0.0	0.0	0.0
45.000	-0.00301	-0.00217	-0.00143	-0.00071	0.0	0.0	0.0	0.0
55.000	-0.00341	-0.00254	-0.00180	-0.00094	-0.00009	0.0	0.0	0.0
70.000	-0.00373	-0.00288	-0.00214	-0.00124	-0.00034	0.0	0.0	0.0
87.200	-0.00384	-0.00305	-0.00232	-0.00151	-0.00071	0.0	0.0	0.0

ENGINEER HP
DATE 10/3/72

FIGURE 5.3-74
HINGE MOMENT COEFFICIENT DUE TO RUDDER



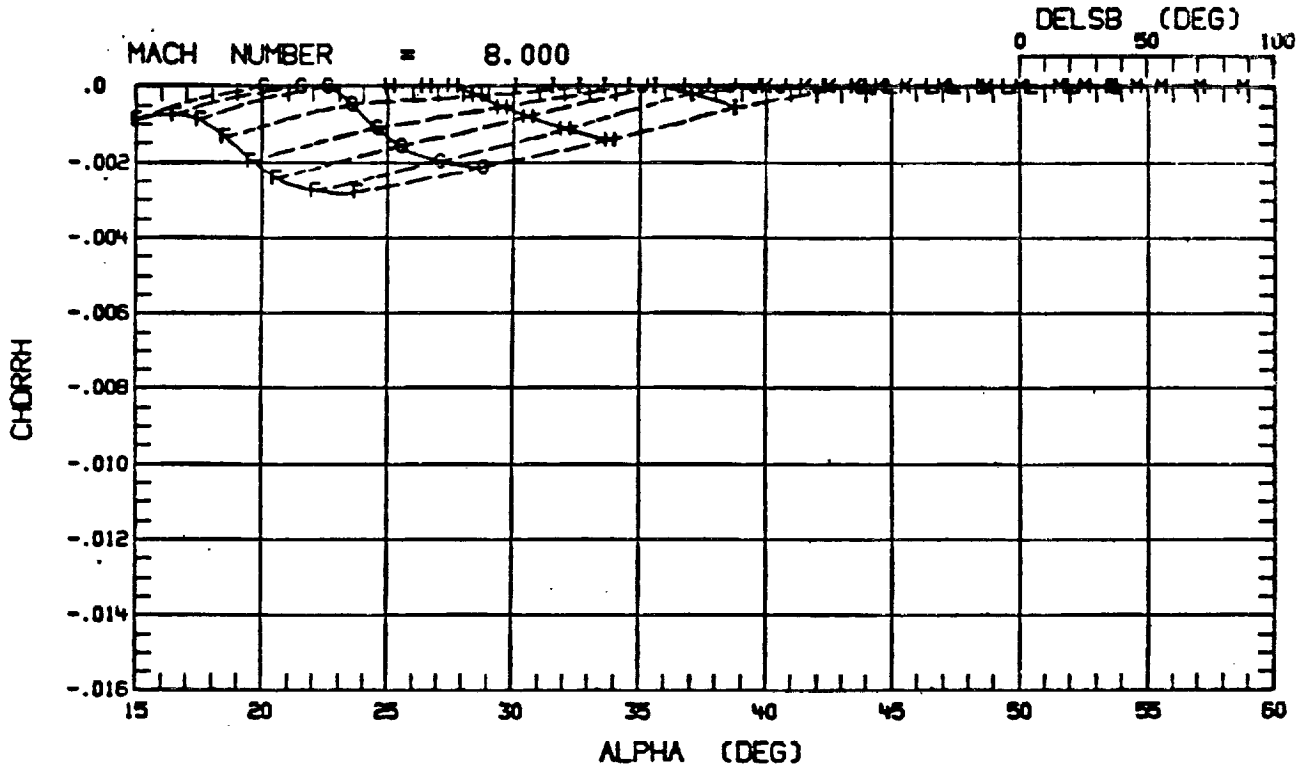
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00352	-0.00339	-0.00303	-0.00245	-0.00183	-0.00091	0.0	0.0
15.000	-0.00342	-0.00329	-0.00292	-0.00233	-0.00170	-0.00077	0.0	0.0
25.000	-0.00353	-0.00339	-0.00303	-0.00245	-0.00182	-0.00091	0.0	0.0
35.000	-0.00385	-0.00373	-0.00339	-0.00283	-0.00223	-0.00136	-0.00048	-0.00025
45.000	-0.00428	-0.00417	-0.00386	-0.00334	-0.00276	-0.00197	-0.00111	-0.00055
55.000	-0.00461	-0.00452	-0.00422	-0.00372	-0.00317	-0.00243	-0.00160	-0.00081
70.000	-0.00489	-0.00479	-0.00448	-0.00397	-0.00348	-0.00277	-0.00200	-0.00114
87.200	-0.00501	-0.00487	-0.00451	-0.00394	-0.00356	-0.00280	-0.00214	-0.00143

ENGINEER AP
DATE 10/2/78

FIGURE 5.3-75
HINGE MOMENT COEFFICIENT DUE TO RUDDER



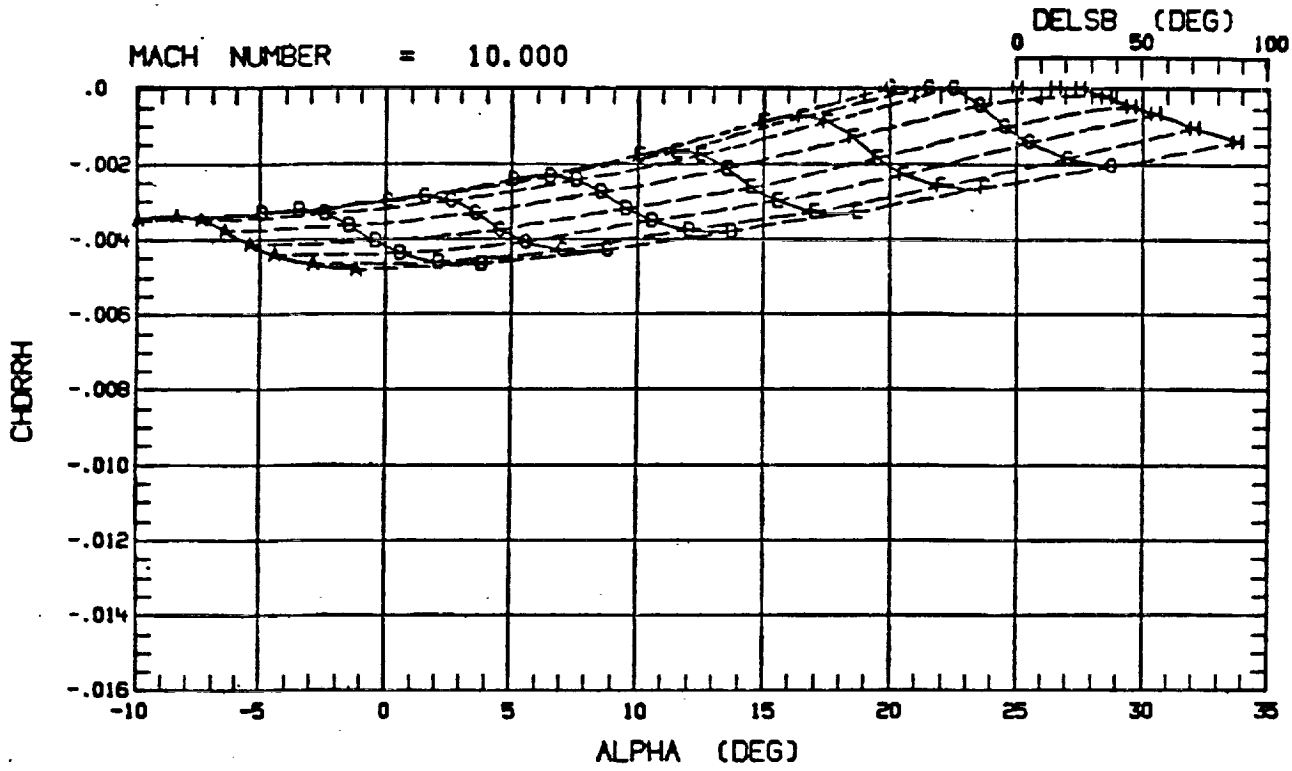
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00091	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00077	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	-0.00091	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00136	-0.00048	-0.00025	0.0	0.0	0.0	0.0	0.0
45.000	-0.00197	-0.00111	-0.00055	0.0	0.0	0.0	0.0	0.0
55.000	-0.00243	-0.00160	-0.00081	0.0	0.0	0.0	0.0	0.0
70.000	-0.00277	-0.00200	-0.00114	-0.00019	0.0	0.0	0.0	0.0
87.200	-0.00280	-0.00214	-0.00143	-0.00057	0.0	0.0	0.0	0.0

ENGINEER MP
DATE 12/2/81

FIGURE 5.3-76
HINGE MOMENT COEFFICIENT DUE TO RUDDER



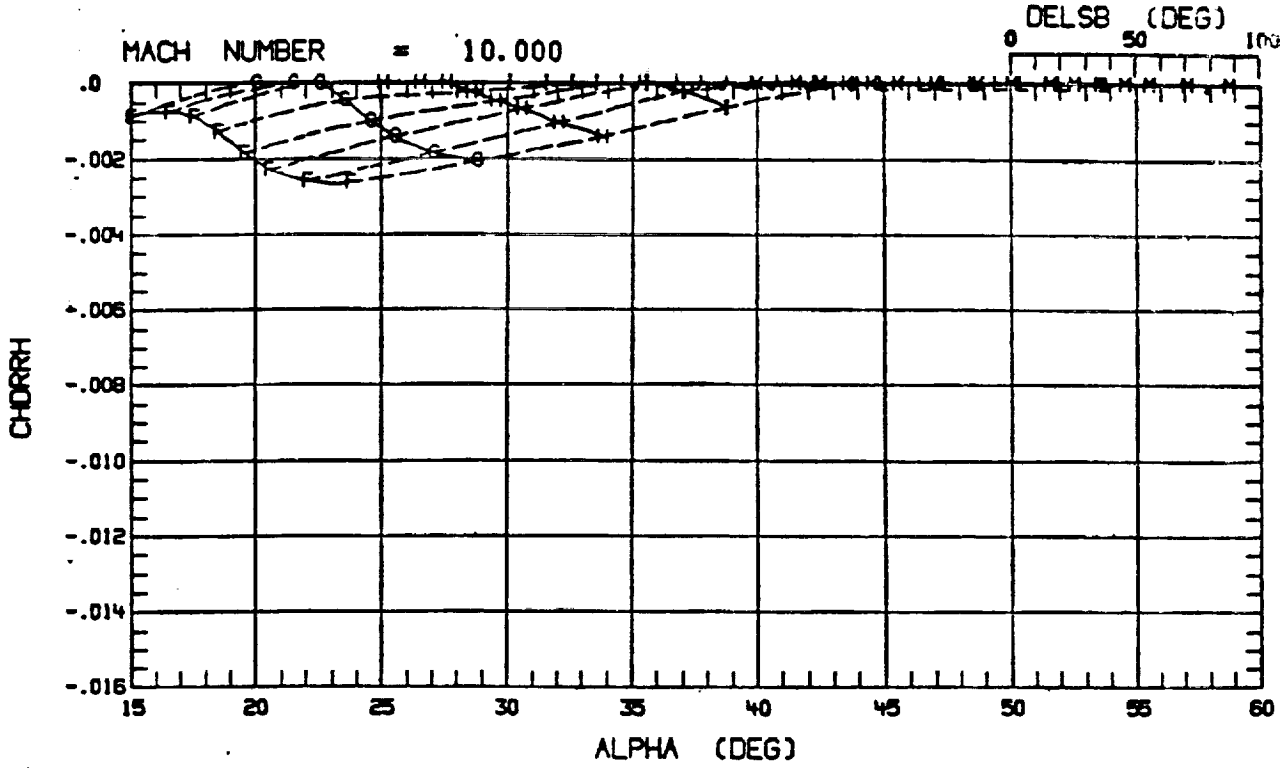
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00350	-0.00335	-0.00300	-0.00245	-0.00180	-0.00089	0.0	0.0
15.000	-0.00342	-0.00326	-0.00290	-0.00235	-0.00169	-0.00076	0.0	0.0
25.000	-0.00350	-0.00335	-0.00300	-0.00245	-0.00180	-0.00089	0.0	0.0
35.000	-0.00378	-0.00366	-0.00332	-0.00277	-0.00216	-0.00131	-0.00044	-0.00023
45.000	-0.00414	-0.00407	-0.00376	-0.00321	-0.00265	-0.00187	-0.00100	-0.00047
55.000	-0.00443	-0.00439	-0.00409	-0.00353	-0.00301	-0.00230	-0.00144	-0.00070
70.000	-0.00469	-0.00462	-0.00431	-0.00377	-0.00328	-0.00261	-0.00186	-0.00104
87.200	-0.00482	-0.00465	-0.00431	-0.00380	-0.00330	-0.00265	-0.00209	-0.00141

ENGINEER HP
DATE 10/22/78

FIGURE 5.3-77
HINGE MOMENT COEFFICIENT DUE TO RUDDER



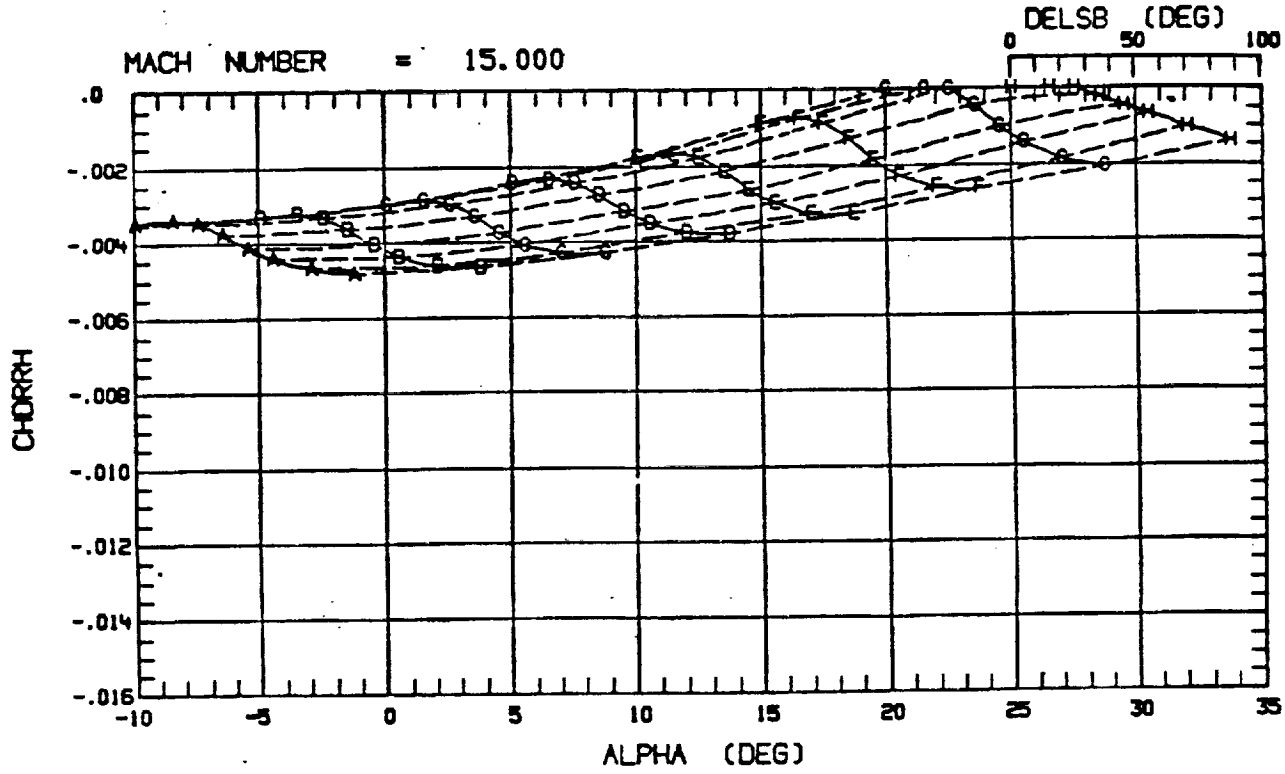
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00089	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00076	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	-0.00089	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00131	-0.00044	-0.00023	0.0	0.0	0.0	0.0	0.0
45.000	-0.00187	-0.00100	-0.00047	0.0	0.0	0.0	0.0	0.0
55.000	-0.00230	-0.00144	-0.00070	0.0	0.0	0.0	0.0	0.0
70.000	-0.00261	-0.00186	-0.00104	-0.00021	0.0	0.0	0.0	0.0
87.200	-0.00265	-0.00209	-0.00141	-0.00063	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/2/78

FIGURE 5.3-78
HINGE MOMENT COEFFICIENT DUE TO RUDDER



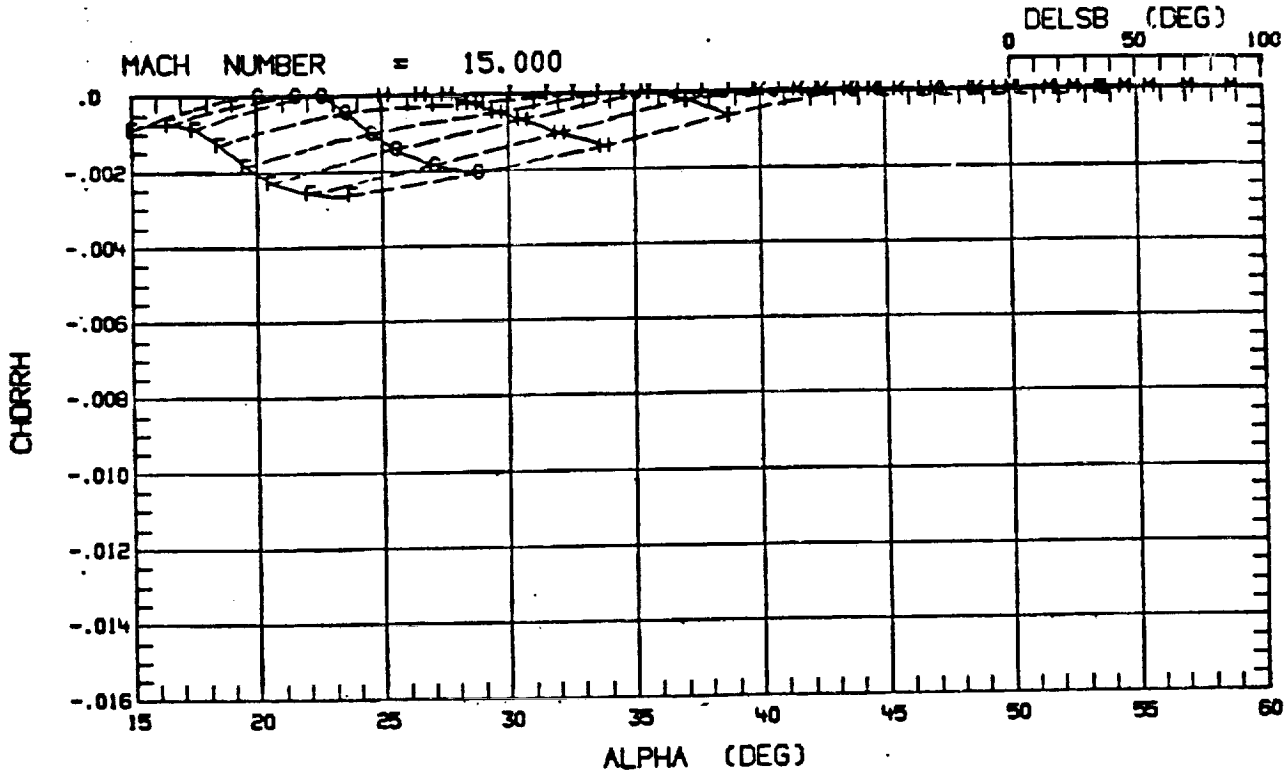
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00350	-0.00335	-0.00300	-0.00245	-0.00180	-0.00089	0.0	0.0
15.000	-0.00342	-0.00326	-0.00290	-0.00235	-0.00169	-0.00076	0.0	0.0
25.000	-0.00350	-0.00335	-0.00300	-0.00245	-0.00180	-0.00089	0.0	0.0
35.000	-0.00378	-0.00366	-0.00332	-0.00277	-0.00216	-0.00131	-0.00044	-0.00023
45.000	-0.00414	-0.00407	-0.00376	-0.00321	-0.00265	-0.00187	-0.00100	-0.00047
55.000	-0.00443	-0.00439	-0.00409	-0.00353	-0.00301	-0.00230	-0.00144	-0.00070
70.000	-0.00469	-0.00462	-0.00431	-0.00377	-0.00328	-0.00261	-0.00186	-0.00104
87.200	-0.00482	-0.00465	-0.00431	-0.00380	-0.00330	-0.00265	-0.00209	-0.00141

ENGINEER HP
DATE 7/23/72

FIGURE 5.3-79
HINGE MOMENT COEFFICIENT DUE TO RUDDER



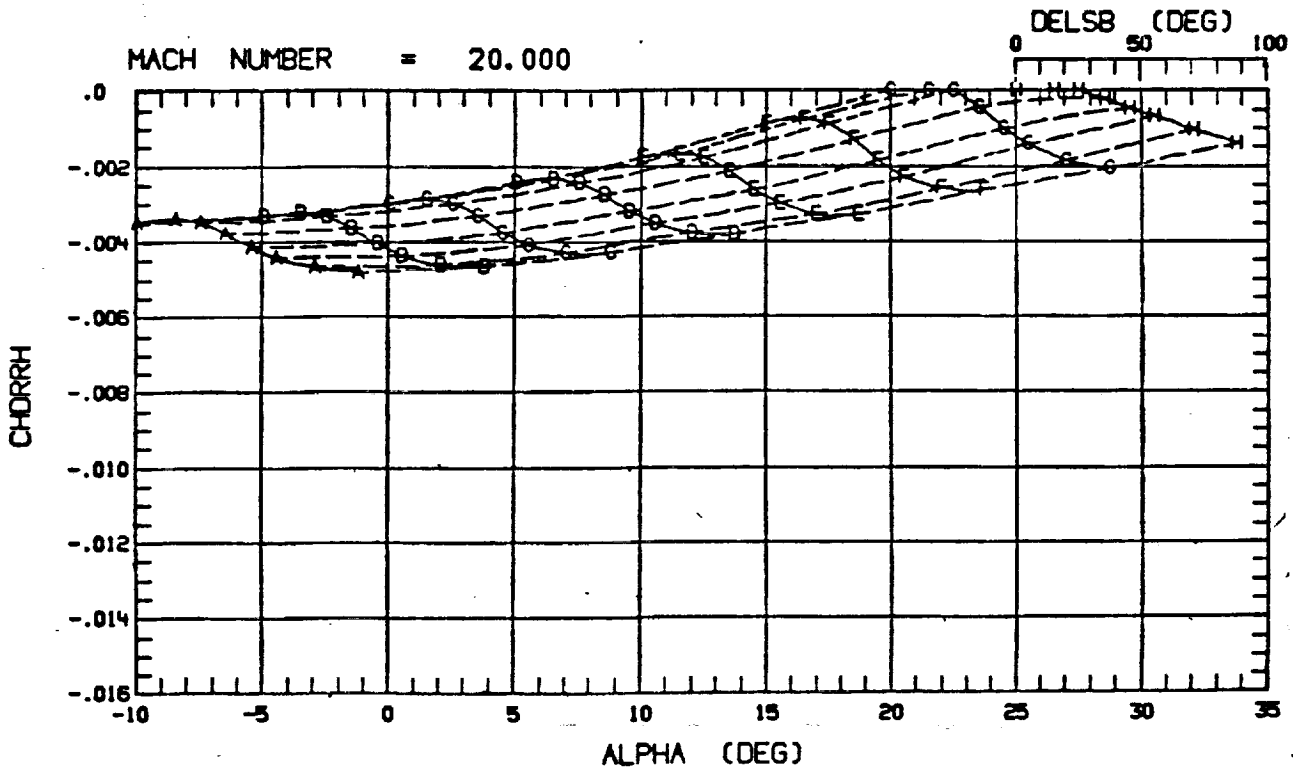
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00089	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00076	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	-0.00089	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00131	-0.00044	-0.00023	0.0	0.0	0.0	0.0	0.0
45.000	-0.00187	-0.00100	-0.00047	0.0	0.0	0.0	0.0	0.0
55.000	-0.00230	-0.00144	-0.00070	0.0	0.0	0.0	0.0	0.0
70.000	-0.00261	-0.00186	-0.00104	-0.00021	0.0	0.0	0.0	0.0
87.200	-0.00265	-0.00209	-0.00141	-0.00063	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 12/27/72

FIGURE 5.3-80
HINGE MOMENT COEFFICIENT DUE TO RUDDER



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00350	-0.00335	-0.00300	-0.00245	-0.00180	-0.00089	0.0	0.0
15.000	-0.00342	-0.00326	-0.00290	-0.00235	-0.00169	-0.00076	0.0	0.0
25.000	-0.00350	-0.00335	-0.00300	-0.00245	-0.00180	-0.00089	0.0	0.0
35.000	-0.00378	-0.00366	-0.00332	-0.00277	-0.00216	-0.00131	-0.00044	-0.00023
45.000	-0.00414	-0.00407	-0.00376	-0.00321	-0.00265	-0.00187	-0.00100	-0.00047
55.000	-0.00443	-0.00439	-0.00409	-0.00353	-0.00301	-0.00230	-0.00144	-0.00070
70.000	-0.00469	-0.00462	-0.00431	-0.00377	-0.00328	-0.00261	-0.00186	-0.00104
87.200	-0.00482	-0.00465	-0.00431	-0.00380	-0.00330	-0.00265	-0.00209	-0.00141

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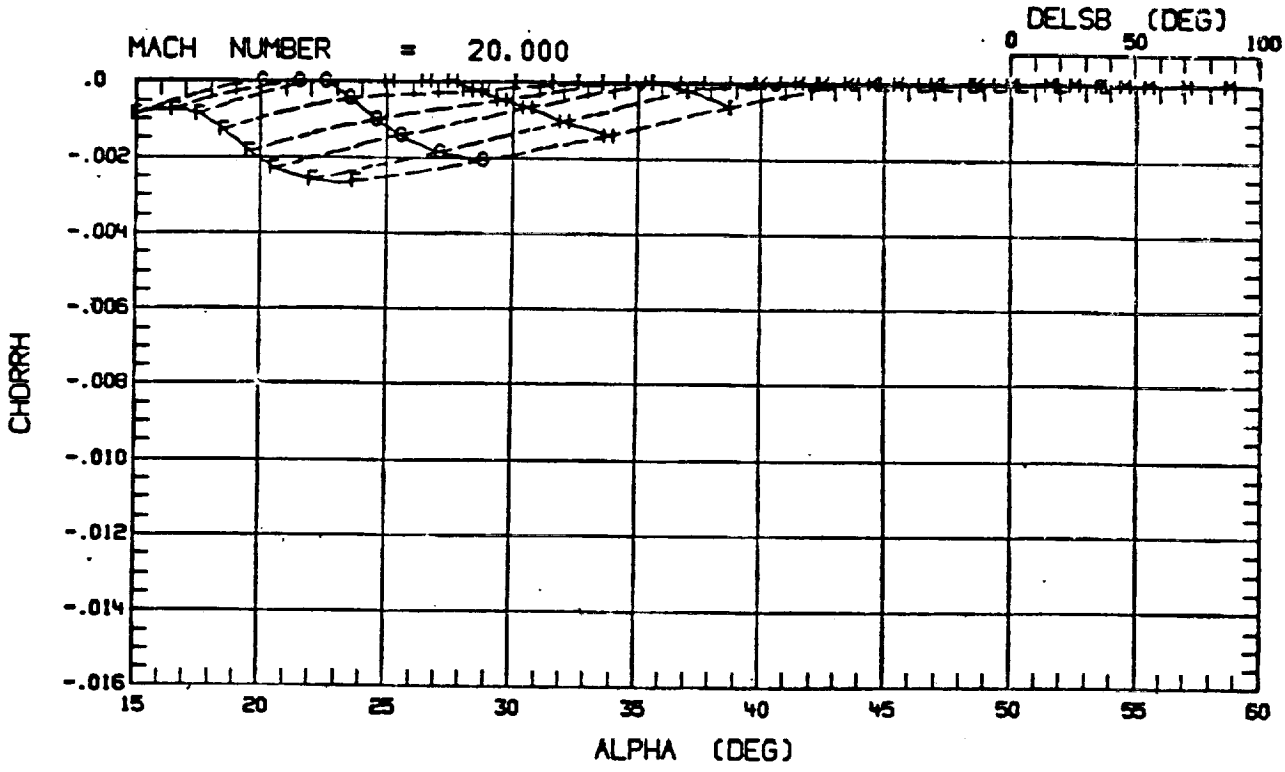
DATE 10/6-178

FIGURE 5.3-81
HINGE MOMENT COEFFICIENT DUE TO RUDDER



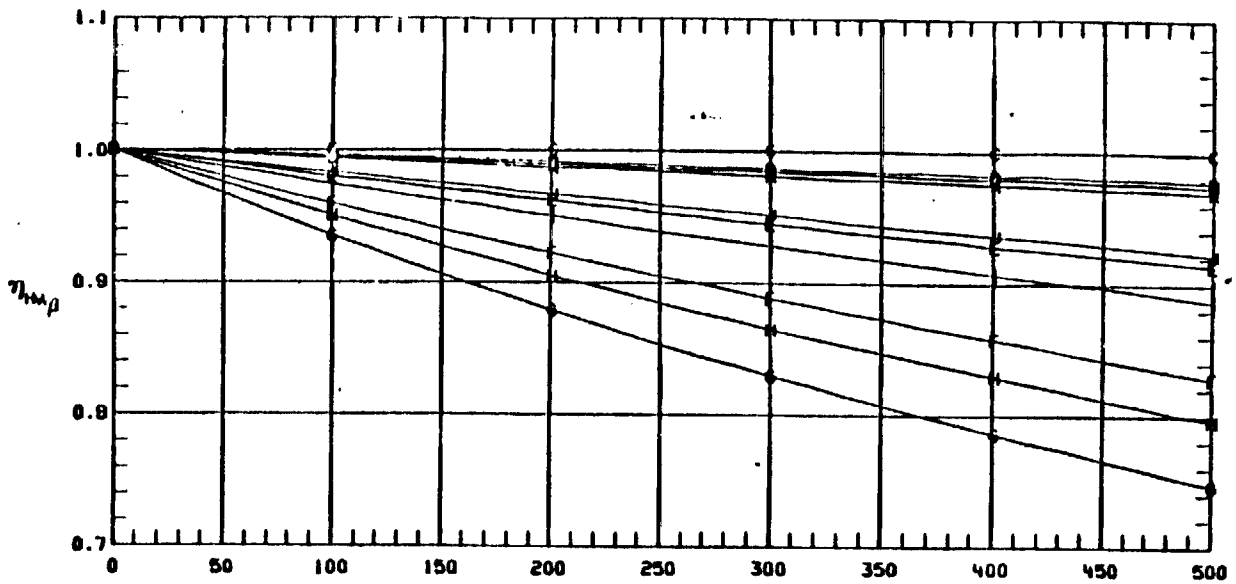
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELSB (DEG)	RUDDER HINGE MOMENT							
0.0	-0.00089	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.000	-0.00076	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.000	-0.00089	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.000	-0.00131	-0.00044	-0.00023	0.0	0.0	0.0	0.0	0.0
45.000	-0.00187	-0.00100	-0.00047	0.0	0.0	0.0	0.0	0.0
55.000	-0.00230	-0.00144	-0.00070	0.0	0.0	0.0	0.0	0.0
70.000	-0.00261	-0.00186	-0.00104	-0.00021	0.0	0.0	0.0	0.0
87.200	-0.00265	-0.00209	-0.00141	-0.00063	0.0	0.0	0.0	0.0

ENGINEER HP
DATE 10/2/72

FIGURE 5.3-82
HINGE MOMENT COEFFICIENT DUE TO RUDDER



$$\eta_{HM\beta} = \frac{C_{h_\beta}^{F}}{C_{h_\beta}^{R}}$$

RUDDER HINGE MOMENT DUE TO SIDESLIP

$\bar{q}$ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{HM\beta}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99319	0.99448	1.00061	0.99538	0.97970	0.95878	0.93494	0.94959	0.97309	0.98274
200.000	0.98674	0.98912	1.00062	0.99080	0.96115	0.92168	0.87826	0.90466	0.94909	0.96630
300.000	0.98056	0.98387	1.00013	0.98626	0.94411	0.88809	0.82909	0.86470	0.92729	0.95066
400.000	0.97451	0.97866	0.99933	0.98181	0.92812	0.85692	0.78577	0.82873	0.90651	0.93579
500.000	0.96852	0.97360	0.99832	0.97734	0.91305	0.82778	0.74702	0.79500	0.88694	0.92169

ENGINEER: DTO
DATE: 9/13/72
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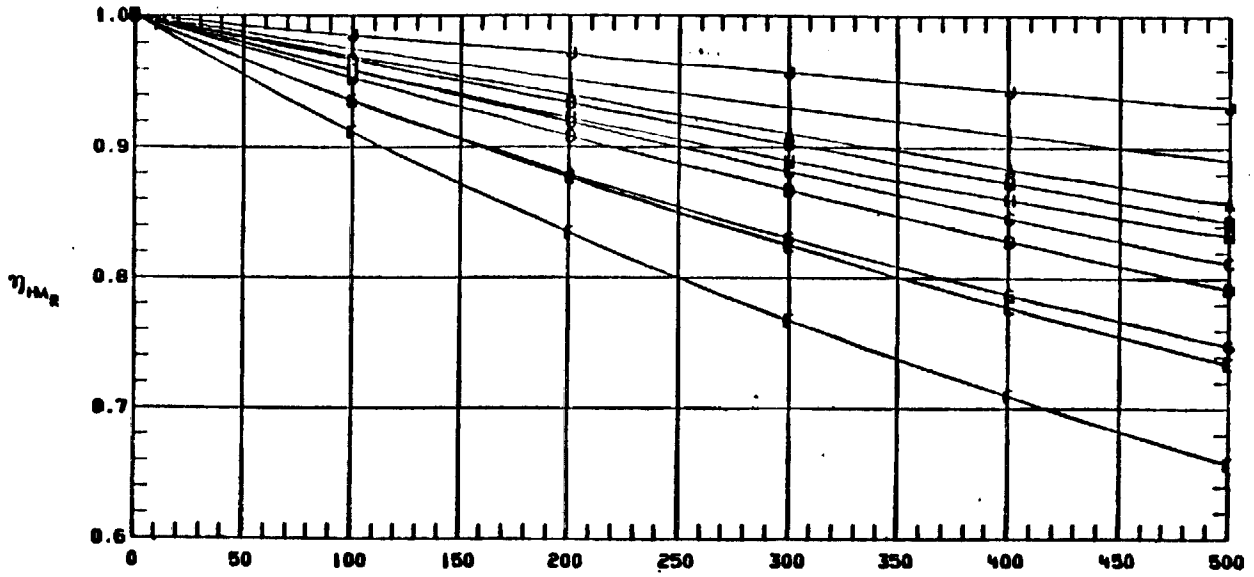
Figure 5.3-83
AEROELASTIC RATIOS

Rockwell International
Space Division



$$\eta_{HM_R} = \frac{C_{h_{\delta_r}}^{f}}{C_{h_{\delta_r}}^{R}}$$

RUDDER HINGE MOMENT DUE TO RUDDER DEFLECTION

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, η_{HM_R}									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.96866	0.96571	0.95807	0.95219	0.93451	0.91095	0.93507	0.95872	0.97451	0.98471
200.000	0.93867	0.93292	0.91829	0.90770	0.87598	0.83367	0.87858	0.92178	0.95100	0.97009
300.000	0.91003	0.90163	0.88057	0.86630	0.82380	0.76702	0.82961	0.88880	0.92926	0.95617
400.000	0.88275	0.87189	0.84475	0.82758	0.77677	0.70878	0.78650	0.85903	0.90891	0.94304
500.000	0.85662	0.84332	0.81058	0.79095	0.73395	0.65732	0.74816	0.83184	0.88978	0.93050

ENGINEER: DTD
DATE: 9/13/77
REVISED:

Figure 5.3-84
AEROELASTIC RATIOS

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Space Division

6.0 AERODYNAMIC DATA UNCERTAINTIES

Aerodynamic data uncertainties and correlation coefficients are presented in this section (6.0). The uncertainties consist of both tolerances and variations and are defined incremental values. For statistical error analysis where uncertainties need to be combined, tolerances and variations can be treated as three-sigma (3σ) errors normally distributed about the mean. Correlation coefficients describe the degree of linear relationship between two aerodynamic coefficients and apply equally to both tolerances and variations.

Laboratory (wind tunnel) or experimental data are always accompanied by measurement precision error. It, therefore, becomes important to assign some parameter such as a limit of error to represent the precision of experimental data measurements. The error of a measurement is the observed value minus the true value, where the true value is unknown. Errors can be classified as either accidental or systematic. Accidental errors are those which, in a large number of measurements will be negative as often as positive and will, therefore, affect a mean value only slightly. Systematic errors, arising from the same cause, will affect the mean in the same sense (either positive or negative) and, rather than balance one another, will result in a definite bias to a mean. Examples of systematic errors would be model support effects, wind tunnel wall effects, blockage, and the like. When all systematic errors have been eliminated (insofar as possible), it is possible to consider the sample of individual repeated measurements of a quantity with the objective of securing the best estimate of the true value and assessing the degree of reproducibility which has been obtained. The best estimate of the unknown true value is the mean value of all the measurements.

The mean values (adjusted for flight conditions) of the aerodynamic characteristics of the Orbiter Vehicle are given in the data sections of this report. Uncertainties, described in this section, represent deviations from those means and describe the scattering of observations about the mean. The tolerance, or lower uncertainty bounds, represent a measure of the experimental data scatter adjusted for flight conditions (essentially support-free and scale effect) about the mean values of the data sections. Tolerances are intended for use in operational subsystem design and may be referred to as *design-to* or *operational* uncertainties. Variations, or upper uncertainty bounds, represent the uncertainties associated with wind tunnel derived experimental data and full-scale vehicle flight measurements, and may be referred to as preorbital flight test uncertainties.

Uncertainty envelopes can be statistically defined. A two-dimensional Gaussian probability-density distribution is represented by a bell-shaped surface in the x, y, z space shown in Figure 6.0-1 (Reference 6-2). The curve formed by the intersection of the distribution surface and a vertical plane parallel to one of the coordinates planes is a curve of the same shape as the normal distribution curve; i.e., a sigma "cut" where the height (or z) represents the proportionate number of errors of the value x (or y) and the greater the value of z, the more closely the errors are clustered about the maximum ordinate (x or y = 0). Therefore, z can be

considered as a precision index or a measure of the concentration of measurements about their mean and may be seen from Figure 6.0-1 to be inversely related to sigma. Sigma (σ) is defined as the standard deviation, or limit in the probability sense, of the square root of the average value of the squared deviation of individual values from the mean as the number of values is increased indefinitely.

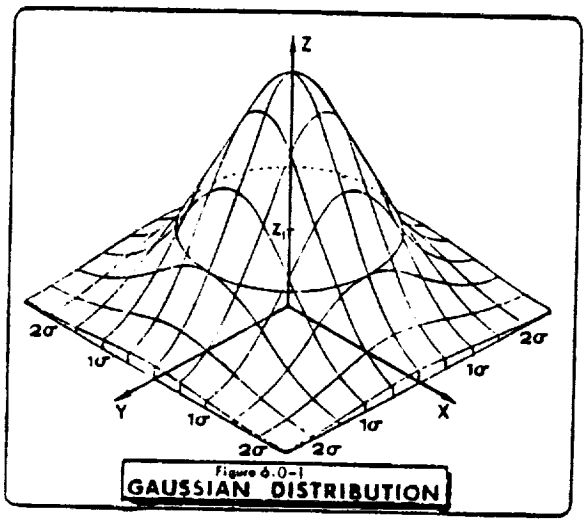


Figure 6.0-1
GAUSSIAN DISTRIBUTION

If a plane normal to the vertical axis, Z, is drawn at z_1, then the intersection of this plane with the surface will describe a curve formed by the locus of points with probability density z. The curve will be a circle provided that the standard deviations are equal for both x and y values. When this condition is not satisfied or x and y are linearly correlated ($-1 < \rho_{x,y} < +1$), the circle deforms into a contour ellipse of the form:

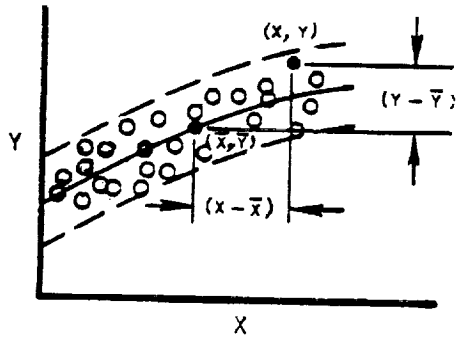
$$\frac{1}{1-\rho_{x,y}^2}\left\{\left(\frac{x-\bar{x}}{\sigma_x}\right)^2 - 2\rho_{x,y}\left(\frac{x-\bar{x}}{\sigma_x}\right)\left(\frac{y-\bar{y}}{\sigma_y}\right) + \left(\frac{y-\bar{y}}{\sigma_y}\right)^2\right\} = \chi^2_{f=2}(P)$$

where $\bar{x}$ and $\bar{y}$ are the normal or mean values, σ_x and σ_y are the standard deviations, $\rho_{x,y}$ is the correlation coefficient between x and y, and $\chi^2_{f=2}(P)$ represents the value of the χ^2 distribution for two degrees of freedom corresponding to a given probability level (P). In order that all ellipses generated will be tangent to a three sigma rectangle ($\chi^2_{f=2} = 9.00$) which corresponds to a probability level of P = 0.98889 and the equation of the contour probability ellipse becomes:

$$\frac{1}{1-\rho_{x,y}^2}\left\{\left(\frac{x-\bar{x}}{\sigma_x}\right)^2 - 2\rho_{x,y}\left(\frac{x-\bar{x}}{\sigma_x}\right)\left(\frac{y-\bar{y}}{\sigma_y}\right) + \left(\frac{y-\bar{y}}{\sigma_y}\right)^2\right\} = 9.00$$

or

$$\frac{1}{1-\rho_{x,y}^2}\left\{\left(\frac{x-\bar{x}}{3\sigma_x}\right)^2 - 2\rho_{x,y}\left(\frac{x-\bar{x}}{3\sigma_x}\right)\left(\frac{y-\bar{y}}{3\sigma_y}\right) + \left(\frac{y-\bar{y}}{3\sigma_y}\right)^2\right\} = 1.00$$



An n-dimensional Gaussian probability density distribution is represented by a "surface" in n-cimensional $(X_1, X_2, \cdots\cdots X_n)$ space. The locus of points with a given probability density will form a contour "surface" given by the following matrix expression:

$$\left(X_n - \bar{X}_n\right)^T M_n^{-1} \left(X_n - \bar{X}_n\right) = \chi^2_{f=n}$$

where X_n is random vector, $\bar{X}_n$ is mean vector, M_n is covariance matrix. If the n parameters consist of m pairs of variables and each pair is assumed uncorrelated and independent of all other pairs then the resulting equation for the contour "surface" is:

$$\sum_{i=1}^{m} \frac{1}{1-\rho^2_{x_i y_i}} \left\{ \left(\frac{x_i - \bar{x}_i}{\sigma_{x_i}}\right)^2 - 2\rho_{x_i y_i} \left(\frac{x_i - \bar{x}_i}{\sigma_{x_i}}\right)\left(\frac{y_i - \bar{y}_i}{\sigma_{y_i}}\right) + \left(\frac{y_i - \bar{y}_i}{\sigma_{y_i}}\right)^2 \right\} = \chi^2_{f=2m}$$

or

$$\sum_{i=1}^{m} F_i = \sum_{i=1}^{m} \chi^2_i = \chi^2_{f=2m}$$

where F_i is the contour ellipse equation for each individual pair of variables and χ^2_i is the portion of the $\chi^2_{f=2m}$ value to be assocated with the F_i ellipse. The total $\chi^2_{f=2m}$ value can be apportioned among the individual pairs in any manner consistent with the restriction $0 \leq \chi^2_i \leq 9.0$.

Use of the above equations is contingent on the following assumptions:

1. Aerodynamic coefficients are normally distributed, and
2. Aerodynamic uncertainties are three-sigma levels.

The correlation coefficients (ρ) which describe the degree of linear relationship between two aerodynamic coefficients apply equally to both the toleances and variations presented herein. The correlation coefficients are to be used only in the equation forms given in Table 6-I which describe the statistical determination for combining uncertainties of functions of the aerodynamic coefficients. Development of the correlation coefficients is described in Reference 3-5.

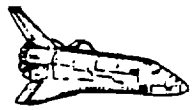
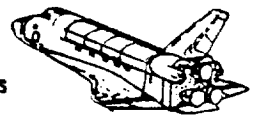


TABLE 6-1

COMBINING UNCERTAINTIES OF FUNCTIONS OF AERODYNAMIC COEFFICIENTS



No	FUNCTION	MEAN VALUE	UNCERTAINTY	REMARKS
1	$y = \sum_{i=1}^{n} K_i X_i$	$\bar{y} = \sum_{i=1}^{n} K_i \bar{X}_i$	$\Delta y = \sqrt{\sum_{i=1}^{n} K_i^2 [\Delta X_i]^2 + 2 \sum_{i<j} \sum K_i K_j \rho_{ij} \Delta X_i \Delta X_j}$	K_i = constant ρ_{ij} = correlation coefficient
2	$y = X_1 X_2$	$\bar{y} = \bar{X}_1 \bar{X}_2 + \rho_{12} \Delta X_1 \Delta X_2$	$\Delta y = \sqrt{(1+\rho_{12}^2)[\Delta X_1 \Delta X_2]^2 + (\Delta X_1)^2 \bar{X}_2^2 + \bar{X}_1^2 (\Delta X_2)^2 + 2 \rho_{12} \bar{X}_1 \bar{X}_2 \Delta X_1 \Delta X_2}$	Exact expression for a bivariate normal distribution (Ref. 6-1, P. 10, Th 2)
3	$y = X_1 X_2 \pm X_3 X_4$	$\bar{y} = \bar{X}_1 \bar{X}_2 + \rho_{12} \Delta X_1 \Delta X_2 + \bar{X}_3 \bar{X}_4 + \rho_{34} \Delta X_3 \Delta X_4$	$\Delta y = \sqrt{(1+\rho_{12}^2)[\Delta X_1 \Delta X_2]^2 + (\Delta X_1)^2 \bar{X}_2^2 + \bar{X}_1^2 (\Delta X_2)^2 + 2 \rho_{12} \bar{X}_1 \bar{X}_2 \Delta X_1 \Delta X_2 + (1+\rho_{34}^2)(\Delta X_3 \Delta X_4)^2 + (\Delta X_3 \bar{X}_4)^2 + (\bar{X}_3 \Delta X_4)^2 + 2 \rho_{34} \bar{X}_3 \bar{X}_4 \Delta X_3 \Delta X_4 \pm 2 [(\rho_{13} \Delta X_1 \Delta X_3) \cdot (\rho_{24} \Delta X_2 \Delta X_4) + (\rho_{23} \Delta X_2 \Delta X_3) \cdot (\rho_{14} \Delta X_1 \Delta X_4) + (\rho_{13} \Delta X_1 \Delta X_3) \bar{X}_2 \bar{X}_4 + (\rho_{14} \Delta X_1 \Delta X_4) \bar{X}_2 \bar{X}_3 + (\rho_{23} \Delta X_2 \Delta X_3) \bar{X}_1 \bar{X}_4 + (\rho_{24} \Delta X_2 \Delta X_4) \bar{X}_1 \bar{X}_3]}$	Exact expression for a multivariate normal distribution (Ref. 6-1, P. 17, Ex 5)
4	$z_1 = \sum_{i=1}^{n} K_i X_i$ $z_2 = \sum_{j=1}^{n} M_j Y_j$	$\bar{z}_1 = \sum_{i=1}^{n} K_i \bar{X}_i$ $\bar{z}_2 = \sum_{j=1}^{n} M_j \bar{Y}_j$	Δz_1 & Δz_2 from function 1 above $\rho_{z_1 z_2} = \left(\sum_{i=1}^{n} \sum_{j=1}^{n} K_i M_j \rho_{x_i y_j} \Delta X_i \Delta Y_j \right) \Big/ \Delta z_1 \Delta z_2$	K_i, M_j = constant $\rho_{x_i y_j}$ = correlation coefficient
5	$y = G(X_1, X_2, \cdots, X_n)$	$\bar{y} = G(\bar{X}_1, \bar{X}_2, \cdots, \bar{X}_n)$	$\Delta Y = \sqrt{\sum_{i=1}^{n} \left(\left[\frac{\partial G}{\partial X_i} \right] \Delta X_i \right)^2 + 2 \sum_{i<j} \sum \left[\frac{\partial G}{\partial X_i} \right] \left[\frac{\partial G}{\partial X_j} \right] \rho_{ij} \Delta X_i \Delta X_j}$	Linearized theory (Ref. No. 6-1, P. 21)
6	$y = \frac{X_1}{X_2}$	$\bar{y} = \frac{\bar{X}_1}{\bar{X}_2}$	$\Delta Y = \sqrt{\frac{(\Delta X_1)^2}{\bar{X}_2^2} + \frac{\bar{X}_1^2 (\Delta X_2)^2}{\bar{X}_2^4} - \frac{2 \rho (\Delta X_1)(\Delta X_2) \bar{X}_1}{\bar{X}_2^3}}$	Derived from Equation No. 5

6.1 LONGITUDINAL AERODYNAMICS. Uncertainties to be used with the longitudinal aerodynamic characteristics (cf. Section 4.1) are given in Figures 6.1-1 through 6.1-7. Longitudinal correlation coefficients (see Table 6-1) are presented in Figure 6.1-8.

SYMBOL	UNCERTAINTY INCREMENT	FIGURE
$\Delta C_{L_{3\sigma}}$	Lift Coefficient	6.1-1
$\Delta C_{D_{3\sigma}}$	Drag Coefficient	6.1-2
$\Delta (L/D)_{3\sigma}$	Lift-to-Drag Ratio	6.1-3
$\Delta C_{m_{3\sigma}}$	Pitching Moment Coefficient	6.1-4
$\Delta C_{m_{\alpha_{3\sigma}}}$, $\Delta C_{m_{\delta_{e_{3\sigma}}}}$	Pitching Moment Derivatives	6.1-5
$\Delta C_{N_{\alpha_{3\sigma}}} = \Delta C_{L_{\alpha_{3\sigma}}}$	Normal Force or Lift Force Coefficient Slope	6.1-6
$\Delta C_{L_{\delta_{e_{3\sigma}}}}$	Lift Derivative Uncertainty	6.1-7
ρ	Correlation Coefficients	6.1-8

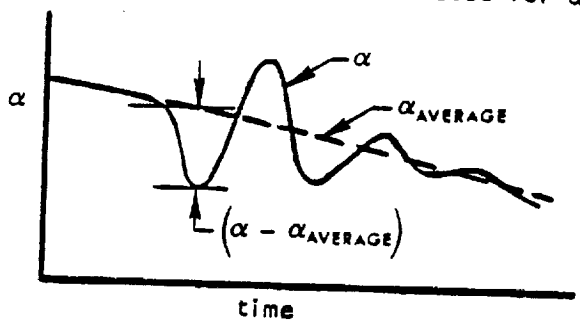
The lift-to-drag ratio uncertainty is presented in Figure 6.1-3 for an angle of attack schedule based on trajectory 14414.1. When the $\Delta L/D$ is needed for another angle of attack, Equation No. 3 of Table 6-1 should be used. This linearized approach will result in maximum and minimum levels of the ratio L/D. An alternate approach is the formal statistical method which uses the two-dimensional Gaussian distribution equation (ellipse equation). This method displays the contour of expected lift and drag coefficients for a 3σ probability ellipse. The appropriate correlation coefficients to be used are presented in Figure 6.1-8.

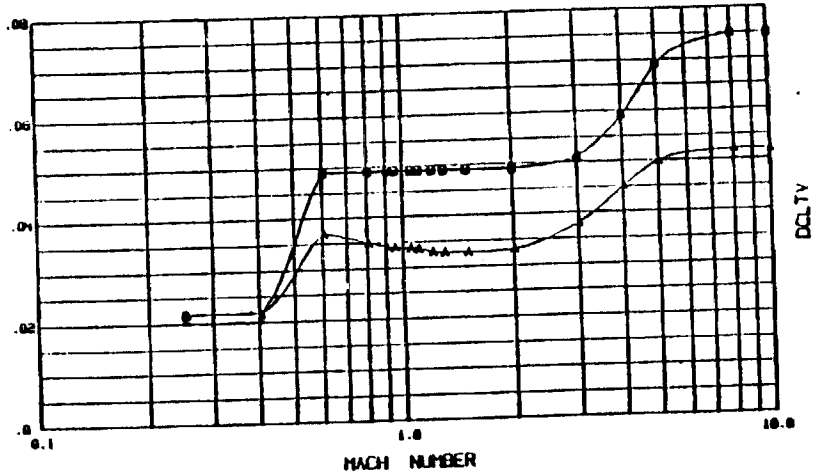
Sensitivity Studies. Uncertainties on $\Delta C_{m_{\delta_{e3\sigma}}}$, $\Delta C_{N_{\alpha_{3\sigma}}}$, $\Delta C_{N_{\delta_{e3\sigma}}}$ and $\Delta C_{m_{\alpha_{3\sigma}}}$, presented in Figures 6.1-5 through 6.107, for use in linearized stability analyses have been included for sensitivity studies. These increments are NOT to be combined with other pitching moment and normal force (or lift coefficient) data presented in this section. When doing small perturbations about α or δ_e these uncertainties should be used in the following manner:

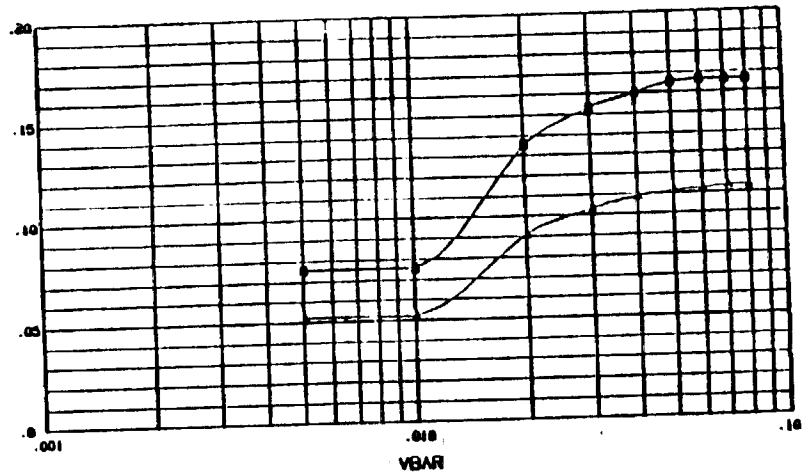
$$\Delta C_{m_{3\sigma}} = \Delta C_{m_{\alpha_{3\sigma}}} (\alpha - \alpha_{AVERAGE}) + \Delta C_{m_{\delta_{e3\sigma}}} (\delta_e - \delta_{e_{AVERAGE}})$$

$$\Delta C_{L_{3\sigma}} = \Delta C_{L_{\alpha_{3\sigma}}} (\alpha - \alpha_{AVERAGE}) + \Delta C_{L_{\delta_{e_{3\sigma}}}} (\delta_e - \delta_{e_{AVERAGE}})$$

where: $\alpha_{AVERAGE}$ or $\delta_{e_{AVERAGE}}$ are obtained from filtered or undisturbed values as illustrated for α in the sketch.







MACH NUMBER	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.250	0.02160	0.02160
0.400	0.02160	0.02160
0.600	0.03700	0.04900
0.800	0.03500	0.04900
0.900	0.03100	0.04900
0.950	0.03390	0.04900
1.050	0.03370	0.04900
1.100	0.03360	0.04900
1.200	0.03290	0.04900
1.300	0.03270	0.04900
1.500	0.03270	0.04900
2.000	0.03300	0.04900
3.000	0.03000	0.05100
4.000	0.04500	0.05900
5.000	0.05000	0.06900
8.000	0.05200	0.07500
10.000	0.05200	0.07500
20.000	0.05200	0.07500

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1038.7 IN.
ON YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.0 IN.

VBAR	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.005	0.05200	0.07500
0.010	0.05200	0.07500
0.020	0.09100	0.13500
0.030	0.10300	0.15300
0.040	0.10850	0.16000
0.050	0.11100	0.16500
0.060	0.11200	0.16600
0.070	0.11300	0.16600
0.080	0.11300	0.16600

ENGINEER DCO
DATE 9-2-72

FIGURE 6.1-1
LIFT COEFFICIENT UNCERTAINTY

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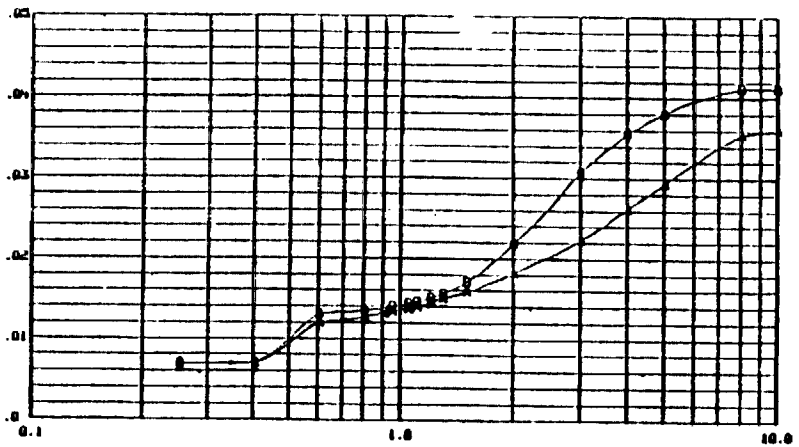

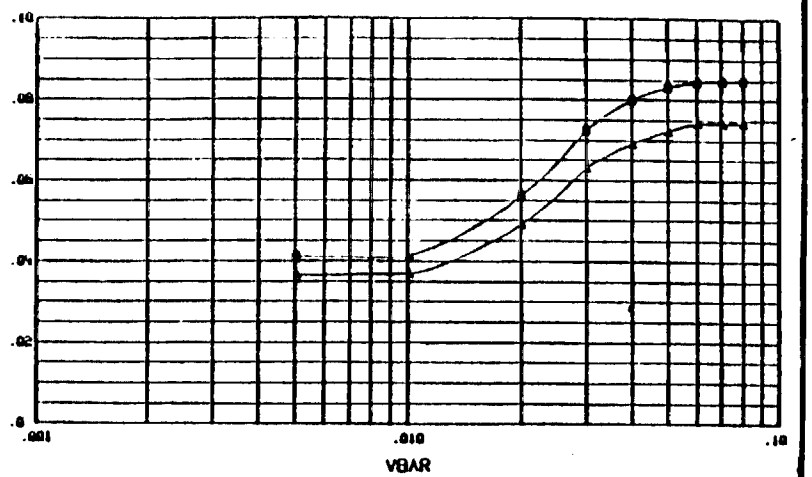

MACH NUMBER	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.250	0.00690	0.00690
0.400	0.00690	0.00690
0.600	0.01190	0.01300
0.800	0.01260	0.01310
0.900	0.01310	0.01370
0.950	0.01330	0.01390
1.050	0.01370	0.01430
1.100	0.01400	0.01450
1.200	0.01440	0.01500
1.300	0.01500	0.01560
1.500	0.01580	0.01700
2.000	0.01820	0.02180
3.000	0.02230	0.03070
4.000	0.02620	0.03550
5.000	0.02930	0.03800
8.000	0.03540	0.04110
10.000	0.03600	0.04110
20.000	0.03600	0.04110

CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XB = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YB = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZB = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH LB = 1290.0 IN	

VBAR	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.005	0.03650	0.04110
0.010	0.03650	0.04110
0.020	0.04900	0.05600
0.030	0.06300	0.07230
0.040	0.06900	0.07990
0.050	0.07220	0.08290
0.060	0.07400	0.08420
0.070	0.07400	0.08460
0.080	0.07400	0.08470

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DATE 9-2-75

FIGURE 6.1-2
DRAG COEFFICIENT UNCERTAINTY

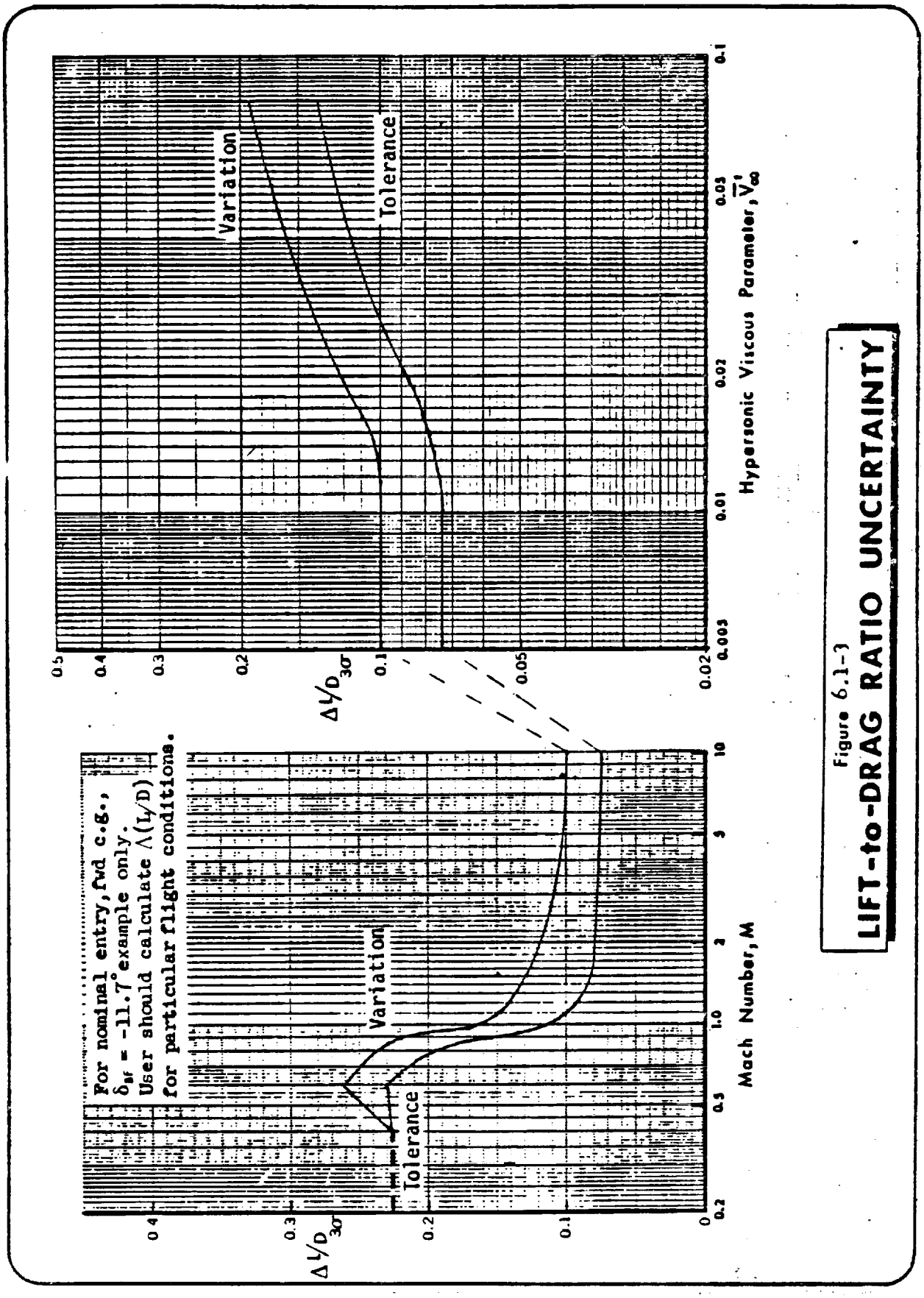
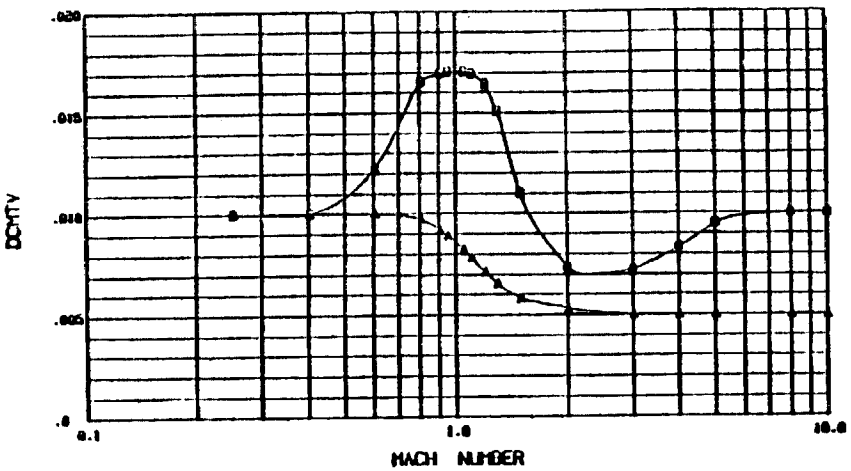
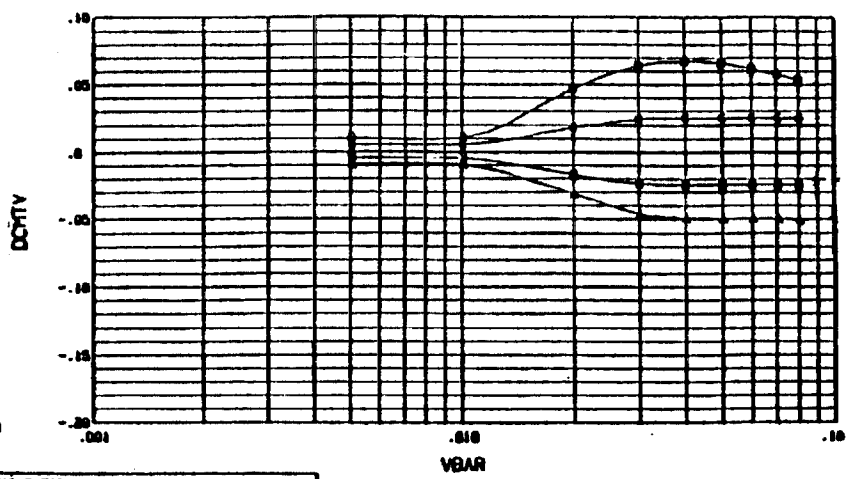


Figure 6.1-3
LIFT-to-DRAG RATIO UNCERTAINTY





CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XB = FS 1878.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YB = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZB = WL 375.0 IN.		M.A.C.	CW = 39.860 FT.
			BODY LENGTH LB = 1290.8 IN.	

	TYPE	
	1.000	2.000
	A	B
MACH NUMBER	TOLERANCE	VARIATION
0.250	0.01000	0.01000
0.400	0.01000	0.01000
0.600	0.01000	0.01220
0.800	0.00970	0.01650
0.900	0.00920	0.01690
0.950	0.00890	0.01700
1.050	0.00820	0.01700
1.100	0.00780	0.01690
1.200	0.00710	0.01640
1.300	0.00650	0.01510
1.500	0.00580	0.01100
2.000	0.00530	0.00730
3.000	0.00500	0.00720
4.000	0.00500	0.00830
5.000	0.00500	0.00950
8.000	0.00500	0.01000
10.000	0.00500	0.01000
20.000	0.00500	0.01000

	TYPE			
	-2.000	-1.000	1.000	2.000
	A	B	C	D
VBAR	VARIATION	TOLERANCE	TOLERANCE	VARIATION
0.005	-0.01000	-0.00500	0.00500	0.01000
0.010	-0.01000	-0.00500	0.00500	0.01000
0.020	-0.03150	-0.01750	0.01750	0.04650
0.030	-0.04650	-0.02400	0.02400	0.06350
0.040	-0.04930	-0.02500	0.02500	0.06700
0.050	-0.04970	-0.02500	0.02500	0.06650
0.060	-0.05000	-0.02500	0.02500	0.06150
0.070	-0.05020	-0.02500	0.02500	0.05700
0.080	-0.05050	-0.02500	0.02500	0.05350

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DATE 9-6-78

FIGURE 6.1-4
PITCHING MOMENT COEFFICIENT UNCERTAINTY

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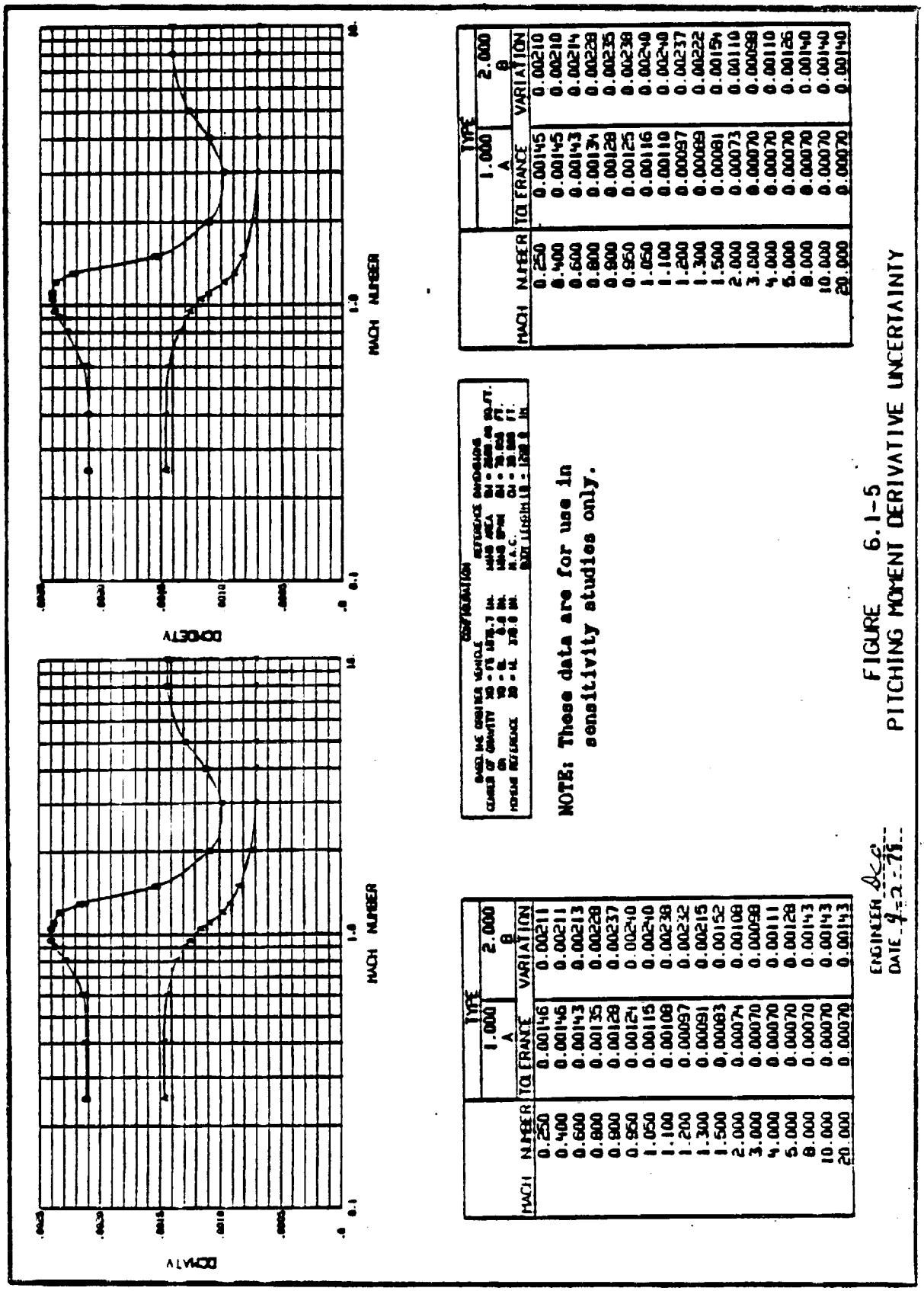

MACH NUMBER	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.250	0.00146	0.00211
0.400	0.00145	0.00211
0.600	0.00143	0.00213
0.800	0.00135	0.00228
0.900	0.00128	0.00237
0.950	0.00121	0.00240
1.050	0.00115	0.00240
1.100	0.00108	0.00238
1.200	0.00097	0.00232
1.300	0.00081	0.00215
1.500	0.00083	0.00152
2.000	0.00074	0.00108
3.000	0.00070	0.00098
4.000	0.00070	0.00111
5.000	0.00070	0.00128
8.000	0.00070	0.00143
10.000	0.00070	0.00143
20.000	0.00070	0.00143

MACH NUMBER	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.250	0.00145	0.00210
0.400	0.00145	0.00210
0.600	0.00143	0.00214
0.800	0.00134	0.00228
0.900	0.00128	0.00235
0.950	0.00125	0.00238
1.050	0.00116	0.00240
1.100	0.00110	0.00240
1.200	0.00097	0.00237
1.300	0.00089	0.00222
1.500	0.00081	0.00154
2.000	0.00073	0.00110
3.000	0.00070	0.00098
4.000	0.00070	0.00110
5.000	0.00070	0.00126
8.000	0.00070	0.00140
10.000	0.00070	0.00140
20.000	0.00070	0.00140

NOTE: These data are for use in sensitivity studies only.

ENGINEER
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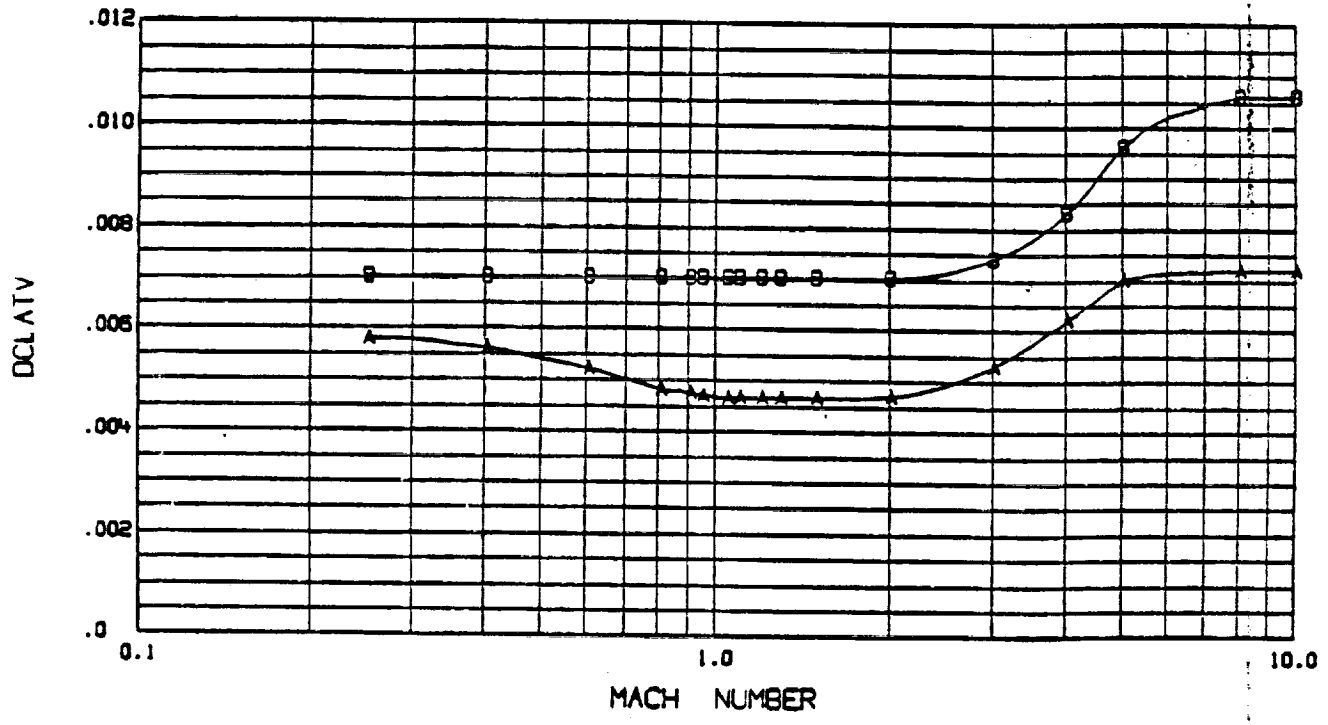
FIGURE 6.1-5
PITCHING MOMENT DERIVATIVE UNCERTAINTY



CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.0 IN.

NOTE: These data are for use in sensitivity studies only.

		TYPE	
		1.000 A	2.000 B
MACH	NUMBER	TOLERANCE	VARIATION
	0.250	0.00580	0.00700
	0.400	0.00560	0.00700
	0.600	0.00520	0.00700
	0.800	0.00480	0.00700
	0.900	0.00475	0.00700
	0.950	0.00470	0.00700
	1.050	0.00465	0.00700
	1.100	0.00465	0.00700
	1.200	0.00465	0.00700
	1.300	0.00465	0.00700
	1.500	0.00465	0.00700
	2.000	0.00470	0.00700
	3.000	0.00530	0.00740
	4.000	0.00620	0.00830
	5.000	0.00700	0.00960
	8.000	0.00720	0.01060
	10.000	0.00720	0.01060
	20.000	0.00720	0.01060

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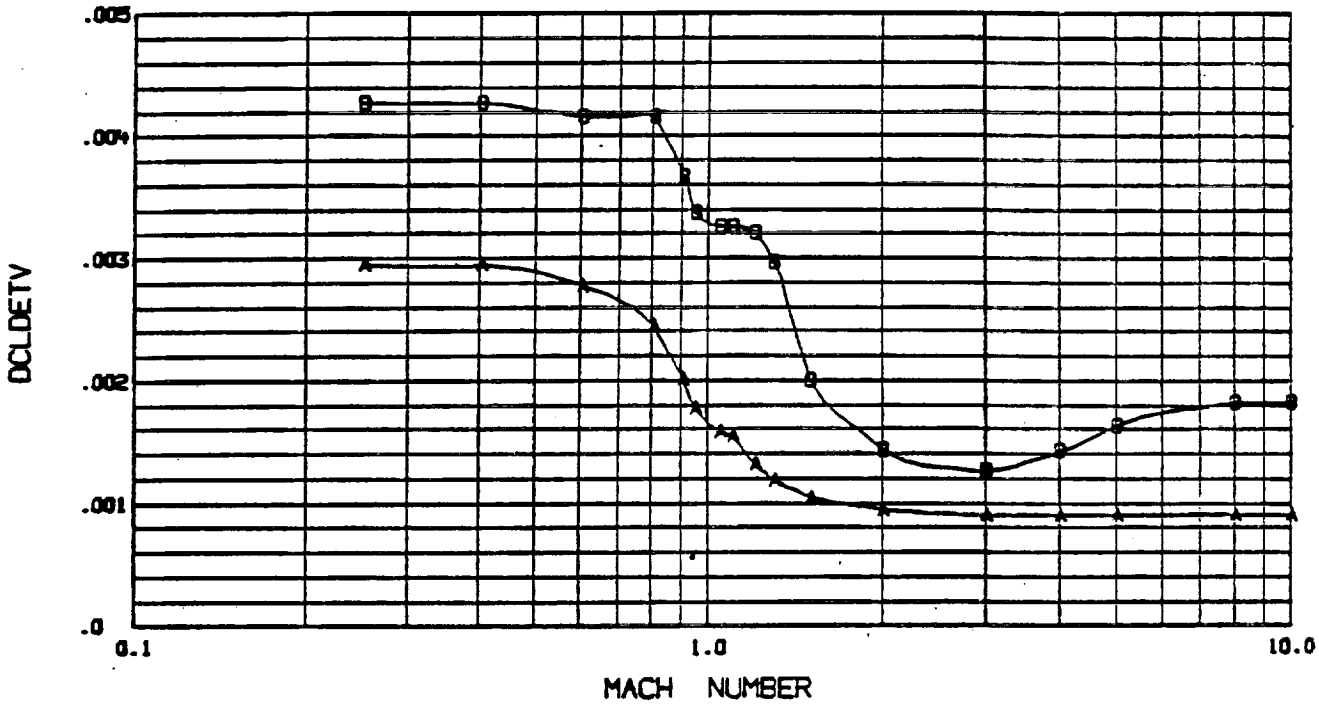
FIGURE 6.1-6
LIFT FORCE DERIVATIVE UNCERTAINTY



CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

NOTE: These data are for use in sensitivity studies only.

		TYPE	
		1.000 A	2.000 B
MACH	NUMBER	TOLERANCE	VARIATION
	0.250	0.00294	0.00426
	0.400	0.00294	0.00426
	0.600	0.00277	0.00415
	0.800	0.00244	0.00415
	0.900	0.00200	0.00366
	0.950	0.00178	0.00338
	1.050	0.00157	0.00325
	1.100	0.00153	0.00325
	1.200	0.00131	0.00320
	1.300	0.00118	0.00298
	1.500	0.00104	0.00199
	2.000	0.00094	0.00142
	3.000	0.00090	0.00128
	4.000	0.00090	0.00142
	5.000	0.00090	0.00183
	8.000	0.00090	0.00181
	10.000	0.00090	0.00181
	20.000	0.00090	0.00181

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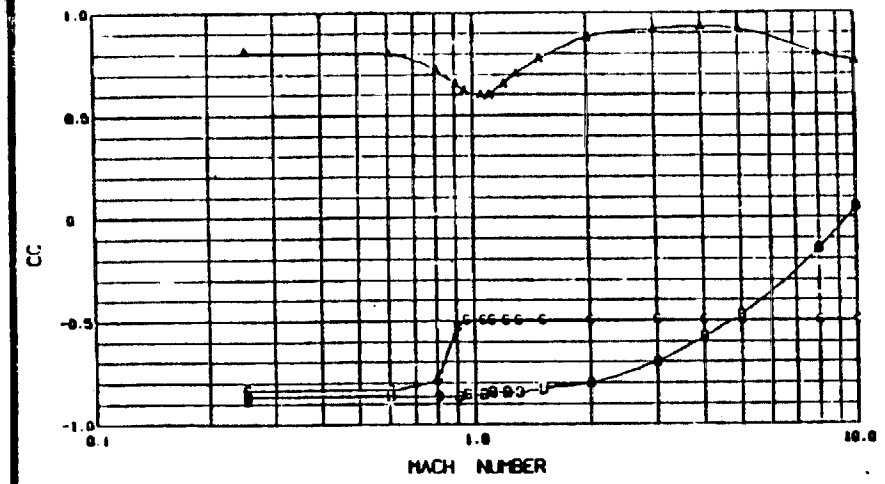
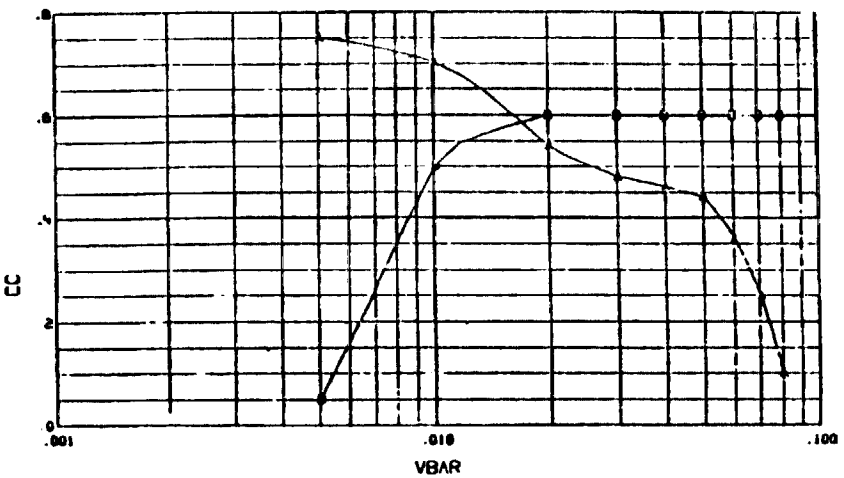
FIGURE 6.1 -7
LIFT COEFFICIENT DERIVATIVE UNCERTAINTY





CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1078.7 IN.		WING AREA	SW = 2690.00 SQ.FT.	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 38.560 FT.	
			BODY LENGTH	LB = 1292.3 IN.	

	ITEM		
	1.000	2.000	3.000
	A	B	C
MACH NUMBER	PCLCD	PCLCM	PCDCM
0.250	0.81000	-0.87000	-0.84000
0.600	0.80000	-0.87000	-0.84000
0.800	0.72000	-0.87000	-0.77000
0.900	0.65000	-0.87000	-0.53000
0.950	0.62000	-0.86000	-0.50000
1.050	0.60000	-0.86000	-0.50000
1.100	0.60000	-0.85000	-0.50000
1.200	0.65000	-0.85000	-0.50000
1.300	0.70000	-0.85000	-0.50000
1.500	0.77000	-0.83000	-0.50000
2.000	0.88000	-0.80000	-0.50000
3.000	0.92000	-0.70000	-0.50000
4.000	0.93000	-0.58000	-0.50000
5.000	0.92000	-0.47000	-0.50000
8.000	0.80000	-0.15000	-0.50000
10.000	0.76000	0.05000	-0.50000

	ITEM	
	1.000	2.000
	A	B
VBAR	VPCLCD	VPCLCM
0.005	0.75000	0.05000
0.010	0.70000	0.50000
0.020	0.54000	0.60000
0.030	0.48000	0.60000
0.040	0.46000	0.60000
0.050	0.44000	0.60000
0.060	0.36000	0.60000
0.070	0.25000	0.60000
0.080	0.10000	0.60000

Figure 6.1-8
LONGITUDINAL CORRELATION COEFFICIENTS

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6.2 LATERAL/DIRECTIONAL AERODYNAMICS. Uncertainties to be used with the lateral/directional aerodynamic characteristics (cf. Section 4.2) are given in Figures 6.2-1 through 6.2-7. Correlation coefficients (see Table 6-1) for control derivatives are given in Figure 6.2-7.

SYMBOL	UNCERTAINTY INCREMENT	FIGURE
$\Delta C_{Y_{\delta r_{3\sigma}}}$, $\Delta C_{Y_{\delta a_{3\sigma}}}$	Side Force Derivatives	6.2-1
$\Delta C_{Y_{\beta_{3\sigma}}}$	Side Force Derivative	6.2-2
$\Delta C_{n_{\delta r_{3\sigma}}}$, $\Delta C_{n_{\delta a_{3\sigma}}}$	Yawing Moment Derivatives	6.2-3
$\Delta C_{n_{\beta_{3\sigma}}}$	Yawing Moment Derivative	6.2-4
$\Delta C_{\ell_{\delta r_{3\sigma}}}$ $\Delta C_{\ell_{\delta a_{3\sigma}}}$	Rolling Moment Derivatives	6.2-4
$\Delta C_{\ell_{\beta_{3\sigma}}}$	Rolling Moment Derivative	6.2-6
ρ	Correlation Coefficients	6.2-7

Total lateral/directional data uncertainties are built-up according to Equations 1 or 4 of Table 6-1 with correlation coefficients (ρ) obtained from Figure 6.2-7. It should be noted that aerodynamic coefficients not linearly correlated have not been presented in Figure 6.2-7, and therefore, a value of $\rho = 0$ should be used in such cases.

The total uncertainty (tolerance or variation) would be,

$$\Delta C_n = \sqrt{(\Delta C_{n_\beta}\ \beta)^2 + (\Delta C_{n_{\delta_a}}\ \delta_a)^2 + (\Delta C_{n_{\delta_r}}\ \delta_r)^2}$$

according to Equation 1 or 4 of Table 6-1 with correlation coefficient equal to zero.

Similarly,

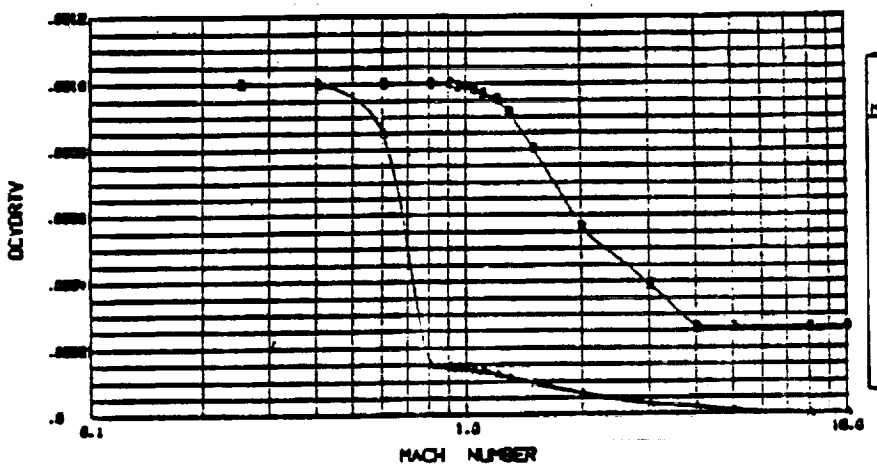
$$\Delta C_\ell = \sqrt{(\Delta C_{\ell_\beta}\ \beta)^2 + (\Delta C_{\ell_{\delta_a}}\ \delta_a)^2 + (\Delta C_{\ell_{\delta_r}}\ \delta_r)^2}$$

and,

$$\Delta C_{Y_\beta} = \sqrt{(\Delta C_{Y_\beta}\ \beta)^2 + (\Delta C_{Y_{\delta_a}}\ \delta_a)^2 + (\Delta C_{Y_{\delta_r}}\ \delta_r)^2}$$

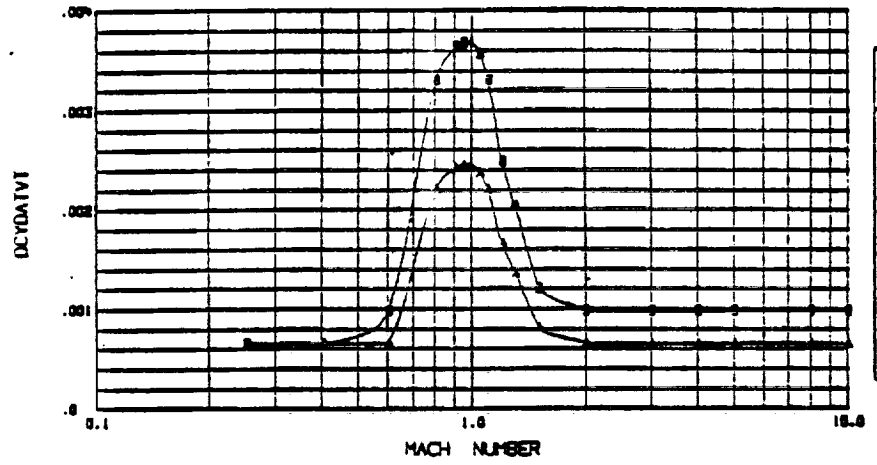
CAUTION APPLICATION OF RUDDER DERIVATIVES MUST BE SUCH THAT CHANGES TO THE SIGN OF THE BASIC DERIVATIVE ARE AVOIDED.

i.e., $C_{(-)_{\delta_r}} \pm \Delta C_{(-)_{\delta_{r_{3\sigma}}}} \geq 0$



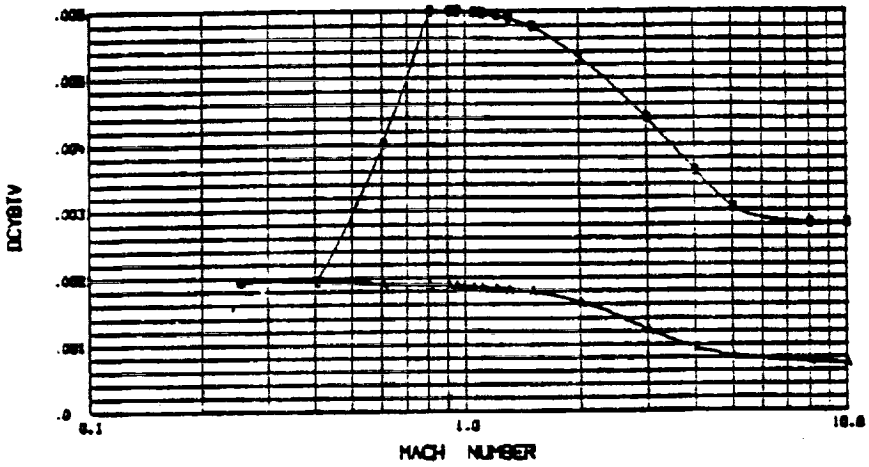
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XB = FS 1678.7 IN.	WING AREA	S = 2690.00 SQ.FT.
	YB = BL 0.0 IN.	WING SPAN	B = 78.058 FT.
MOMENT REFERENCE	ZB = WL 378.0 IN.	M.A.C.	C = 39.580 FT.
		BODY LENGTH	LB = 1292.1 IN.



ENGINEER
DATE 3/8/79

Figure 6.2-1
SIDE FORCE DERIVATIVE UNCERTAINTY

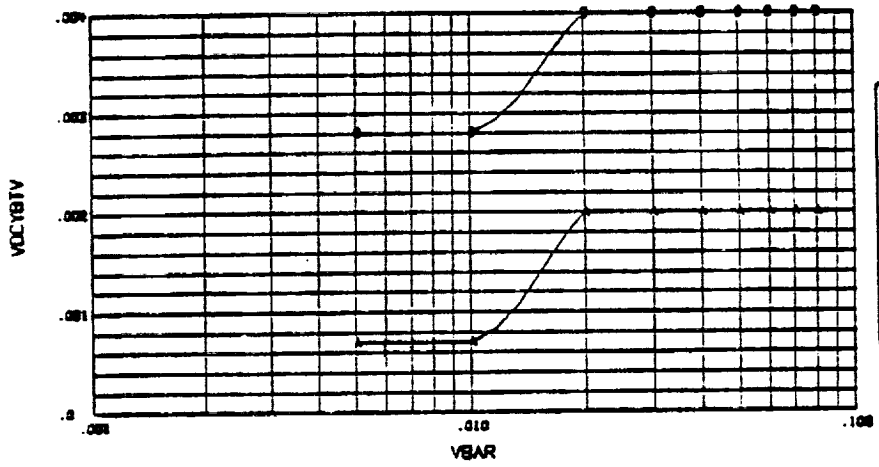


$\Delta C_{Y_{\beta_{3\sigma}}}$

	TYPE	
	1.000	2.000
	Δ	
MACH NUMBER	TOLERANCE	VARIATION
0.250	0.00194	0.00194
0.400	0.00194	0.00194
0.600	0.00192	0.00400
0.800	0.00188	0.00800
0.900	0.00188	0.02800
0.950	0.00187	0.00800
1.000	0.00188	0.00598
1.100	0.00194	0.00587
1.200	0.00193	0.00594
1.300	0.00191	0.00588
1.500	0.00179	0.00577
2.000	0.00168	0.00530
3.000	0.00121	0.00438
4.000	0.00083	0.00360
5.000	0.00061	0.00303
8.000	0.00070	0.00280
10.000	0.00070	0.00280
20.000	0.00070	0.00280

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XB = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YB = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZB = WL 378.0 IN.	M.A.C.	CW = 39.589 FT.
		BODY LENGTH	LB = 1292.3 IN.

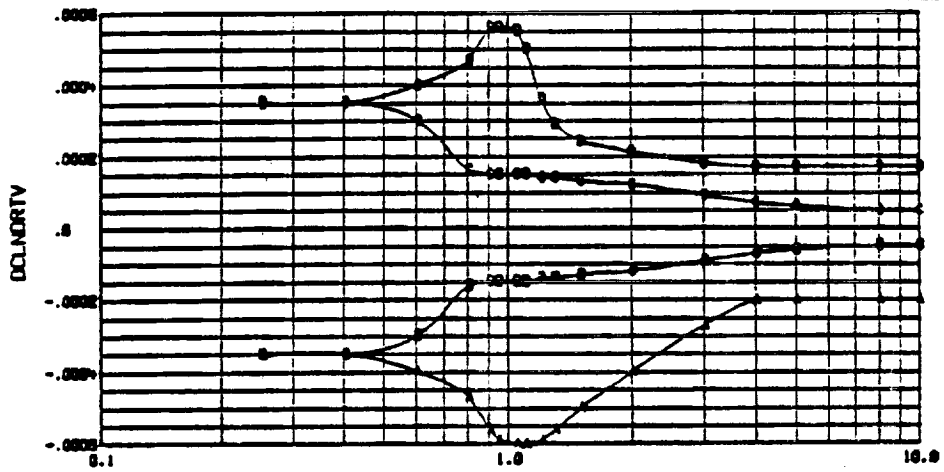


$\Delta C_{Y_{\beta_{3\sigma}}}$

	TYPE	
	1.000	2.000
	Δ	
VBAR	TOLERANCE	VARIATION
0.005	0.00070	0.00280
0.010	0.00070	0.00280
0.020	0.00200	0.00400
0.030	0.00200	0.00400
0.040	0.00200	0.00400
0.050	0.00200	0.00400
0.060	0.00200	0.00400
0.070	0.00200	0.00400
0.080	0.00200	0.00400

ENGINEER
DATE 3/8/79

Figure 6.2-2
SIDE FORCE DERIVATIVE UNCERTAINTY

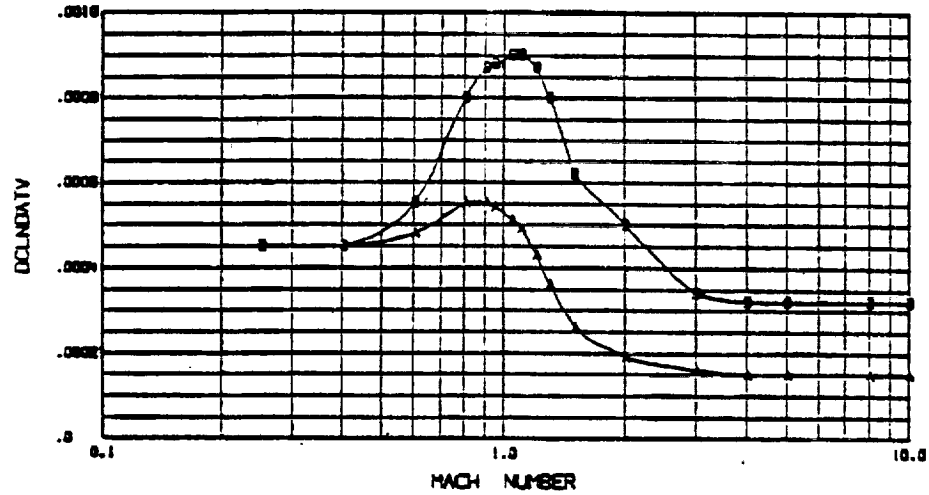


$\Delta C_{n_{\delta r_{3\sigma}}}$

MACH NUMBER	TYPE A -2.000 VARIATION	TYPE B -1.000 TOLERANCE	TYPE C 1.000 TOLERANCE	TYPE D 2.000 VARIATION
0.250	-0.00035	-0.00035	0.00035	0.00035
0.400	-0.00035	-0.00035	0.00035	0.00035
0.600	-0.00040	-0.00030	0.00030	0.00040
0.800	-0.00047	-0.00016	0.00016	0.00047
0.900	-0.00058	-0.00015	0.00015	0.00058
0.950	-0.00058	-0.00015	0.00015	0.00058
1.050	-0.00060	-0.00015	0.00015	0.00058
1.100	-0.00060	-0.00015	0.00015	0.00050
1.200	-0.00058	-0.00014	0.00014	0.00038
1.300	-0.00058	-0.00014	0.00014	0.00029
1.500	-0.00050	-0.00013	0.00013	0.00024
2.000	-0.00040	-0.00012	0.00012	0.00021
3.000	-0.00027	-0.00009	0.00009	0.00018
4.000	-0.00020	-0.00007	0.00007	0.00017
5.000	-0.00020	-0.00008	0.00008	0.00017
8.000	-0.00020	-0.00005	0.00005	0.00017
10.000	-0.00020	-0.00005	0.00005	0.00017
20.000	-0.00020	-0.00005	0.00005	0.00017

CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XB = FS 1078.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YB = BL 0.0	IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZB = WL 375.0	IN.	M.A.C.	CW = 38.980	FT.
			BODY LENGTH	LB = 1290.3	IN.

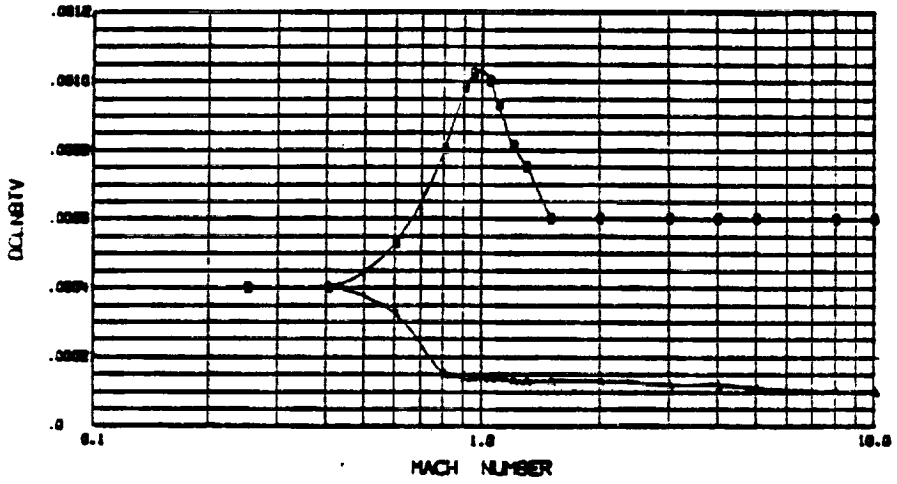


$\Delta C_{n_{\delta a_{3\sigma}}}$

MACH NUMBER	TYPE A 1.000 TOLERANCE	TYPE B 2.000 VARIATION
0.250	0.00045	0.00045
0.400	0.00045	0.00045
0.600	0.00048	0.00055
0.800	0.00055	0.00080
0.900	0.00058	0.00087
0.950	0.00054	0.00088
1.050	0.00051	0.00090
1.100	0.00048	0.00090
1.200	0.00043	0.00087
1.300	0.00038	0.00080
1.500	0.00028	0.00062
2.000	0.00019	0.00050
3.000	0.00018	0.00034
4.000	0.00015	0.00032
5.000	0.00015	0.00032
8.000	0.00015	0.00032
10.000	0.00015	0.00032
20.000	0.00015	0.00032

ENGINEER
DATE 3/8/79
REV 5/14/80

Figure 6.2-3
YAWING MOMENT DERIVATIVE UNCERTAINTY

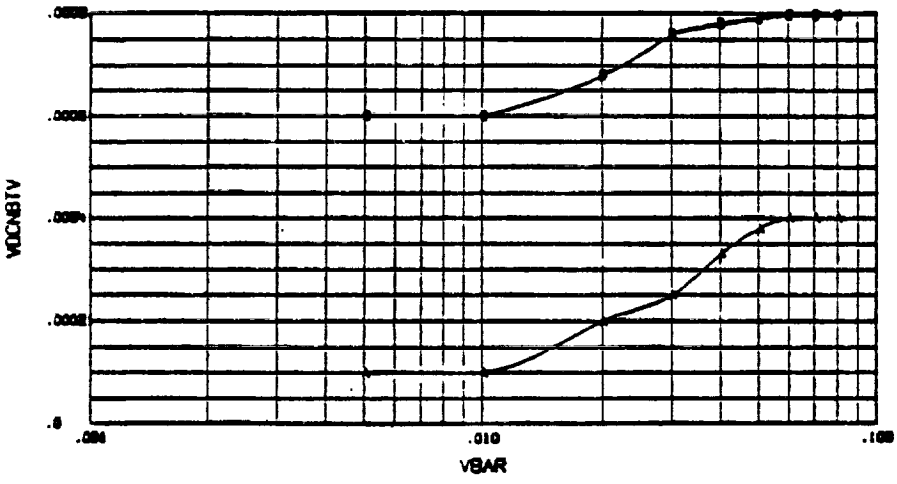


$\Delta C_{n\beta_{3\sigma}}$

MACH NUMBER	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.200	0.00040	0.00040
0.400	0.00040	0.00040
0.800	0.00032	0.00053
0.850	0.00015	0.00080
0.900	0.00014	0.00088
0.950	0.00014	0.00102
1.000	0.00014	0.00100
1.100	0.00014	0.00083
1.200	0.00013	0.00081
1.300	0.00013	0.00079
1.500	0.00013	0.00080
2.000	0.00013	0.00080
3.000	0.00012	0.00080
4.000	0.00012	0.00080
5.000	0.00011	0.00080
8.000	0.00010	0.00080
10.000	0.00010	0.00080
20.000	0.00010	0.00080

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XG = FS 1676.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YG = BL 0.0 IN.	WING SPAN	BW = 78.058 FT.
MOMENT REFERENCE	ZG = WL 375.0 IN.	M.A.C.	CM = 39.588 FT.
		BODY LENGTH	LB = 1290.3 IN.

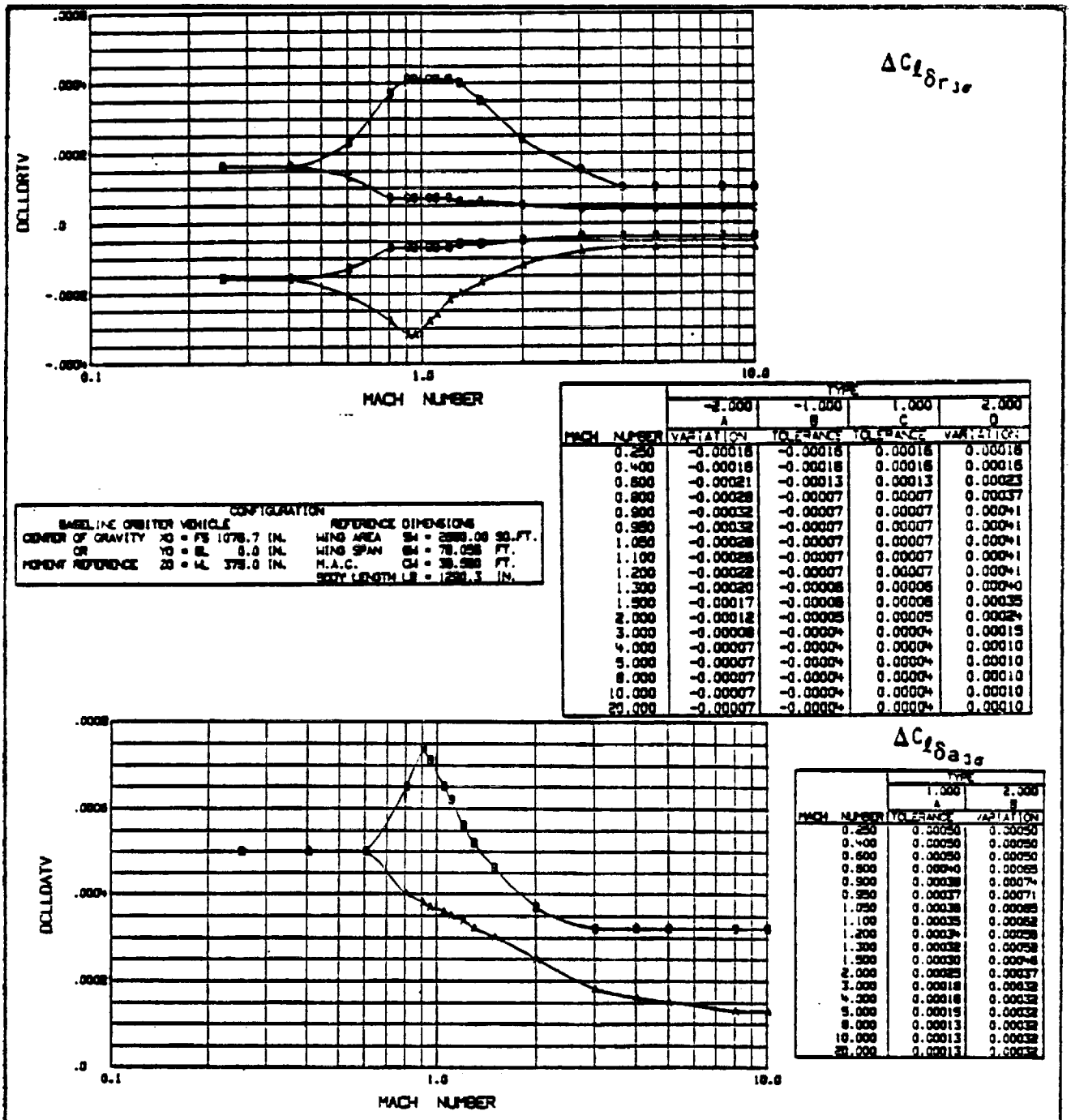


$\Delta C_{n\beta_{3\sigma}}$

VBAR	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.000	0.00010	0.00760
0.010	0.00010	0.00080
0.020	0.00080	0.00080
0.030	0.00033	0.00078
0.040	0.00033	0.00078
0.050	0.00038	0.00079
0.060	0.00040	0.00079
0.070	0.00040	0.00079
0.080	0.00040	0.00079

ENGINEER
DATE 3/8/72

Figure 6.2-4
YAWING MOMENT DERIVATIVE UNCERTAINTY



MACH NUMBER	TYPE -2.000 A VARIATION	-1.000 B TOLERANCE	1.000 C TOLERANCE	2.000 D VARIATION
0.250	-0.00018	-0.00018	0.00018	0.00018
0.400	-0.00018	-0.00018	0.00018	0.00018
0.800	-0.00021	-0.00013	0.00013	0.00023
0.900	-0.00028	-0.00007	0.00007	0.00037
0.950	-0.00032	-0.00007	0.00007	0.00041
0.980	-0.00032	-0.00007	0.00007	0.00041
1.050	-0.00028	-0.00007	0.00007	0.00041
1.100	-0.00028	-0.00007	0.00007	0.00041
1.200	-0.00022	-0.00007	0.00007	0.00041
1.300	-0.00020	-0.00006	0.00006	0.00040
1.500	-0.00017	-0.00006	0.00006	0.00035
2.000	-0.00012	-0.00005	0.00005	0.00024
3.000	-0.00008	-0.00004	0.00004	0.00015
4.000	-0.00007	-0.00004	0.00004	0.00010
5.000	-0.00007	-0.00004	0.00004	0.00010
8.000	-0.00007	-0.00004	0.00004	0.00010
10.000	-0.00007	-0.00004	0.00004	0.00010
20.000	-0.00007	-0.00004	0.00004	0.00010

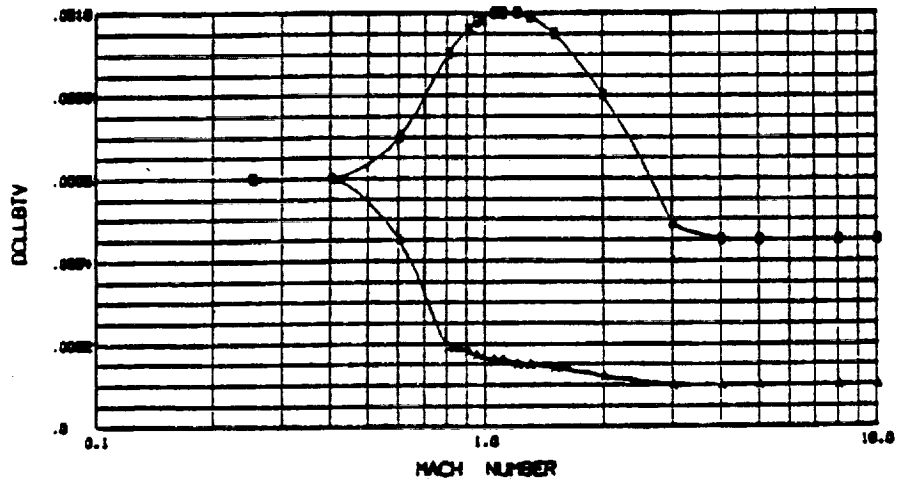
CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY XG = FS 1076.7 IN.
OR YG = BL 0.0 IN.
MOMENT REFERENCE ZG = WL 378.0 IN.
REFERENCE DIMENSIONS
WING AREA S = 2690.00 SQ.FT.
WING SPAN B = 78.056 FT.
M.A.C. C = 39.580 FT.
BODY LENGTH LB = 1291.3 IN.

MACH NUMBER	TYPE 1.000 A TOLERANCE	2.000 B VARIATION
0.250	0.00050	0.00050
0.400	0.00050	0.00050
0.600	0.00050	0.00050
0.800	0.00040	0.00065
0.900	0.00038	0.00074
0.950	0.00037	0.00071
1.050	0.00038	0.00065
1.100	0.00035	0.00062
1.200	0.00034	0.00058
1.300	0.00032	0.00058
1.500	0.00030	0.00046
2.000	0.00023	0.00037
3.000	0.00018	0.00032
4.000	0.00018	0.00032
5.000	0.00019	0.00032
8.000	0.00013	0.00032
10.000	0.00013	0.00032
20.000	0.00013	0.00032

ENGINEER
DATE 3/8/79
REV 5/14/80

Figure 6.2-5

ROLLING MOMENT DERIVATIVE UNCERTAINTY

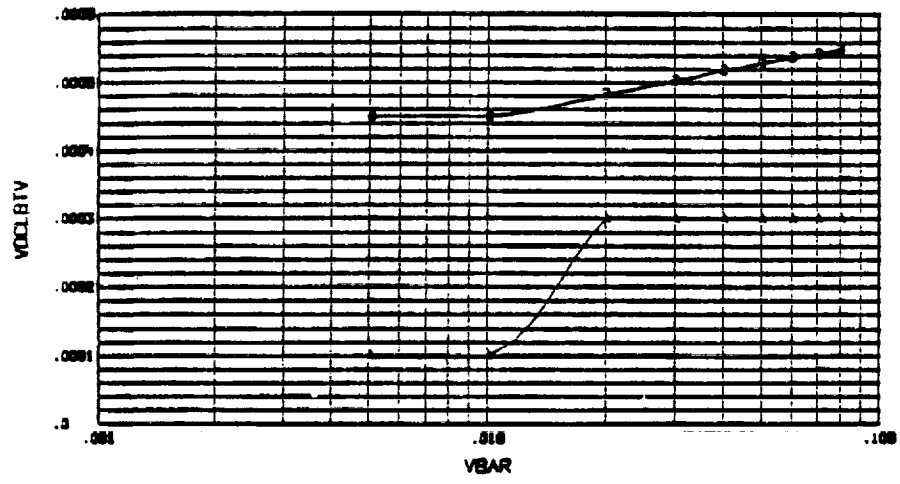


$\Delta C_{l_{\beta_{3\sigma}}}$

MACH NUMBER	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.200	0.00080	0.00080
0.400	0.00080	0.00080
0.800	0.00045	0.00070
0.900	0.00010	0.00080
0.950	0.00010	0.00080
0.980	0.00017	0.00080
1.000	0.00010	0.00100
1.100	0.00010	0.00100
1.200	0.00015	0.00100
1.300	0.00015	0.00080
1.500	0.00014	0.00080
2.000	0.00012	0.00080
3.000	0.00010	0.00045
4.000	0.00010	0.00045
5.000	0.00010	0.00045
8.000	0.00010	0.00045
10.000	0.00010	0.00045
20.000	0.00010	0.00045

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XB = FS 1678.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YB = BL 0.0 IN.	WING SPAN	BW = 78.058 FT.
MOMENT REFERENCE	ZB = WL 375.0 IN.	M.A.C.	CW = 39.588 FT.
		BODY LENGTH	LB = 1292.3 IN.



$\Delta C_{l_{\beta_{3\sigma}}}$

VBAR	TYPE 1.000 A TOLERANCE	TYPE 2.000 B VARIATION
0.000	0.00010	0.00045
0.010	0.00010	0.00045
0.020	0.00030	0.00045
0.030	0.00030	0.00050
0.040	0.00030	0.00052
0.050	0.00030	0.00053
0.060	0.00030	0.00054
0.070	0.00030	0.00054
0.080	0.00030	0.00055

ENGINEER
DATE 3/8/79

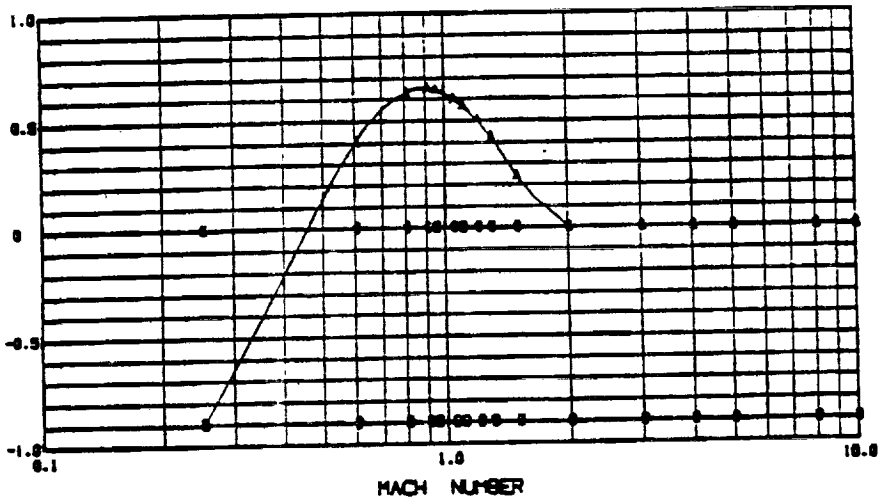
Figure 6.2-6

ROLLING MOMENT DERIVATIVE UNCERTAINTY

CONFIGURATION

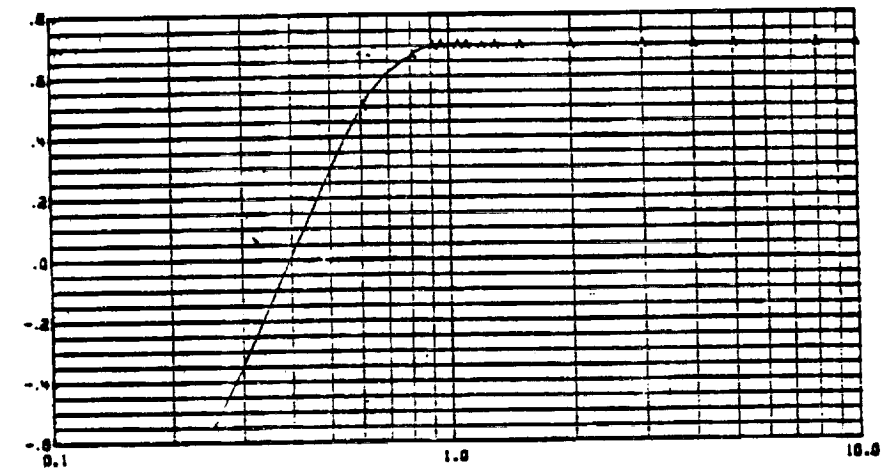
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY	XB = FS 1078.7 IN.	REFERENCE DIMENSIONS	WING AREA	SW = 2690.00 SQ.FT.
	YB = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZB = WL 375.0 IN.		M.A.C.	CW = 38.550 FT.
			BODY LENGTH	LB = 1290.3 IN.



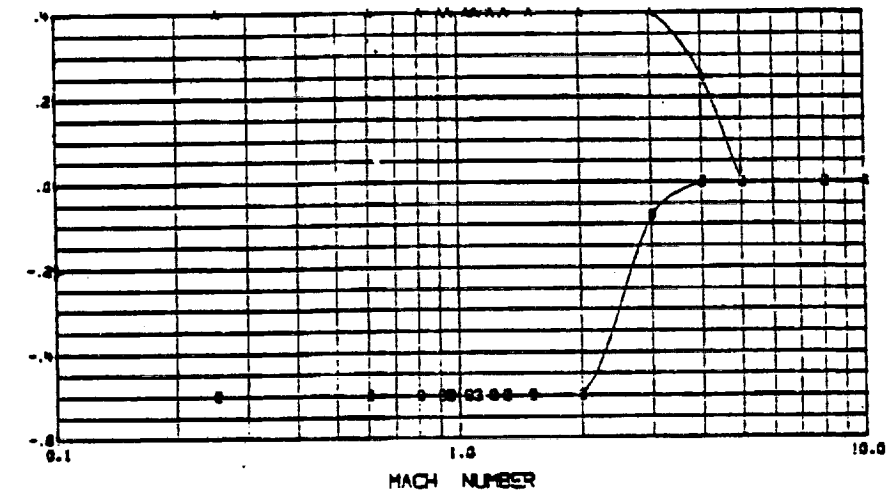
$C_{n_{\delta_a}} C_{l_{\delta_a}}$ $C_{n_{\delta_r}} C_{l_{\delta_r}}$ $C_{n_\beta} C_{l_\beta}$

	ITEM		
	1.000	2.000	3.000
	A	B	C
MACH NUMBER	CDCCDA	CDCCDR	CDCCB
0.250	-0.90000	-0.90000	0.0
0.600	0.40000	-0.90000	0.0
0.800	0.63000	-0.90000	0.0
0.900	0.68000	-0.90000	0.0
0.950	0.84000	-0.90000	0.0
1.000	0.80000	-0.90000	0.0
1.100	0.57000	-0.90000	0.0
1.200	0.50000	-0.90000	0.0
1.300	0.42000	-0.90000	0.0
1.500	0.24000	-0.90000	0.0
2.000	0.0	-0.90000	0.0
3.000	0.0	-0.90000	0.0
4.000	0.0	-0.90000	0.0
5.000	0.0	-0.90000	0.0
8.000	0.0	-0.90000	0.0
10.200	0.0	-0.90000	0.0



$C_{n_{\delta_a}} C_{m_{\delta_a}}$

	ITEM
	0.0
	A
MACH NUMBER	CLNCMDA
0.250	-0.55000
0.600	0.50000
0.800	0.67000
0.900	0.70000
0.950	0.70000
1.000	0.70000
1.100	0.70000
1.200	0.70000
1.300	0.70000
1.500	0.70000
2.000	0.70000
3.000	0.70000
4.000	0.70000
5.000	0.70000
8.000	0.70000
10.000	0.70000



$C_{n_{\delta_r}} C_{h_{\delta_r}}$ $C_{l_{\delta_r}} C_{h_{\delta_r}}$

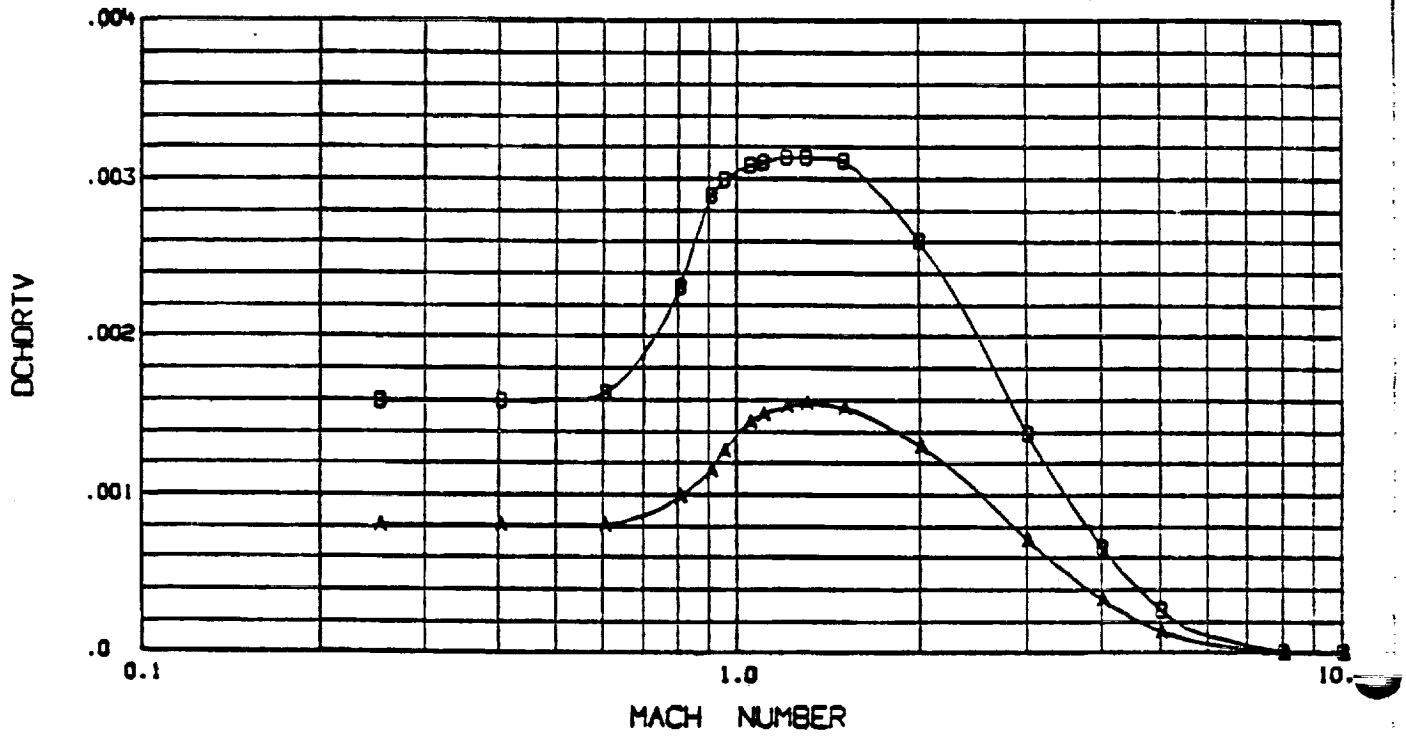
	ITEM	
	1.000	2.000
	A	B
MACH NUMBER	CLNCHDR	CLCHDR
0.250	0.40000	-0.50000
0.600	0.40000	-0.50000
0.800	0.40000	-0.50000
0.900	0.40000	-0.50000
0.950	0.40000	-0.50000
1.000	0.40000	-0.50000
1.100	0.40000	-0.50000
1.200	0.40000	-0.50000
1.300	0.40000	-0.50000
1.500	0.40000	-0.50000
2.000	0.40000	-0.50000
3.000	0.40000	-0.08000
4.000	0.25000	0.0
5.000	0.0	0.0
8.000	0.0	0.0
10.200	0.0	0.0

Figure 6.2-7
CONTROL DERIVATIVE CORRELATION COEFFICIENTS

REV 9/4/80

6.3 HINGE MOMENTS. Uncertainties to be used with the hinge moment coefficients (cf. Section 5.0) are given in the following figures:

$\Delta C_{h_{\delta_{R_{3\sigma}}}}$	Rudder hinge moment tolerance and variation due to rudder deflection.	(Figure 6.3-1)
$\Delta C_{h_{R_{\beta_{3\sigma}}}}$	Rudder hinge moment tolerance and variation due to sideslip.	(Figure 6.3-2)
$\Delta C_{h_{e_{3\sigma}}}$	Elevon hinge moment tolerance and variation .	(Figure 6.3-3)
$\Delta C_{h_{BF_{3\sigma}}}$	Body flap hinge moment tolerance and variation.	(Figure 6.3-4)
$\Delta C_{h_{SB_{3\sigma}}}$	Speedbrake hinge moment tolerance and variation.	(Figure 6.3-5)



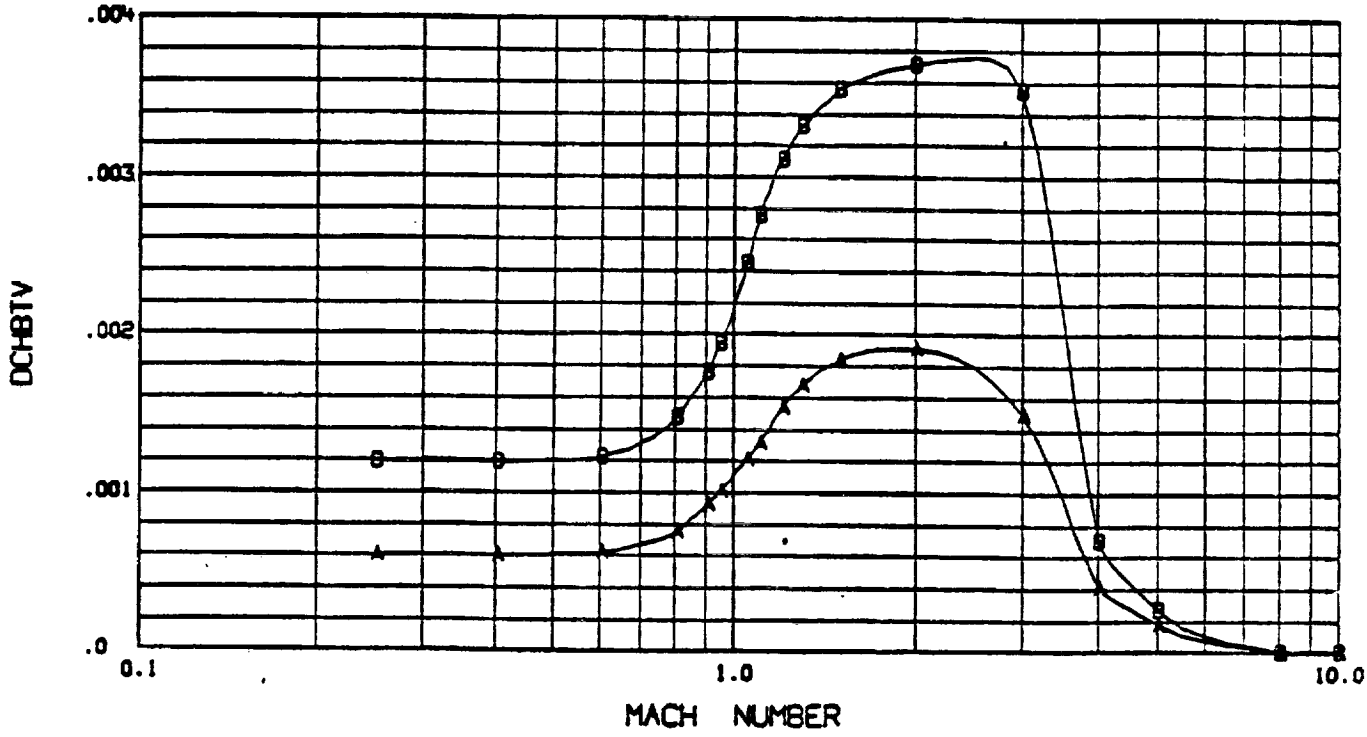
CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1078.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

$$\Delta C_{h_{\delta_{R_{LH}}}} = \Delta C_{h_{\delta_{R_{RH}}}} = \frac{\Delta C_{h_{\delta_{R_{3\sigma}}}}}{\sqrt{2}}$$

		TYPE	
		1.000 A	2.000 B
MACH	NUMBER	TOLERANCE	VARIATION
	0.250	0.00080	0.00158
	0.400	0.00080	0.00158
	0.600	0.00080	0.00163
	0.800	0.00098	0.00230
	0.900	0.00115	0.00288
	0.950	0.00127	0.00298
	1.050	0.00145	0.00308
	1.100	0.00150	0.00310
	1.200	0.00155	0.00313
	1.300	0.00157	0.00313
	1.500	0.00154	0.00311
	2.000	0.00130	0.00260
	3.000	0.00071	0.00138
	4.000	0.00033	0.00066
	5.000	0.00013	0.00026
	8.000	0.0	0.0
	10.000	0.0	0.0
	20.000	0.0	0.0

ENGINEER DCO
DATE 9-7-79

FIGURE 6.3-1
RUDDER HINGE MOMENT UNCERTAINTY



CONFIGURATION

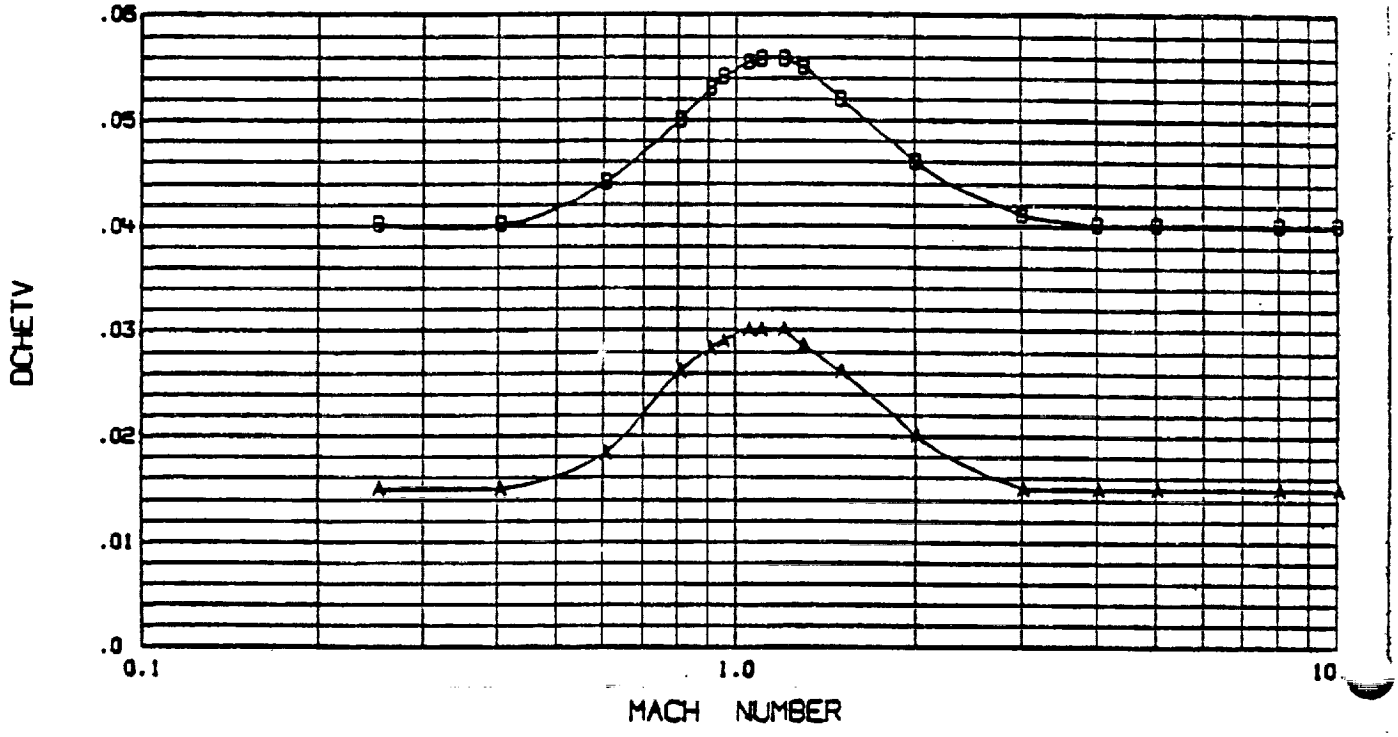
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

$$\Delta C_{h_{\beta_{PANEL}}} = \frac{\Delta C_{h_{\beta_{TOTAL}}}}{\sqrt{2}}$$

	TYPE	
	1.000 A	2.000 B
MACH NUMBER	TOLERANCE	VARIATION
0.250	0.00060	0.00119
0.400	0.00060	0.00119
0.600	0.00062	0.00122
0.800	0.00075	0.00147
0.900	0.00092	0.00176
0.950	0.00101	0.00194
1.050	0.00121	0.00245
1.100	0.00131	0.00275
1.200	0.00153	0.00311
1.300	0.00168	0.00332
1.500	0.00184	0.00355
2.000	0.00191	0.00371
3.000	0.00149	0.00354
4.000	0.00041	0.00070
5.000	0.00017	0.00026
8.000	0.0	0.0
10.000	0.0	0.0
20.000	0.0	0.0

ENGINEER Dec
TE 9-2-82

FIGURE 6.3-2
RUDDER HINGE MOMENT UNCERTAINTY



CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1078.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

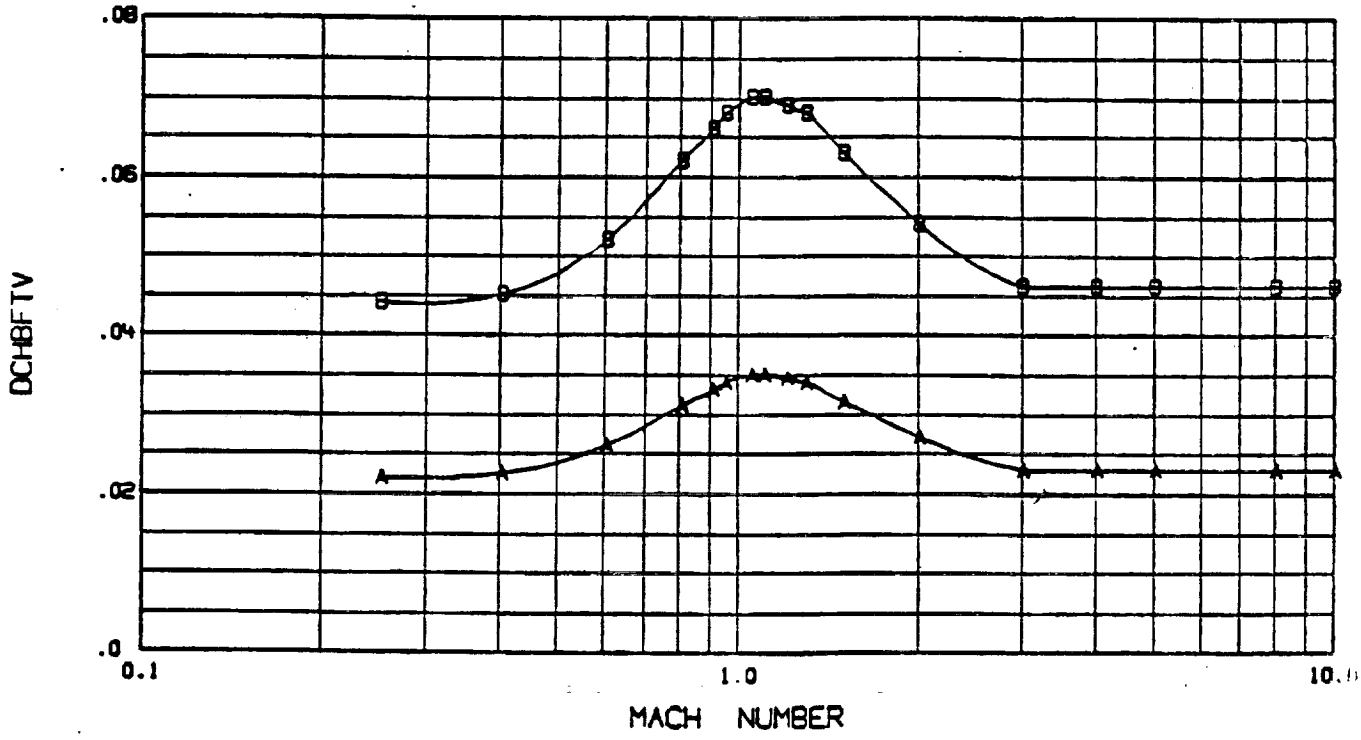
Elevon
Applicable to $C_{h_{e_{TOTAL}}}$
[INBOARD & OUTBOARD PANELS OF ONE WING]

$$\Delta C_{h_{e_{3\sigma_{inboard}}}} = \Delta C_{h_{e_{3\sigma_{outboard}}}} = \frac{\Delta C_{h_{e_{3\sigma}}}}{\sqrt{2}}$$

		TYPE	
		1.000 A	2.000 B
MACH	NUMBER	TOLERANCE	VARIATION
	0.250	0.01500	0.04000
	0.400	0.01500	0.04000
	0.600	0.01830	0.04400
	0.800	0.02500	0.05000
	0.900	0.02820	0.05300
	0.950	0.02900	0.05400
	1.050	0.03000	0.05550
	1.100	0.03000	0.05580
	1.200	0.03000	0.05580
	1.300	0.02850	0.05500
	1.500	0.02600	0.05200
	2.000	0.02000	0.04600
	3.000	0.01500	0.04100
	4.000	0.01500	0.04000
	5.000	0.01500	0.04000
	8.000	0.01500	0.04000
	10.000	0.01500	0.04000
	20.000	0.01500	0.04000

ENGINEER DCO
DATE 9-7-78

FIGURE 6.3-3
ELEVON HINGE MOMENT UNCERTAINTY

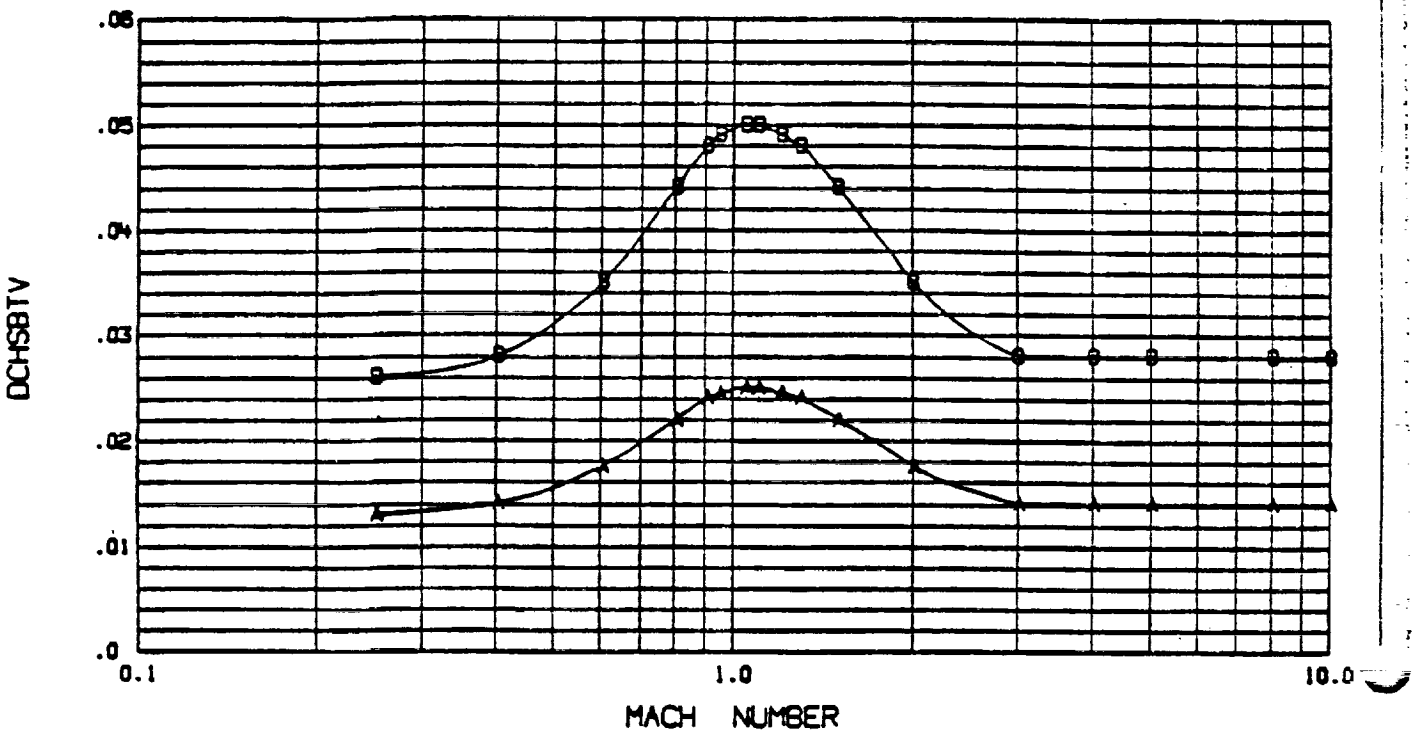


CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

		TYPE	
		1.000 A	2.000 B
MACH	NUMBER	TOLERANCE	VARIATION
	0.250	0.02200	0.04400
	0.400	0.02250	0.04500
	0.600	0.02600	0.05200
	0.800	0.03100	0.06200
	0.900	0.03300	0.06600
	0.950	0.03400	0.06800
	1.050	0.03500	0.07000
	1.100	0.03500	0.07000
	1.200	0.03450	0.06900
	1.300	0.03400	0.06800
	1.500	0.03150	0.06300
	2.000	0.02700	0.05400
	3.000	0.02300	0.04600
	4.000	0.02300	0.04600
	5.000	0.02300	0.04600
	8.000	0.02300	0.04600
	10.000	0.02300	0.04600
	20.000	0.02300	0.04600

ENGINEER [signature]
DATE 9-1-78

FIGURE 6.3-4
BODYFLAP HINGE MOMENT UNCERTAINTY



CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1078.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.0	IN.

$$\Delta C_{h_{SB_{PANEL}}} = \frac{\Delta C_{h_{SB_{TOTAL}}}}{\sqrt{2}}$$

		TYPE	
		1.000 A	2.000 B
MACH	NUMBER	TOLERANCE	VARIATION
	0.250	0.01300	0.02600
	0.400	0.01400	0.02800
	0.600	0.01750	0.03500
	0.800	0.02200	0.04400
	0.900	0.02400	0.04800
	0.950	0.02450	0.04900
	1.050	0.02500	0.05000
	1.100	0.02500	0.05000
	1.200	0.02450	0.04900
	1.300	0.02400	0.04800
	1.500	0.02200	0.04400
	2.000	0.01750	0.03500
	3.000	0.01400	0.02800
	4.000	0.01400	0.02800
	5.000	0.01400	0.02800
	8.000	0.01400	0.02800
	10.000	0.01400	0.02800
	20.000	0.01400	0.02800

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FIGURE 6.3-5
SPEEDBRAKE HINGE MOMENT UNCERTAINTY

6.4 CREW ESCAPE SYSTEM. Uncertainties to be used with the crew escape system aerodynamic characteristics (cf. Section 4.3) are presented in Table 6.4-1.

Table 6.4-1. CREW ESCAPE SYSTEM UNCERTAINTIES

PARAMETER	UNCERTAINTY (%)	PARAMETER	UNCERTAINTY (%)
$C_{N_{FREESTREAM}}$	±25	$C_{m_{FREESTREAM}}$	±25
$\Delta C_{N_{FOOT\ REST}}$	±25	$\Delta C_{m_{FOOT\ REST}}$	±25
$\Delta C_{N_{PROXIMITY}}$	±100	$\Delta C_{m_{PROXIMITY}}$	±100
$C_{A_{FREESTREAM}}$	±25	$C_{Y_{FREESTREAM}}$	±25
$\Delta C_{A_{FOOT\ REST}}$	±25	$\Delta C_{Y_{PROXIMITY}}$	±100
$\Delta C_{A_{PROXIMITY}}$	±100	$C_{n_{FREESTREAM}}$	±25
		$\Delta C_{n_{PROXIMITY}}$	±100
$C_{D_{MAN/SEAT}}$	±25	$C_{\ell_{FREESTREAM}}$	±25
$C_{D_{MAN\ SEAT\ +DROGUE}}$	±25	$\Delta C_{\ell_{PROXIMITY}}$	±100
$C_{D_{SEAT+DROGUE}}$	±25		
$C_{D_{DROGUE\ BEHIND\ SEAT}}$	±25		
$C_{D_{SEAT}}$	±25		

6.5 GROUND EFFECT UNCERTAINTIES. The uncertainties in ground effect are presented in Figure 6.5-1 and -2. Data are given as a function of height above the ground to wing span ratio (h/b) (see also Section 3.4). Uncertainties in ground effect increments are to be combined with the free air uncertainties as follows:

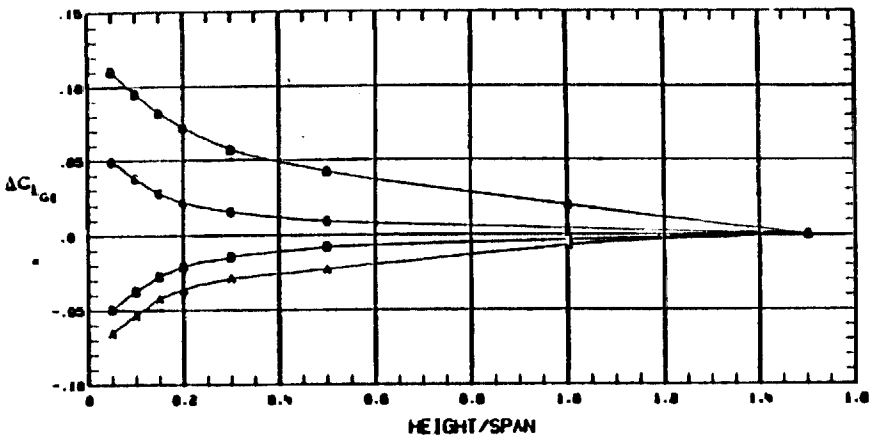
$$\pm\Delta C_{(\,)_{TOTAL}} = \left\{ [\Delta C_{(\,)}]^2_{\substack{\text{FREE AIR TOLERANCE} \\ \text{OR} \\ \text{VARIATION}}} + [\Delta C_{(\,)}]^2_{\substack{\text{GROUND EFFECT} \\ \text{TOL. OR VAR.} \\ \text{FIG 6.5-1,2}}} \right\}^{1/2}$$

Where Δ implies uncertainty and $C_{(\,)}$ represents any aerodynamic coefficient. In the longitudinal plane, $\Delta C_{m_{\delta e}}$ and $\Delta C_{L_{\delta e}}$ are to be used for sensitivity studies only about a particular δe. These values are not combined with ΔC_m. In the lateral/directional plane, $\Delta C_{n_{\delta a}}$ and $\Delta C_{\ell_{\delta a}}$ are combined (root-sum-square fashion) to obtain total uncertainty. Thus,

$$\Delta C_{n_{GE}} = \sqrt{(\Delta C_{n_{\beta_{GE}}}\beta)^2 + [(\Delta C_{n_{\delta a_{GE}}})\,\delta a]^2}$$

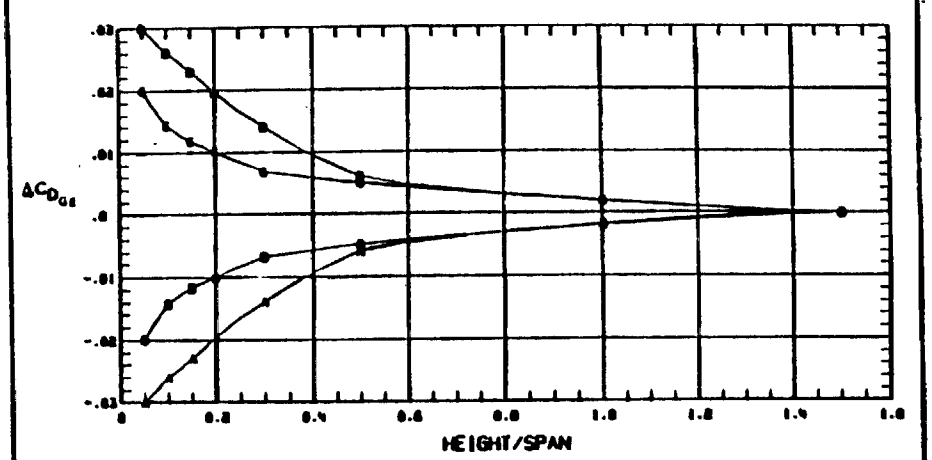
$$\Delta C_{\ell_{GE}} = \sqrt{(\Delta C_{\ell_{\beta_{GE}}}\beta)^2 + [(\Delta C_{\ell_{\delta a_{GE}}})\,\delta a]^2}$$

SYMBOL	UNCERTAINTY INCREMENT	FIGURE
$\Delta C_{L_{GE}}$	Lift Coefficient	6.5-1
$\Delta C_{D_{GE}}$	Drag Coefficient	6.5-2
$\Delta C_{m_{GE}}$	Pitching Moment Coefficient	6.5-3
$\Delta C_{Y_{\beta_{GE}}}$	Side Force Derivative	6.5-4
$\Delta C_{n_{\beta_{GE}}}$	Yawing Moment Derivative	6.5-5
$\Delta C_{\ell_{\beta_{GE}}}$	Rolling Moment Derivative	6.5-6
$\Delta C_{L_{\delta e_{GE}}}$	Elevon Lift Effectiveness	6.5-7
$\Delta C_{m_{\delta e_{GE}}}$	Elevon Pitching Moment Effectiveness	6.5-8
$\Delta C_{n_{\delta a_{GE}}}$	Aileron Yaw Effectiveness	6.5-9
$\Delta C_{\ell_{\delta a_{GE}}}$	Aileron Roll Effectiveness	6.5-10
$\Delta C_{L_{\delta_{BF}}}$	Body Flap Lift Effectiveness	Negligible
$\Delta C_{m_{\delta_{BF}}}$	Body Flap Pitching Moment Effectiveness	Negligible



h/b	Variation A	Tolerance B	Tolerance C	Variation D
	UNCERTAINTIES ON LIFT COEFFICIENT			
0.050	-0.06500	-0.04930	0.04930	0.11620
0.100	-0.05360	-0.03770	0.03770	0.09190
0.150	-0.04230	-0.02770	0.02770	0.06200
0.200	-0.03650	-0.02120	0.02120	0.07200
0.300	-0.02920	-0.01500	0.01500	0.05700
0.500	-0.02310	-0.00865	0.00865	0.04200
1.000	-0.00770	-0.00305	0.00305	0.01920
1.500	0.0	0.0	0.0	0.0

Figure 6.5-1
GROUND EFFECT UNCERTAINTY



h/b	Variation A	Tolerance B	Tolerance C	Variation D
	UNCERTAINTIES ON DRAG COEFFICIENT			
0.050	-0.03000	-0.02000	0.02000	0.03000
0.100	-0.02605	-0.01440	0.01440	0.02605
0.150	-0.02300	-0.01170	0.01170	0.02300
0.200	-0.01850	-0.01000	0.01000	0.01850
0.300	-0.01300	-0.00680	0.00680	0.01300
0.500	-0.00600	-0.00400	0.00400	0.00600
1.000	-0.00192	-0.00102	0.00102	0.00192
1.500	0.0	0.0	0.0	0.0

Figure 6.5-2
GROUND EFFECT UNCERTAINTY

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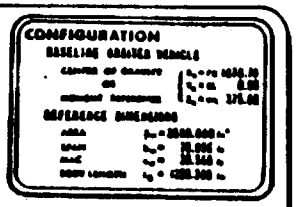
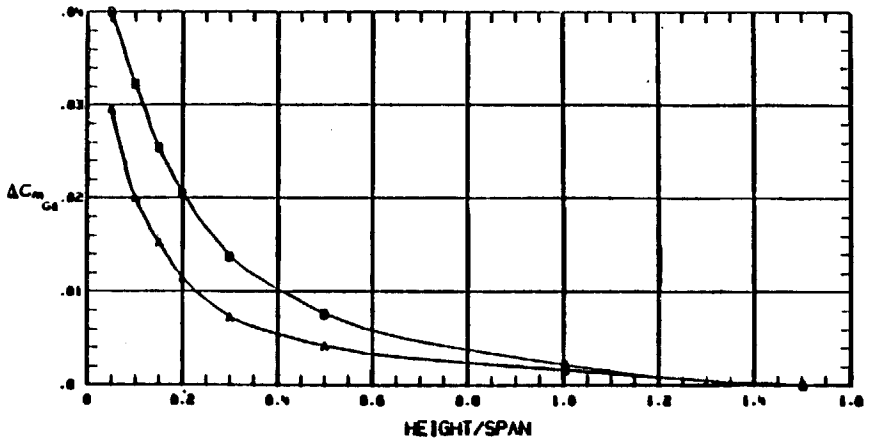
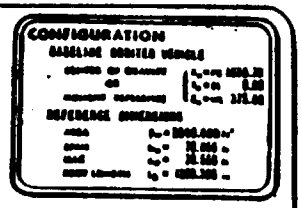
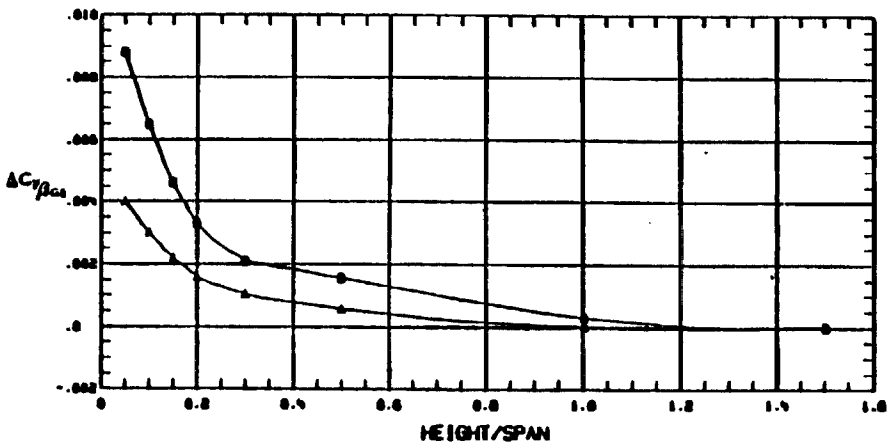




HEIGHT/SPAN h/b	Tolerance A	Variation B	Variation C	Tolerance D
	UNCERTAINTIES ON PITCH MOM COEF			
0.050	0.02950	0.04000		
0.100	0.02000	0.03230		
0.150	0.01520	0.02540		
0.200	0.01150	0.02060		
0.300	0.00731	0.01300		
0.500	0.00415	0.00760		
1.000	0.00154	0.00215		
1.500	0.0	0.0		

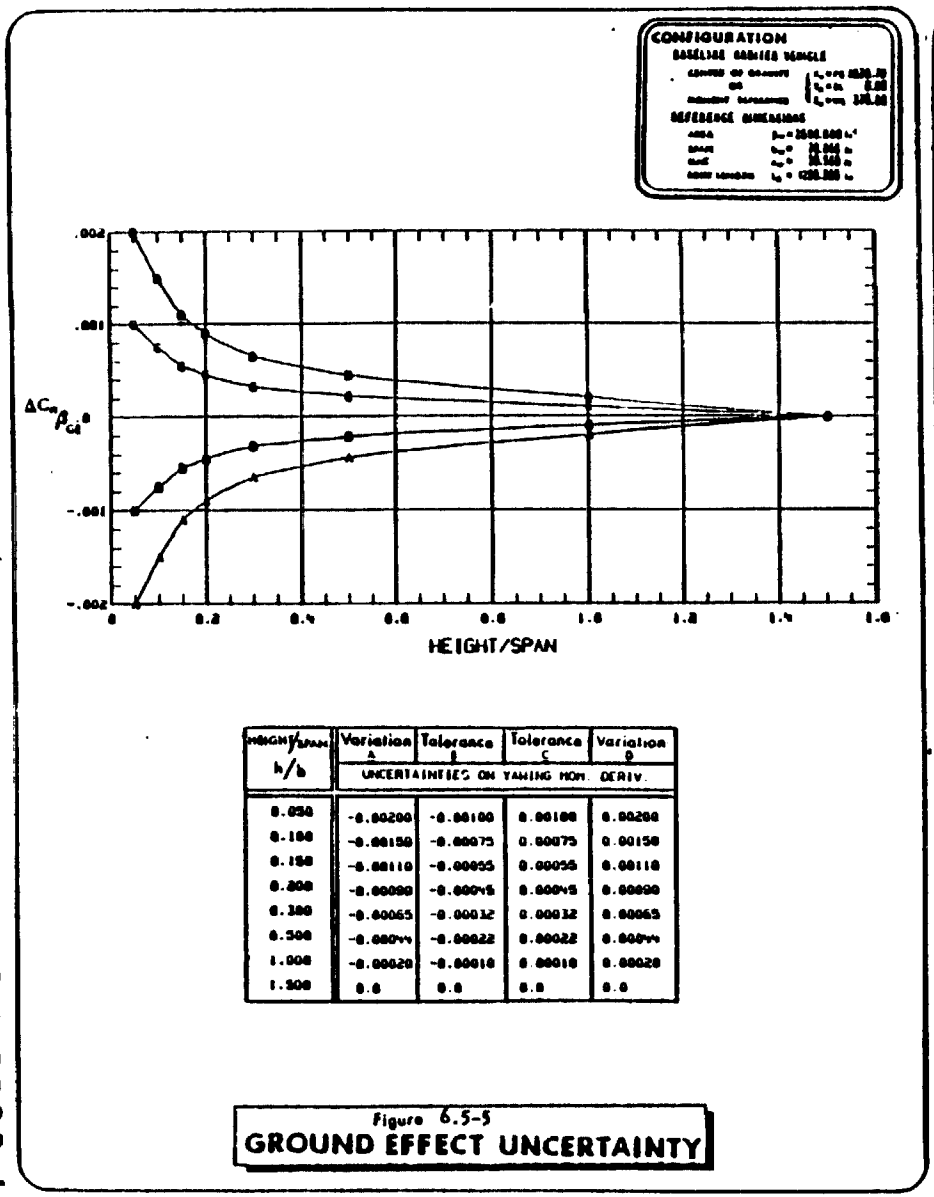
Figure 6.5-3
GROUND EFFECT UNCERTAINTY





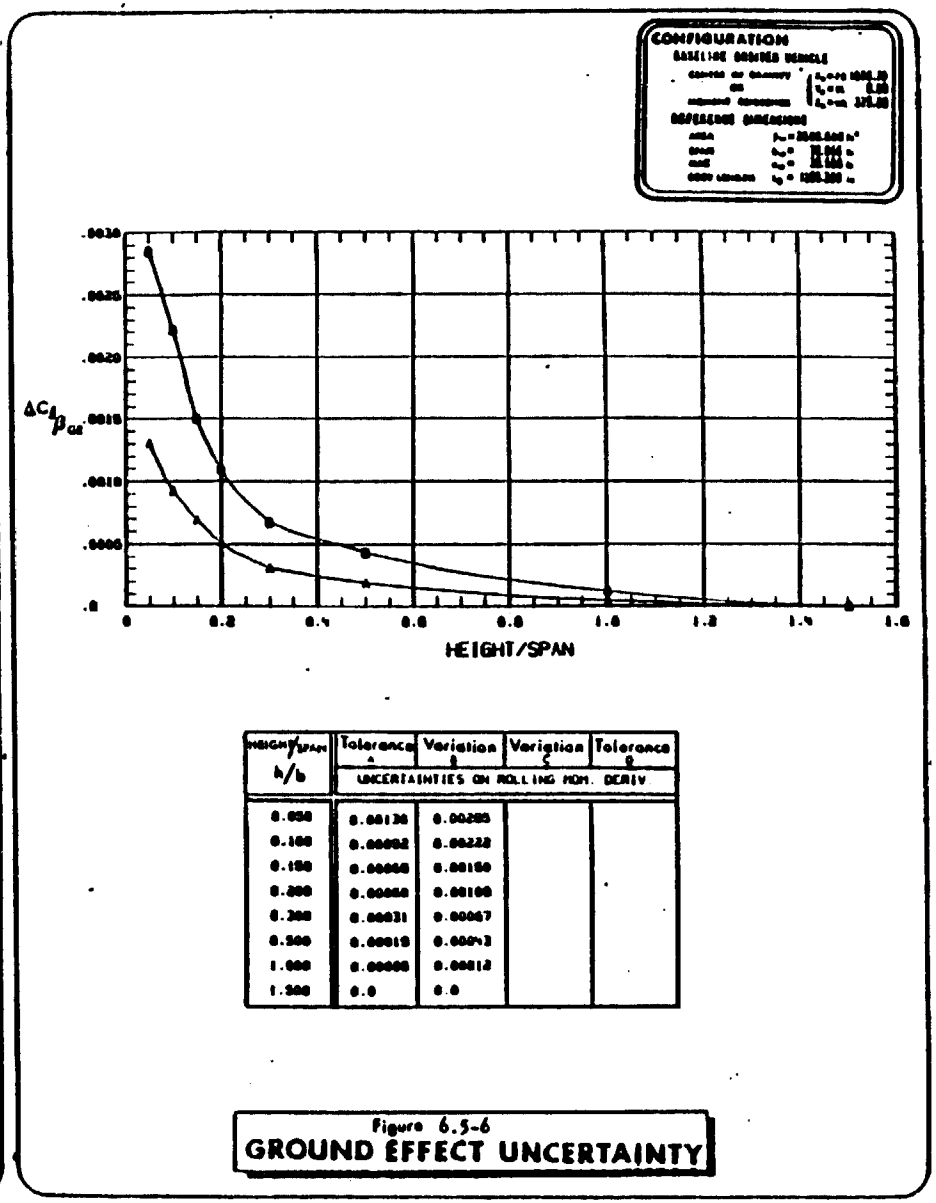
HEIGHT/SPAN h/b	Tolerance A	Variation B	Variation C	Tolerance D
	UNCERTAINTIES ON SIDE FORCE DERIV			
0.050	0.00165	0.00080		
0.100	0.00300	0.00060		
0.150	0.00220	0.00040		
0.200	0.00150	0.00330		
0.300	0.00102	0.00210		
0.500	0.00056	0.00154		
1.000	0.0	0.00020		
1.500	0.0	0.0		

Figure 6.5-4
GROUND EFFECT UNCERTAINTY



h/b	Variation A	Tolerance B	Tolerance C	Variation D
	UNCERTAINTIES ON YAWING MOM. DERIV.			
0.050	-0.00200	-0.00100	0.00100	0.00200
0.100	-0.00150	-0.00075	0.00075	0.00150
0.150	-0.00110	-0.00055	0.00055	0.00110
0.200	-0.00090	-0.00045	0.00045	0.00090
0.300	-0.00065	-0.00032	0.00032	0.00065
0.500	-0.00044	-0.00022	0.00022	0.00044
1.000	-0.00020	-0.00010	0.00010	0.00020
1.500	0.0	0.0	0.0	0.0

Figure 6.5-5
GROUND EFFECT UNCERTAINTY



h/b	Tolerance A	Variation B	Variation C	Tolerance D
	UNCERTAINTIES ON ROLLING MOM. DERIV			
0.050	0.00135	0.00285		
0.100	0.00092	0.00222		
0.150	0.00068	0.00150		
0.200	0.00058	0.00100		
0.300	0.00031	0.00067		
0.500	0.00019	0.00043		
1.000	0.00008	0.00012		
1.500	0.0	0.0		

Figure 6.5-6
GROUND EFFECT UNCERTAINTY

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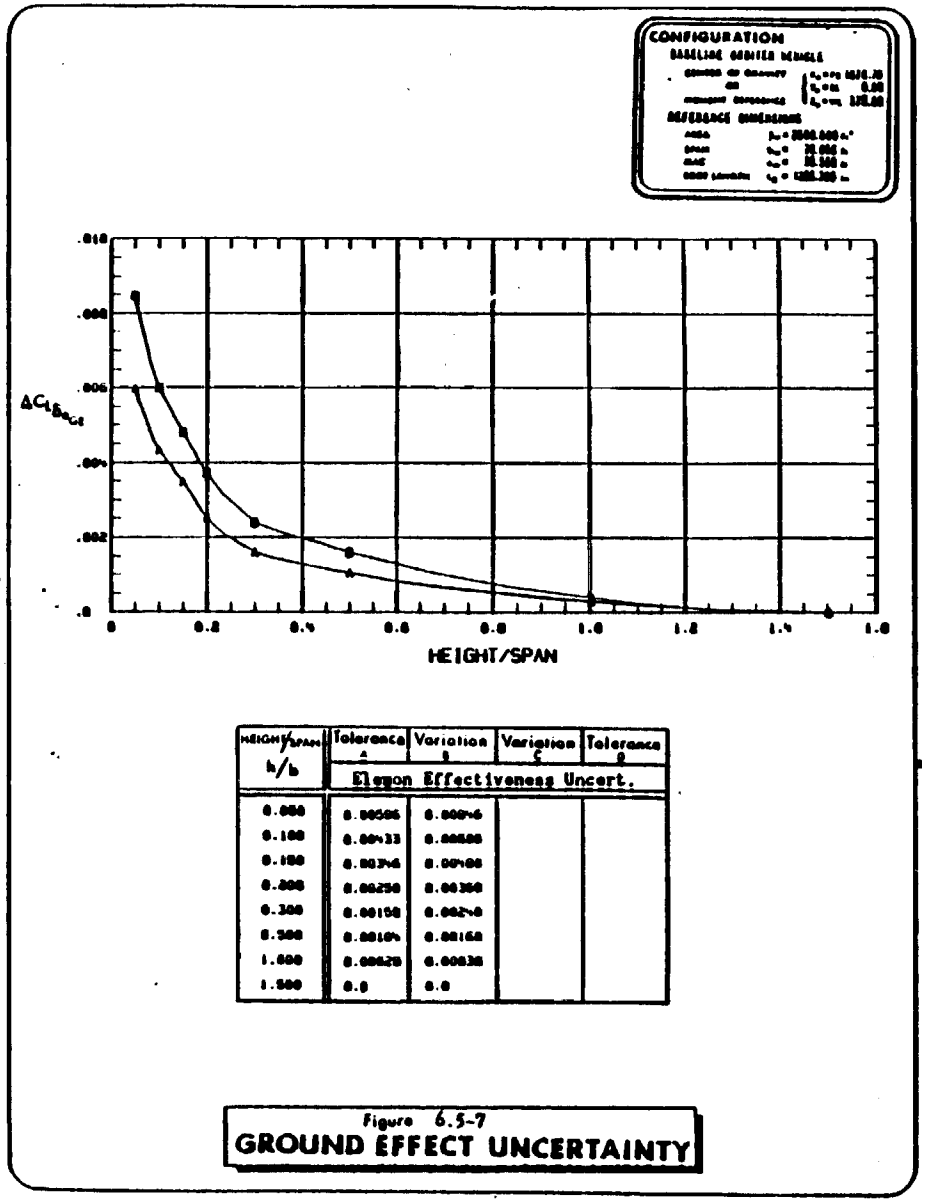

h/b	Tolerance A	Variation B	Variation C	Tolerance D
	Elevon Effectiveness Uncert.			
0.050	0.00215	0.00387		
0.100	0.00152	0.00282		
0.150	0.00100	0.00192		
0.200	0.00081	0.00138		
0.300	0.00040	0.00084		
0.500	0.00018	0.00047		
1.000	0.00008	0.00015		
1.500	0.0	0.0		

Figure 6.5-8
GROUND EFFECT UNCERTAINTY

h/b	Tolerance A	Variation B	Variation C	Tolerance D
	Elegon Effectiveness Uncert.			
0.050	0.00505	0.00946		
0.100	0.00433	0.00808		
0.150	0.00346	0.00648		
0.200	0.00250	0.00360		
0.300	0.00150	0.00240		
0.500	0.00104	0.00168		
1.000	0.00028	0.00038		
1.500	0.0	0.0		

Figure 6.5-7
GROUND EFFECT UNCERTAINTY

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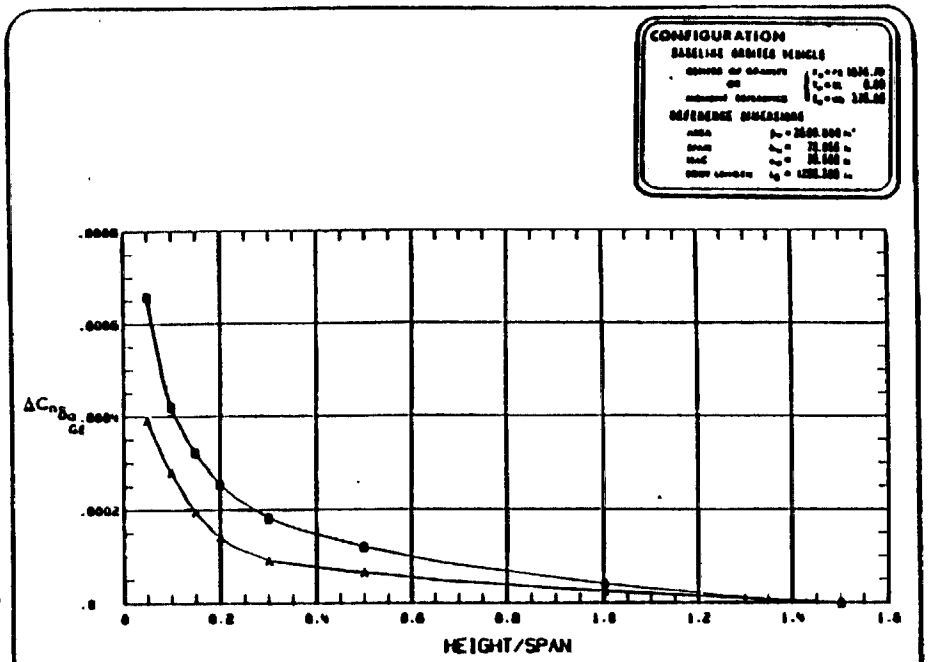
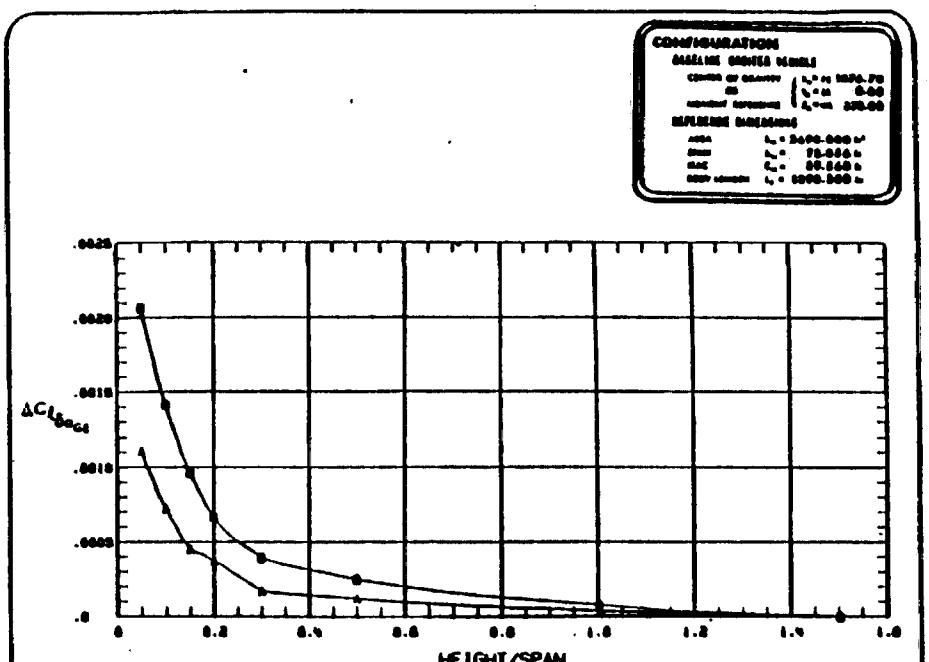


HEIGHT/SPAN h/b	Tolerance A	Variation B	Variation C	Tolerance D
	Aileron Effectiveness Uncert.			
0.050	0.00030	0.00055		
0.100	0.00028	0.00042		
0.150	0.00020	0.00032		
0.200	0.00014	0.00026		
0.300	0.00008	0.00018		
0.500	0.00007	0.00012		
1.000	0.00003	0.00004		
1.500	0.0	0.0		

Figure 6.5-9
GROUND EFFECT UNCERTAINTY



HEIGHT/SPAN h/b	Tolerance A	Variation B	Variation C	Tolerance D
	Aileron Effectiveness Uncert.			
0.050	0.00110	0.00206		
0.100	0.00070	0.00141		
0.150	0.00045	0.00085		
0.200	0.00037	0.00066		
0.300	0.00017	0.00038		
0.500	0.00012	0.00025		
1.000	0.00004	0.00008		
1.500	0.0	0.0		

Figure 6.5-10
GROUND EFFECT UNCERTAINTY

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6.6 RCS UNCERTAINTIES. Uncertainties associated with the aft RCS jet effects are presented as data variations in Tables 6.6-1 and 6.6-2 for each individual control mode. The interaction variations in Table 6.6-1 are based on a ±2σ band of virtually all Shuttle RCS aero interaction test data and include effects due to freestream Mach number, RT scaling (gas constant times temperature), Reynolds number, and RCS nozzle geometry. The all-inclusive nature of the interaction uncertainty justifies designating the values presented in Table 6.6-1 as ±3σ variations. These ±3σ variations are applicable to the least-square polynomial curve-fits of the incremental RCS jet interaction data. The tolerance and variation format, typically found in other sections of this document, does not pertain to RCS uncertainties.

Jet interaction force and moment coefficient variations are limited to $\bar{q} \leq 30$ psf for the upfiring and downfiring jets. Side firing jet coefficient variations are constant for $\bar{q} \leq 30$ psf [mass flow rate ratio ($\bar{q} = 30$ psf), $\dot{m}_j/\dot{m}_\infty \cong 0.00666$] and a linear function of mass flow rate (using the values presented in Table 6.6-1) between $\dot{m}_j/\dot{m}_\infty = 0.00666$ and $\dot{m}_j/\dot{m}_\infty = 0.00001$. The RCS interaction variations are set to zero for $\dot{m}_j/\dot{m}_\infty < 0.00001$.

RCS jet plume impingement variations are provided for each applicable control model in Table 6.6-2.

RCS jet impingement and interaction variation for the various control modes are combined in accordance with the following ground rules:

STEP 1 - Combine Interaction Variations in the Following Manner:

TYPE OF FIRING	LONGITUDINAL	LATERAL/DIRECTIONAL
Symmetric	RSS variations	Variation is zero (i.e., terms cancel)
Unsymmetric	RSS variations	RSS variations
Combination of symmetric & unsymmetric	1) RSS variations of symmetric portions 2) RSS results from (1) with remaining variations	1) Use variations of symmetric portion only once 2) RSS result from (1) with remaining variations

STEP 2 - RSS Applicable Impingement Variations

STEP 3 - Combine Interactions & Impingement Variations Steps (1) & (2) by RSS

The equations required to calculate variations for the RCS data are presented in Appendix D. These variations should be used for design studies related to OFT-1.

The values presented in Tables 6.6-1 and 6.6-2 are based on full power-on, steady state thrust levels for the RCS engines. During periods of thrust build-up and decay, the combined interaction and impingement variation (Step 3) will be reduced by the ratio of actual-to-full power-on RCS thruster chamber pessure (c.f. Appendix B).

TABLE 6.6.-1
RCS JET PLUME INTERACTION VARIATIONS
(Note: Variations shown as ± Values)

DOWNFIRING JETS ($\bar{q}_\infty \leq 30$ PSF)

COEFFICIENT	ANGLE OF ATTACK, α ~ Deg.				
	17.5	22.5	27.5	32.5	38.75
$\Delta C_{A_{VAR}}$	.0062	.0050	.0043	.0053	.0048
$\Delta C_{N_{VAR}}$	.0150	.0210	.0290	.0375	.0425
$\Delta C_{m_{VAR}}$	.0052	.0047	.0038	.0041	.0043
$\Delta C_{Y_{VAR}}$	.0046	.0047	.0048	.0048	.0046
$\Delta C_{n_{VAR}}$	.0018	.0021	.0024	.0024	.0026
$\Delta C_{\ell_{VAR}}$	.0015	.0015	.0015	.0013	.0012

SIDEFIRING JETS ($\dot{m}j/\dot{m}_\infty \geq 0.00666$ ~ $\bar{q}_\infty \leq 30$ PSF)

COEFFICIENT	ANGLE OF ATTACK, α ~ Deg.						
	7.5	12.5	17.5	22.5	27.5	32.5	38.75
$\Delta C_{A_{VAR}}$	.0043	.0040	.0040	.0035	.0031	.0042	.0040
$\Delta C_{N_{VAR}}$	.0122	.0121	.0151	.0210	.0300	.0430	.0440
$\Delta C_{m_{VAR}}$	.0042	.0053	.0064	.0046	.0046	.0054	.0045
$\Delta C_{Y_{VAR}}$	.0053	.0052	.0037	.0035	.0038	.0038	.0042
$\Delta C_{n_{VAR}}$	.0017	.0020	.0011	.0006	.0006	.0007	.0007
$\Delta C_{\ell_{VAR}}$	.0017	.0025	.0030	.0030	.0028	.0030	.0031

SIDEFIRING JETS ($\dot{m}/\dot{m}_\infty = 0.00001$ ~ $\bar{q} > 30$ PSF)

COEFFICIENT	ANGLE OF ATTACK, α ~ Deg.						
	7.5	12.5	17.5	22.5	27.5	32.5	38.75
$\Delta C_{A_{VAR}}$	.0022	.0022	.0022	.0022	.0022	.0022	.0022
$\Delta C_{N_{VAR}}$	.0070	.0070	.0070	.0070	.0070	.0100	.0100
$\Delta C_{m_{VAR}}$	.0042	.0052	.0030	.0014	.0014	.0014	.0014
$\Delta C_{Y_{VAR}}$	.0020	.0020	.0020	.0020	.0026	.0031	.0036
$\Delta C_{n_{VAR}}$	.0003	.0003	.0003	.0004	.0005	.0005	.0005
$\Delta C_{\ell_{VAR}}$	.0002	.0002	.0002	.0004	.0004	.0003	.0004

UPFIRING JETS ($\bar{q}_\infty \leq 30$ PSF)

COEFFICIENT	ANGLE OF ATTACK, α ~ Deg.				
	17.5	22.5	27.5	32.5	38.75
$\Delta C_{A_{VAR}}$	.0043	.0036	.0033	.0040	.0048
$\Delta C_{N_{VAR}}$	.0140	.0190	.0255	.0325	.0370
$\Delta C_{m_{VAR}}$	.0028	.0047	.0017	.0028	.0031
$\Delta C_{Y_{VAR}}$	.0049	.0050	.0050	.0054	.0079
$\Delta C_{n_{VAR}}$	.0020	.0020	.0021	.0018	.0018
$\Delta C_{\ell_{VAR}}$	.0013	.0014	.0014	.0011	.0011

TABLE 6.6-2

RCS JET PLUME IMPINGEMENT VARIATIONS

(NOTE: Variations Independent of Angle of Attack)

JET MODE	A_{Surf} Imp	N_{Surf} Imp	Y_{Surf} Imp	M_{Surf} Imp	$\mathscr{N}_{Surf}$ Imp	$\mathscr{L}_{Surf}$ Imp
Downfiring	[2] 0.47	0.23	0.44	0.26	0.82	0.31
Sidefiring	[1] N/D	N/D	N/D	N/D	N/D	N/D
Upfiring	N/D	N/D	0.5	N/D	0.5	0.25

[1] Not defined.

[2] Values represent fractions of calculated impingement effect - data supplied by NASA/JSC

6.7 ASYMMETRIC UNCERTAINTIES. Uncertainties in rolling and yawing moments at zero sideslip are considered to be the result of:

1) vehicle deformations as obtained from manufacturing misalignments and non-symmetric heating during orbital flight,
2) aerodynamic asymmetries for a perfect aligned vehicle

The uncertainties are assumed to be independent of Mach number and angle of attack and are applicable to rolling and yawing moments only. Opposite signs are to be used for C_{ℓ_o} and C_{n_o}. These uncertainties are to be utilized in the following manner:

	Values	Conditions
Application No. 1:	* $C_{\ell_o} = \pm.0005$ * $C_{n_o} = \pm.0005$	* Combine with other uncertainties
Application No. 2:	* $C_{\ell_o} = \pm.001$ * $C_{n_o} = \pm.001$	* Combine with nominal C_{n_β} and C_{ℓ_β}. * DO NOT use with β derivative uncertainties.

7.0 REFERENCES

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1-3 SD73-SH-0178, "Ascent Performance Data Book," Rockwell International, Space Division, Downey, California (May 1976)

1-4 SD73-SH-0185, "Entry Performance Data Book," Rockwell International, Space Division, Downey, California (May 1976)

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1-6 SD76-SH-0133, "Space Shuttle Abort Baseline and Criteria Document," Rockwell International, Space Division, Downey, California (July 1976)

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2-2 MCR 200 (Rev. 5), "Space Division Master Change Record No. 200," (Rockwell International, Space Division, Downey, California (January 22, 1974)

Section 3.0 CONFIGURATION DESCRIPTION

3-1 MJ070-0001-1B, "Orbiter Vehicle End Item Specification," Rockwell International, Space Division, Downey, California (January 1976)

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APPENDIX

A. AEROELASTICITY. Appendix A is presented in four subsections:

A.1 THEORETICAL

A.2 ELEVON TORSIONAL STIFFNESS

A.3 COMPARISON OF RIGID AND FLEXIBLE AERO

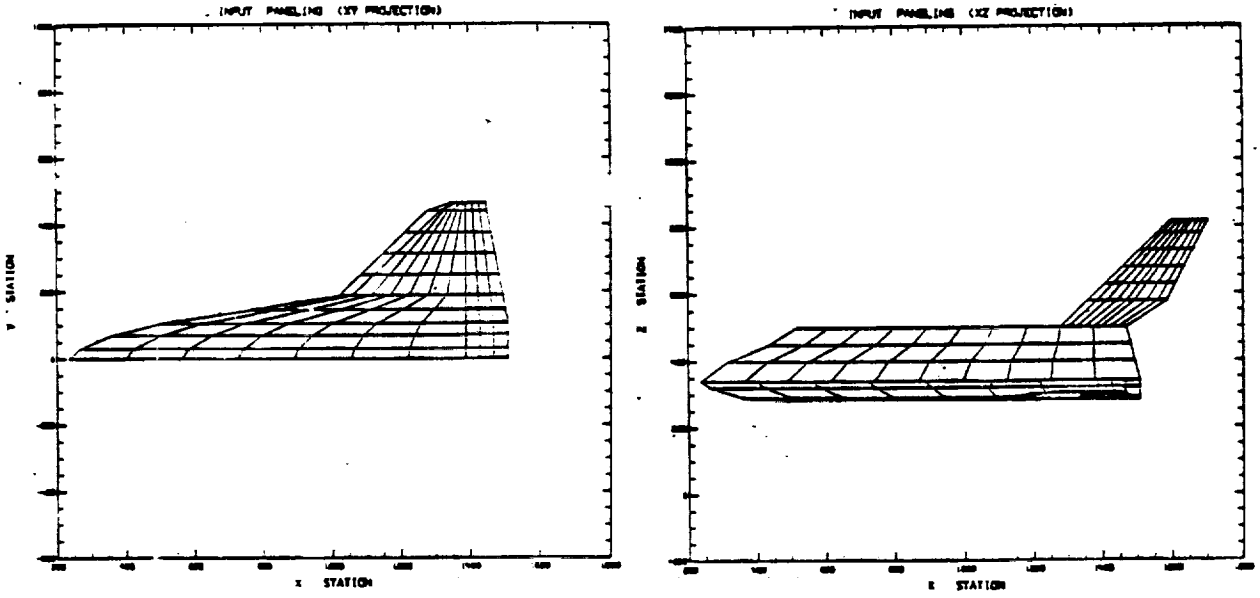
A.4 CONTINGENCY ABORT AEROELASTICITY

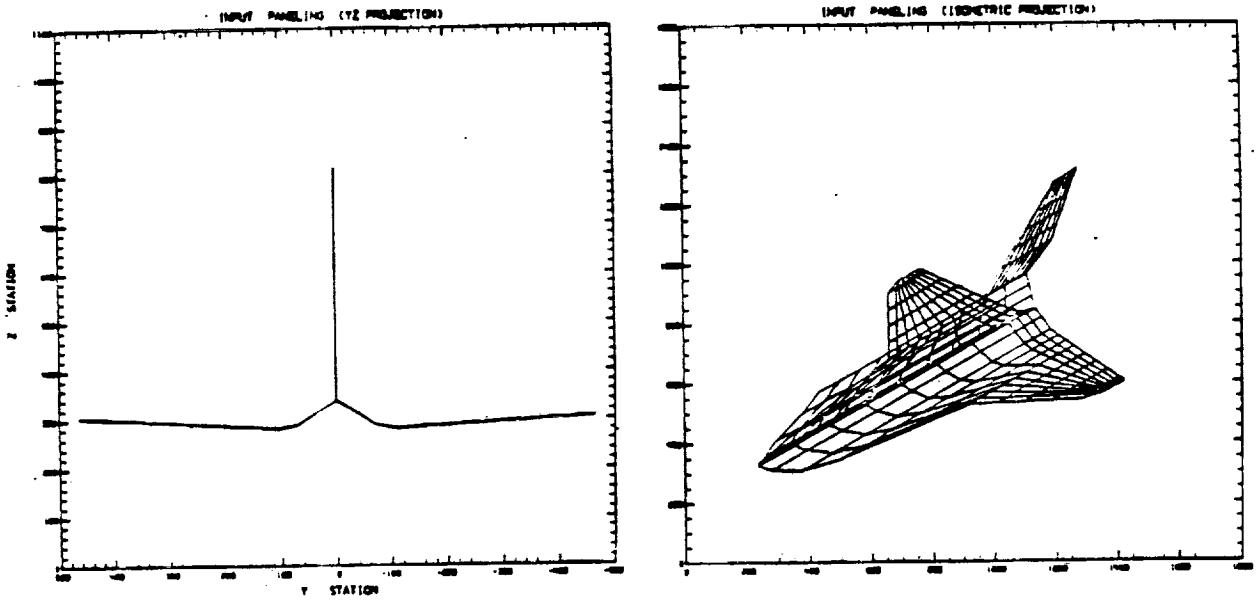
APPENDIX

A. THEORETICAL. The stability and control characteristics of flight vehicles can be greatly influenced by the elastic deformation of the structure under aerodynamic loads. Structures of flight vehicles which are designed to be as light as possible are inevitably very flexible and the Orbiter Vehicle is no exception. In general, the aeroelastic phenomena can be subdivided into static and dynamic cases. Static cases are those in which steady state distortions are associated with steady loads and are the cases considered in this report. Dynamic cases include buffeting and flutter.

Many of the most important effects of elastic distortion can be accounted for by altering the aerodynamic derivatives. The deformation analysis is almost invariably treated by linear or quasi-static theory which assumes that the distortional motions are small and that all aerodynamic forces are linear functions. Thus a change in load produces a proportional change in the shape of the vehicle, which in turn influences the load. These may be considered as feedback effects on the aerodynamic forces of changes in the shape of the airframe caused by the aerodynamic forces. In order to understand and analyze all the effects, the equations governing elastic deformations and the changes that such deformations produce are required.

Estimation of the Orbiter Vehicle static aeroelastic effects was accomplished by linear aerodynamic and elastic theory. The external geometry of the vehicle was idealized as a grid composed of thin panels which approximates the projected side and plan views of the Orbiter as illustrated below.





The aerodynamic pressure coefficient (c_{p_i}) on each panel (i) is expressed as a linear function of the local angle of incidence of each individual panel (j),

$$c_{p_i} = a_{i1}\,\alpha_1 + a_{i2}\,\alpha_2 \cdots a_{ij}\,\alpha_j \cdots (j = 1, n)$$

and the net force on each panel is expressed as

$$\ell_i = \bar{q}\, S_i\, c_{p_i}.$$

Similar equations are written for each panel with the resulting system of equations expressed in matrix form

$$\{c_p\} = [A]\{\alpha\}$$

and

$$\{\ell\} = \bar{q}[S]\{c_p\} = \bar{q}[S][A]\{\alpha\}$$

The structure of the vehicle is idealized as a grid work of structural elements which approximate the strength and stiffness of the Orbiter Vehicle. The change in local angle of incidence (θ_i) of each panel is expressed as a linear function of the load on each individual panel,

$$\theta_i = s_{i1}\,\ell_1 + s_{i2}\,\ell_2 \cdots s_{ij}\,\ell_j \cdots (j = 1, n)$$

and the matrix form for the entire system becomes

$$\{\theta\} = [s]\{\ell\} .$$

Combining the relationships describing the change of aerodynamic loading with local angle of incidence and the change of local angle of incidence with loading, an analytical expression relating the resultant flexible load to the initial geometry can be derived such that

$$\{\ell^f\} = \bar{q}\,[S]\{c_p^f\}$$

where,

$$\{c_p^f\} = \left[[A]^{-1} - \bar{q}\,[s]\,[S]\right]^{-1}\{\alpha^R\}$$

Since the analysis is linear, the flexibility effect due to various types of loading (i.e., basic, angle of attack or sideslip, control surface deflection, or vehicle rotation) can be combined to obtain the total aeroelastic effect. The different loadings are, therefore, analyzed separately.

To obtain the effects of flexibility due to the basic loading ($\alpha = 0°$), the rigid local angles of incidence which describe the vehicle camber and twist are input as $\{\alpha^R\}$. The effects due to angle of attack or angle of sideslip loading are obtained by setting the appropriate local angles to unit incidence, $\{\alpha^R\} = \{1\}$. Flexibility effects on control surface effectiveness are calculated by using an $\{\alpha^R\}$ representing the desired control surface deflection. The effects of flexibility on rotary derivatives are determined by setting $\{\alpha^R\}$ equal to the local angle of incidence induced by the rotating velocity of the vehicle. For example, a given pitch rate, Q, and vehicle velocity, V, induce the following angle of attack distribution:

$$\{\alpha^R\}_Q = \frac{Q}{V}\{X - X_{CG}\}$$

or for a unit nondimensional pitch rate; i.e., $\hat{Q} = \frac{Q\bar{c}}{2V} = 1$

$$\{\alpha^R\}_{\hat{Q}=1} = \frac{2}{\bar{c}}\{X - X_{CG}\}$$

Pitch, yaw, and roll moments are calculated by summing the product of aerodynamic load times the appropriate moment arm. For example, pitching moment is determined as follows:

$$P.M.^R = -[X - X_{CG}]\{LOAD^R\}$$

$$P.M.^f = -[X - X_{CG}]\{LOAD^f\}$$

The longitudinal wing-body characteristics have been assumed independent of the vertical tail characteristics. Half of the wing-body is panelled and the aerodynamic and structural influence coefficients for the longitudinal analysis are determined using symmetric boundary conditions. For lateral-directional characteristics, the side body and vertical tail are panelled in addition to half of the wing-body and the aerodynamic and structural influence coefficients are determined using asymmetric boundary conditions on the side body and vertical tail and antisymmetric boundary conditions on the half wing-body.

LONGITUDINAL CHARACTERISTICS

BASED ON PANELLING RIGHT-HALF OF WING-BODY [A], [s] BASED ON SYMMETRIC BOUNDARY CONDITIONS

$$\{L^f\} = \bar{q}\left[S_{LONG}\right]\left[[A]^{-1} - \bar{q}[s]\left[S_{\diagdown}\right]\right]^{-1}\{\alpha^R\}$$

$$C_L^f = \frac{1}{qS}\,[1]\{L^f\}$$

$$C_m^f = \frac{-1}{qS\bar{c}}\,[X - X_{CG}]\{L^f\}$$

BASIC CONFIGURATION EFFECTS

$\{\alpha\}_o$ = LOCAL TWIST AND CAMBER

DATA OBTAINED:

$$\Delta C_{N_o},\ \Delta C_{m_o},\ \Delta C_{h_{e_{I_{0,0}}}},\ \Delta C_{h_{e_{O_{0,0}}}},\ \Delta C_{h_{SF_{0,0}}}$$

ANGLE OF ATTACK EFFECTS

$\{\alpha^R\} = \{1\}$ i.e., ALL PANELS AT UNIT ANGLE OF ATTACK INCIDENCE

DATA OBTAINED:

$$\eta_{N_\alpha},\ \eta_{l_\alpha},\ \eta_{M_\alpha},\ (a.c.)_\alpha,\ \eta_{HM_{e_{I_\alpha}}},\ \eta_{HM_{e_{O_\alpha}}},\ \eta_{HM_{SF_\alpha}}$$

CONTROL SURFACE EFFECTS

$$\{\alpha^R\}_{\delta_e,\delta_{SF}} = \begin{Bmatrix} 0 \\ 0 \\ 1 \end{Bmatrix}$$ i.e., CONTROL SURFACE PANELS AT UNIT INCIDENCE

DATA OBTAINED:

$$\eta_{L_\alpha}, \eta_{L_{SF}}, \eta_{M_\alpha}, \eta_{M_{SF}}, \eta_{HM_{\alpha_{I_{\delta_e}}}}, \eta_{HM_{\alpha_{O_{\delta_e}}}}, \eta_{HM_{SF_{\delta_{SF}}}}$$

PITCH RATE EFFECTS

$$\{\alpha^R\}_{\hat{Q}} = \frac{2}{\bar{c}}\{X - X_{CG}\}$$

i.e., INDUCED ANGLE OF ATTACK DUE TO UNIT NONDIMENSIONAL PITCH RATE, $\hat{Q} = \frac{Q\bar{c}}{2V} = 1$

DATA OBTAINED:

$$\eta_{M_Q}$$

LATERAL-DIRECTIONAL CHARACTERISTICS

BASED ON PANELLING RIGHT-HALF OF WING-BODY PLUS SIDE BODY AND VERTICAL TAIL. [A], [s] BASED ON ASYMMETRIC AND ANTISYMMETRIC BOUNDARY CONDITIONS.

$$\{L^r\} = \bar{q}\left[S_{LONG}\right]\left[[A]^{-1} - \bar{q}[s]\left[S\right]\right]^{-1}\{\alpha^R\}$$

$$\{SF^r\} = \bar{q}\left[S_{LAT-DIR}\right]\left[[A]^{-1} - \bar{q}[s]\left[S\right]\right]^{-1}\{\alpha^R\}$$

$$C_Y^r = \frac{1}{\bar{q}S}\lfloor 1 \rfloor \{SF^r\}$$

$$C_n^r = -\frac{1}{\bar{q}Sb}\lfloor X - X_{CG} \rfloor \{SF^r\}$$

$$C_\ell^r = -\frac{1}{\bar{q}Sb}\lfloor Y - Y_{CG} \rfloor \{L^r\} + \frac{1}{\bar{q}Sb}\lfloor Z - Z_{CG} \rfloor \{SF^r\}$$

ANGLE OF SIDESLIP EFFECTS

$\{\alpha^R\}_\beta = \{1\}$; i.e., ALL PANELS AT UNIT SIDESLIP INCIDENCE

DATA OBTAINED:

$$\eta_{Y_{WB}}, \eta_{Y_V}, \eta_{n_{WB}}, \eta_{n_V}, \eta_{\ell_{WB}}, \eta_{\ell_V}, \eta_{HM_\beta}$$

CONTROL SURFACE EFFECTS

$$\{\alpha^R\}_{\delta_e,\delta_r} = \begin{Bmatrix} 0 \\ 0 \\ 1 \end{Bmatrix}; \text{ i.e., CONTROL SURFACE PANELS AT UNIT INCIDENCE}$$

DATA OBTAINED:

$$\eta_{Y_c}, \eta_{n_a}, \eta_{\ell_a}, \eta_{Y_r}, \eta_{n_r}, \eta_{\ell_r}, \eta_{HM_3},$$

YAW RATE EFFECTS

$$\{\alpha^R\}_{\hat{r}} = \frac{2}{b} \begin{Bmatrix} X - X_{CG} \\ Y - Y_{CG} \end{Bmatrix}; \text{ i.e., INDUCED ANGLE OF INCIDENCE DUE TO UNIT NON-DIMENSIONAL YAW RATE, } \hat{r} = \frac{rb}{2V} = 1$$

DATA OBTAINED:

$$\eta_{n_{\hat{r}}}, \eta_{\ell_{\hat{r}}}$$

ROLL RATE EFFECTS

$$\{\alpha^R\}_{\hat{p}} = \frac{2}{b} \begin{Bmatrix} Y - Y_{CG} \\ Z - Z_{CG} \end{Bmatrix}; \text{ i.e., INDUCED ANGLE OF INCIDENCE DUE TO UNIT NON-DIMENSIONAL ROLL RATE, } \hat{p} = \frac{pb}{2V} = 1$$

DATA OBTAINED:

$$\eta_{n_{\hat{p}}}, \eta_{\ell_{\hat{p}}}$$

The aerodynamic and structural influence coefficients are dependent on the modeling used to describe the geometry and structure of the vehicle. The wing and body effects can be separated by partitioning the matrices as follows:

$$\begin{Bmatrix} L_B^F \\ L_W^F \end{Bmatrix} = \left[\begin{bmatrix} I & 0 \\ 0 & I \end{bmatrix} - \bar{q} \begin{bmatrix} S_B & 0 \\ 0 & S_W \end{bmatrix} \begin{bmatrix} A_{B-B} & A_{B-W} \\ A_{W-B} & A_{W-W} \end{bmatrix} \begin{bmatrix} s_{B-B} & s_{B-W} \\ s_{W-B} & s_{W-W} \end{bmatrix} \right]^{-1} \bar{q} \begin{bmatrix} S_B & 0 \\ 0 & S_W \end{bmatrix} \begin{bmatrix} A_{B-B} & A_{B-W} \\ A_{W-B} & A_{W-W} \end{bmatrix} \begin{Bmatrix} \alpha_B^R \\ \alpha_W^R \end{Bmatrix}$$

where B is body, W is wing, B-B is effect of body on body, B-W is effect of wing on body, W-B is effect of body on wing, and W-W is effect of wing on wing.

The longitudinal and lateral-directional aeroelastic data in this report were obtained with the complete wing-body-vertical tail panelling. The corresponding aerodynamic and structural matrices are then written as

$$[A] = \begin{bmatrix} A_{W-W} & A_{W-B} & A_{W-VT} \\ A_{B-W} & A_{B-B} & A_{B-VT} \\ A_{VT-W} & A_{VT-B} & A_{VT-VT} \end{bmatrix} ; [s] = \begin{bmatrix} s_{W-W} & s_{W-B} & s_{W-VT} \\ s_{B-W} & s_{B-B} & s_{B-VT} \\ s_{VT-W} & s_{VT-B} & s_{VT-VT} \end{bmatrix}$$

The analysis simulates a flexible wing-body-vertical tail with structural coupling and includes wing-body-vertical tail aerodynamics with mutual interference.

The structural influence coefficient matrix, [s], discussed above, corresponds to changes in slope of the aerodynamic grid panels. This [s] matrix is formed by mapping structural nodal deflection influence coefficients, denoted by [z], into rotations of the aerodynamic grid panels.

The determination of the [z] matrix is usually performed by imposing a clamped boundary condition at some point on the structure. These "fixed" structural influence coefficients represent a massless structure which is held in equilibrium by the reactions of the clamped point. Under actual conditions there is no clamped point and the entire structure is free to move. Unbalanced aerodynamic forces are opposed by inertia forces throughout the structure rather than by a reaction at one specified point. The "free" structural influence coefficients can be obtained by performing a transformation on the "fixed" structural influence coefficients. The derivation of the transformation is presented in Reference A-1.

The transformation is applied to the "fixed" structural nodal deflection matrix to obtain the "free" matrix, $[\tilde{z}]$.

$$[\tilde{z}] = [R][z][R]^T$$

where [z] is the "fixed" structural deflection matrix with z_{ij} the lineal deflection of panel (i) due to a unit load on panel (j).

The "free" structural matrix, $[\tilde{z}]$ is then mapped to the aerodynamic grid to form the "free" matrix, $[\tilde{s}]$. The flexible effects for the "free-free" system are then obtained by replacing [s] with $[\tilde{s}]$ in the equations previously discussed.

The above analysis represents a "free-free" longitudinal and lateral-directional analysis and includes structural coupling between the wing, body, and vertical tail. Concurrently, the complete aerodynamic configuration is idealized; thus, including aerodynamic interference effects. Therefore, the aeroelastic data presented in this report represent the most exact estimate to date of the Orbiter aeroelastic effects during entry.

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The equations defining any given total aerodynamic coefficient in this report include an incremental element to account for the effect of aeroelastic deformation such that the total flexible coefficient is, in essence, defined as $C_{TOTAL} = C^R + \Delta C^F$. This flexibility increment can be expanded and defined in terms of the rigid data, flexible-to-rigid ratios (η), and flexibility increments. Substitution of the resulting expression for the aeroelastic increment into the basic equation, and simplifying, leads to a more concise definition of the total flexible aerodynamic coefficient as summarized in this appendix. Terms which were previously determined to be zero or which, for lack of precise information, were denoted as "assume zero" have been omitted.

LIFT COEFFICIENT

$$C_{L_{TOTAL}} = C^R_{L_{O_{BASIC}}} + \Delta C^F_{L_O} + \eta_N (C^R_L - C^R_{L_O}) + \Delta C^R_{L_{LG}} + \Delta C^R_{L_{GE}} + \eta_{L_e}(\Delta C^R_{L_e} + \Delta C^R_{L_{AILERON}}) + \eta_{L_{SB}}^{1.0} \Delta C^R_{L_{SB}} + \eta_{L_{BF}} \Delta C^R_{L_{BF}}$$

DRAG COEFFICIENT*

$$C_{D_{TOTAL}} = C^R_{D_{BASIC}} + \Delta C^R_{D_{LG}} + \Delta C^R_{D_{GE}} + \Delta C^R_{D_e} + \Delta C^R_{D_{AILERON}} + \Delta C^R_{D_{SB}} + \Delta C^R_{D_{BF}} + \Delta C^F_D$$

PITCHING MOMENT COEFFICIENT

$$C_{m_{TOTAL}} = C^R_{m_{O_{BASIC}}} + \Delta C^F_{m_O} + \eta_N \left[(C^R_m - C^R_{m_O}) - \left(\frac{\Delta X_{a.c.}}{\bar{c}} \right) (C^R_N - C^R_{N_O}) \right] + \Delta C^R_{m_{LG}} + \Delta C^R_{m_{GE}}$$

$$+ \eta_{M_e} (\Delta C^R_{m_e} + \Delta C^R_{m_{AILERON}}) + \eta_{M_{SB}}^{1.0} \Delta C^R_{m_{SB}} + \eta_{M_{BF}} \Delta C^R_{m_{BF}} +$$

$$+ \eta_{Mq} [C^R_{m_q} + \Delta C^R_{m_{q_{SB}}}] \frac{q\bar{c}}{2V}$$

SIDE FORCE COEFFICIENT

$$C_{Y_{TOTAL}} = \eta_{Y_{WB}} (C^R_{Y_{BASIC}} - \Delta C^R_{Y_{\beta_V}} \beta) + \Delta C^R_{Y_{\beta_{LG}}} \beta + \eta_{Y_a} C^R_{Y_{\delta_a}} \delta_a + \eta_{Y_V} (\Delta C^R_{Y_{\beta_V}} + \Delta C^R_{Y_{\beta_{SB}}}) \beta$$

$$+ \eta_{Y_r} C^R_{Y_{\delta_r}} \delta_r + \Delta C^R_{Y_{\beta_e}} \beta$$

YAWING MOMENT COEFFICIENT

$$C_{n_{TOTAL}} = \eta_{n_{WB}}(C^R_{n_{BASIC}} - \Delta C^R_{n_{\beta_V}}\beta) + \Delta C^R_{n_{\beta_{LG}}}\beta + \Delta C^R_{n_{\beta_e}}\beta + \eta_{n_a} C^R_{n_{\delta_a}}\delta_a + \eta_{n_V}(\Delta C^R_{n_{\beta_V}} + \Delta C^R_{n_{\beta_{SB}}})\beta$$

$$+ \eta_{n_R} C^R_{n_{\delta_r}}\delta_r + \eta_{n_{\hat{r}}} C^R_{n_{\hat{r}}}\frac{rb}{2V} + \eta_{n_{\hat{p}}} C^R_{n_{\hat{p}}}\frac{pb}{2V}$$

ROLLING MOMENT COEFFICIENT

$$C_{\ell_{TOTAL}} = \eta_{\ell_{WB}}(C^R_{\ell_{BASIC}} - \Delta C^R_{\ell_{\beta_V}}\beta) + \Delta C^R_{\ell_{\beta_{LG}}}\beta + \Delta C^R_{\ell_{GE}} + \Delta C^R_{\ell_{\beta_e}}\beta + \eta_{\ell_a} C^R_{\ell_{\delta_a}}\delta_a$$

$$+ \eta_{\ell_V}(\Delta C^R_{\ell_{\beta_V}} + \Delta C^R_{\ell_{\beta_{SB}}})\beta + \eta_{\ell_r} C^R_{\ell_{\delta_r}}\delta_r + \eta_{\ell_{\hat{r}}} C^R_{\ell_{\hat{r}}}\frac{rb}{2V} + \eta_{\ell_{\hat{p}}} C^R_{\ell_{\hat{p}}}\frac{pb}{2V}$$

HINGE MOMENTS

ELEVONS

$$C^F_{h_{e_{INBOARD}}} = \eta_{C_{h_{e_i}}} C^R_{h_{e_{INBOARD}}}$$
$$C^F_{h_{e_{OUTBOARD}}} = \eta_{C_{h_{e_o}}} C^R_{h_{e_{OUTBOARD}}}$$

BODY FLAP

$$C^F_{h_{BF}} = C^R_{h_{BF_{\substack{\alpha=0\\ \delta_{BF}=\delta_{BF}}}}} + C^R_{h_{BF_{\substack{\alpha=\alpha\\ \delta_{BF}=0}}}} - C^R_{h_{BF_{\substack{\alpha=\alpha\\ \delta_{BF}=\delta_{BF}}}}} + \Delta C^F_{h_{BF_{\substack{\alpha=0\\ \delta_{BF}=0}}}} + \eta_{HM_{BF_\alpha}}(C^R_{h_{BF_{\substack{\alpha=\alpha\\ \delta_{BF}=\delta_{BF}}}}} - C^R_{h_{BF_{\substack{\alpha=0\\ \delta_{BF}=\delta_{BF}}}}})$$

$$+ \eta_{HM_{BF_\beta}}(C^R_{h_{BF_{\substack{\alpha=\alpha\\ \delta_{BF}=\delta_{BF}}}}} - C^R_{h_{BF_{\substack{\alpha=\alpha\\ \delta_{BF}=0}}}})$$

RUDDER/SPEEDBRAKE

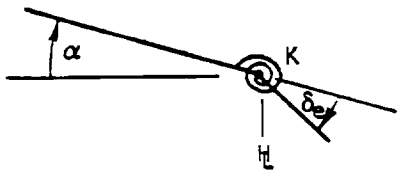
$$C^F_{h_{\substack{RUDDER/\\ SPEEDBRAKE}}} = C^R_{h_{PANEL}} + \eta_{HM_\beta} C^R_{h_\beta}\beta + \eta_{HM_\delta} C^R_{h_{\delta r}}\delta_r \qquad \text{Equation for } \begin{cases} \text{TOTAL} \\ \text{OR} \\ \text{LEFT} \\ \text{OR} \\ \text{RIGHT} \end{cases}$$

To determine the coefficients for left-hand panel and right-hand panel, note that;

$$C^R_{h_{\substack{PANEL\\ LEFT}}} = C^R_{h_{\substack{PANEL\\ RIGHT}}}$$

$$C^R_{h_{\beta_{LEFT}}} = -C^R_{h_{\beta_{RIGHT}}} \qquad C^R_{h_{\delta r_{LEFT}}} = -C^R_{h_{\delta r_{RIGHT}}}$$

A.2 ELEVON TORSIONAL STIFFNESS. An alternate method of determining the change in the longitudinal coefficients, lateral/directional aileron effectiveness and elevon hinge moment coefficient due to aeroelastic rotation of the elevon about its hinge line is presented in this section. The flexible elevon deflection angles are proportional to the hinge moment on the elevon. The proportionality constant is represented by a torsional spring at the elevon hinge line.



$$C_h^F = C_h^R + \Delta C_h^F$$

$$\Delta C_h^F = C_{h_{\delta_e}}^R \Delta\delta_e$$

$$\Delta\delta_e^F = K\,\bar{q}\,S_e\,\bar{c}_e\,C_h^F$$

$$C_h^F = C_h^R + C_{h_{\delta_e}}^R K\,\bar{q}\,S_e\,\bar{c}_e\,C_h^F$$

$$C_h^F = \frac{C_h^R}{1 - C_{h_{\delta_e}}^R K\,\bar{q}\,S_e\,\bar{c}_e}$$

The flexible longitudinal coefficients and lateral/directional aileron effectiveness may be obtained by determining the rigid coefficient values using the equations presented in Appendix D (Data Tape Usage) with the flexible elevon deflection angles replacing the rigid elevon deflection angles. The flexible elevon deflection and hinge moment coefficients are obtained as follows:

$$\delta^F_{e_{1_{(O)}}} = \delta_{e_{1_{(O)}}} + \Delta\delta^F_{e_{1_{(O)}}}$$

where,

$$\Delta\delta^F_{e_{1_{(O)}}} = K_{1_{(O)}}\,\bar{q}\,S_e\,\bar{c}_e\,C^F_{h_{e_{1_{(O)}}}}$$

K_1 = Inboard elevon spring constant (1.547×10^{-6} deg/inch-pounds)

K_o = Outboard elevon spring contsnt (3.323×10^{-6} deg/inch-pounds)

$$C^F_{h_{e_1}} = \frac{C^R_{h_{e_1}}}{1 - C^R_{h_{e_{1\delta_e}}} K_1\,\bar{q}\,S_e\,\bar{c}_e}$$

$$C^F_{h_{e_o}} = \frac{C^R_{h_{e_o}}}{1 - C^R_{h_{e_{o\delta_e}}} K_o\,\bar{q}\,S_e\,\bar{c}_e}$$

$$C^R_{h_{e_1}\delta_e} = \frac{C^R_{h_{e_1}}(@\delta^R_e + \delta_e') - C^R_{h_{e_1}}(@\delta^R_e - \delta_e')}{2\delta_e'}$$

$$C^R_{h_{e_o}\delta_e} = \frac{C^R_{h_{e_o}}(@\delta^R_e + \delta_e') - C^R_{h_{e_o}}(@\delta^R_e - \delta_e')}{2\delta_e'}$$

Recommend: $\delta_e' = 1°$

A.3 COMPARISON OF RIGID AND FLEXIBLE AERO. Both aeroelastic ($\bar{q}$ = 300 psf) and rigid ($\bar{q}$ = 0 psf) aerodynamic parameters are presented as a function of Mach number for the mid center of gravity position (0.667 L_B). The first 18 figures for this subsection present the normal force coefficient versus pitching moment coefficient for various elevon positions with the body flap in the retracted position of -11.7 degrees. Data are presented for Mach numbers 0.25 through 10.0.

Lateral/directional aeroelastic and rigid data are presented in the remaining figures of this subsection. Figures A.3-19 and A.3-20 present the angle of attack and elevon trim deflection for the high dynamic pressure entry trajectory as a function of Mach number. The aerodynamic parameters presented in the remaining figures utilized these angles as well as the body flap angles noted on each figure.

OV102 AERO APR79 DATA DELE TRIM 04/25/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
0.250	-11.700	25.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

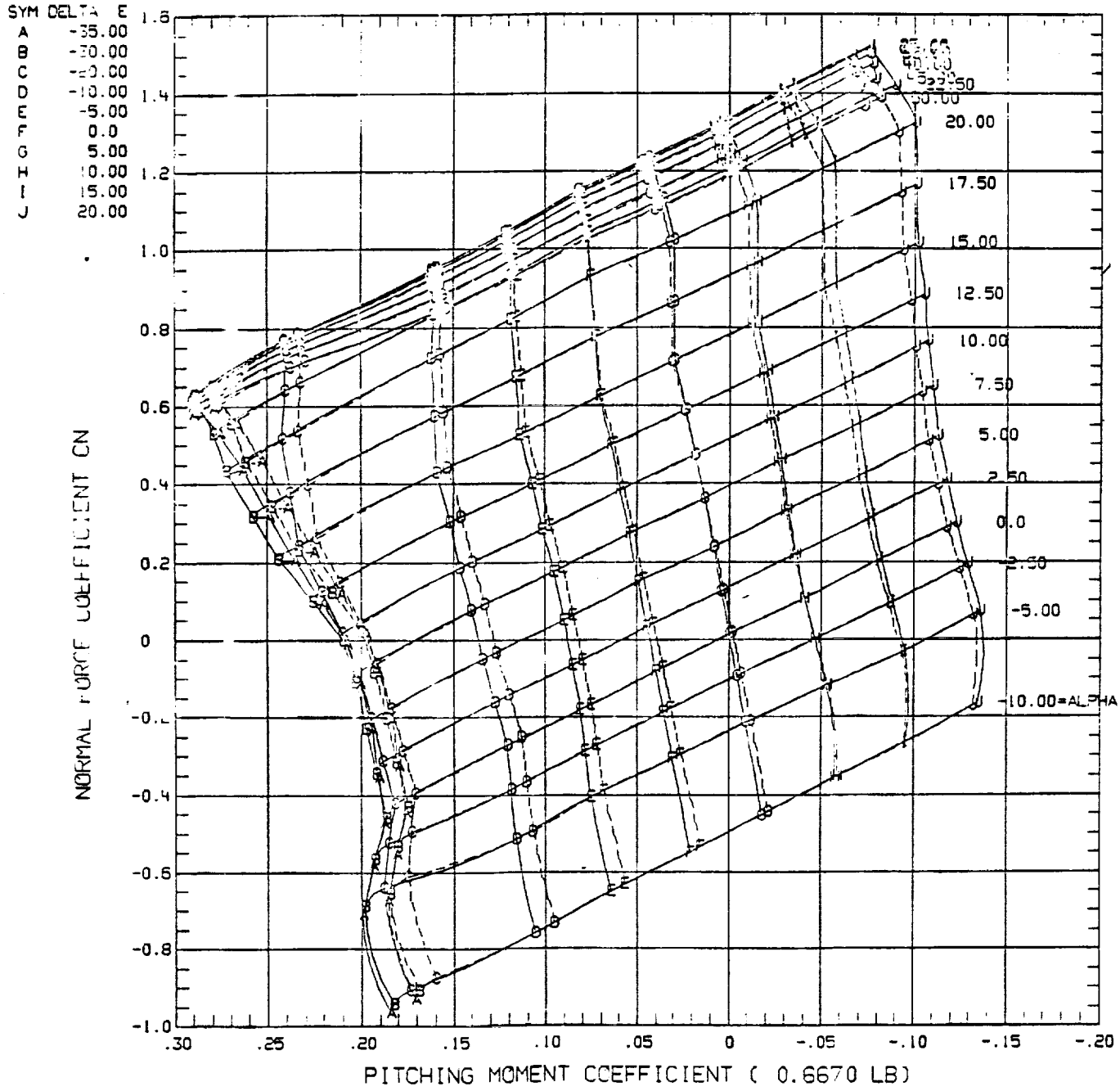


Figure A.3-1
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 0.25

DGD 6/79

OV102 AERO APR79 DATA DELE TRIM 04/25/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
0.400	-11.700	25.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

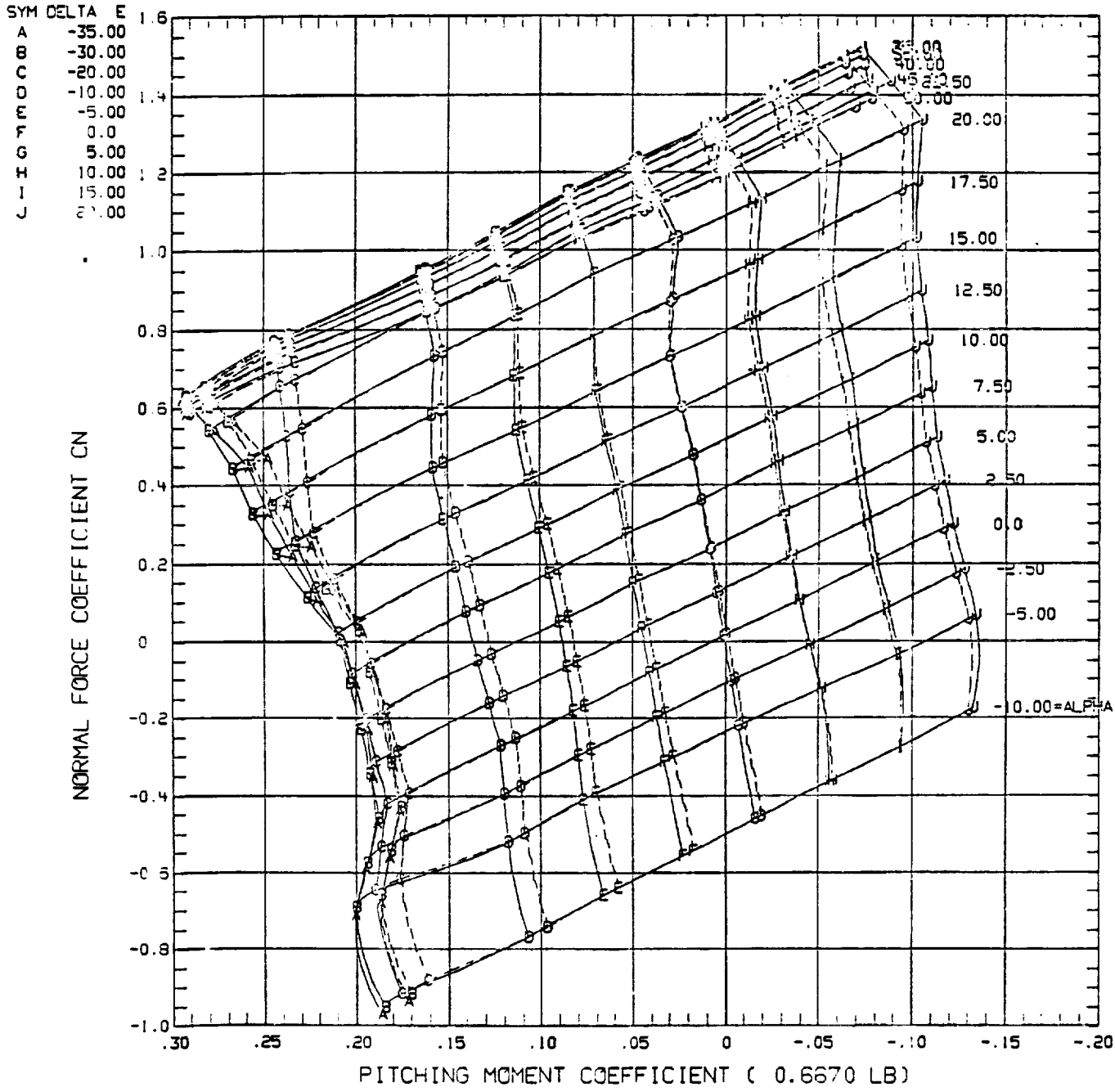


Figure A.3-2
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 0.40

XGD 6/79

OV102 AERO AER79 DATA DELE TRIM 04/25/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
0.600	-11.700	25.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

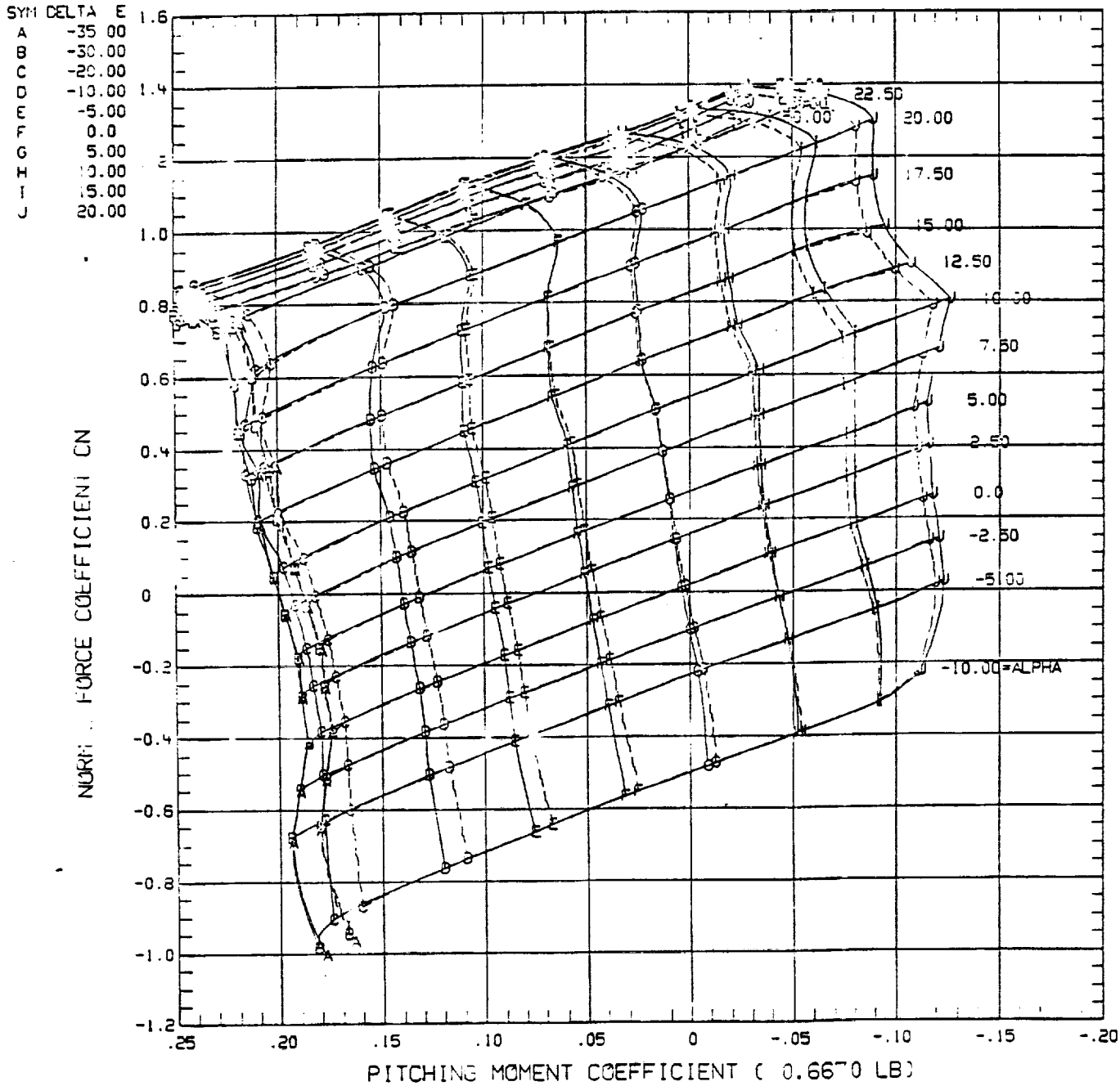


Figure A.3-3
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 0.60

0V102 AERO APR79 DATA DELE TRIM 04/25/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
0.800	-11.700	25.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

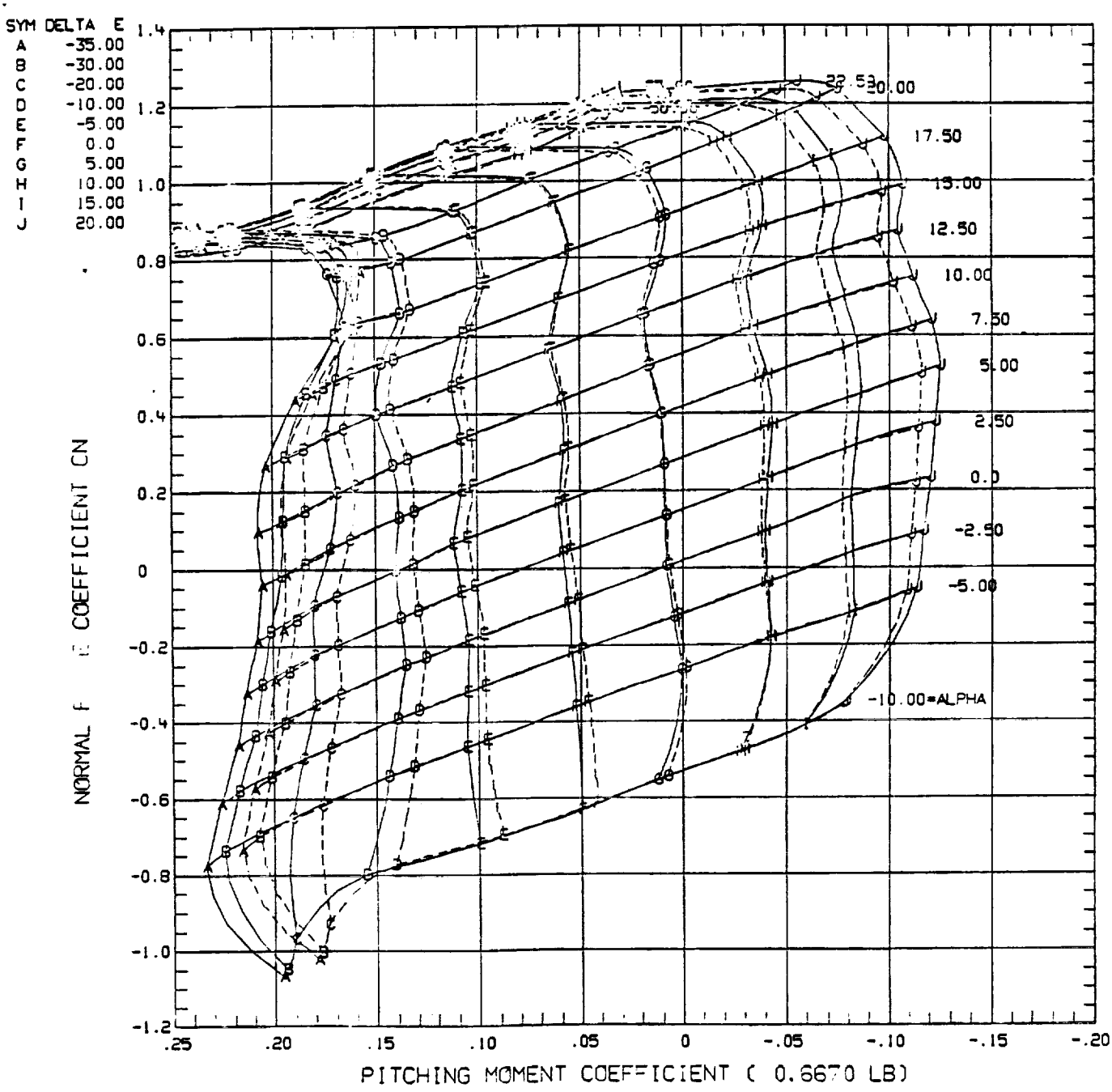


Figure A.3-4
RIGIDFLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 0.80

OV102 AERO APR79 DATA DELE TRIM 04/25/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
0.900	-11.700	25.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

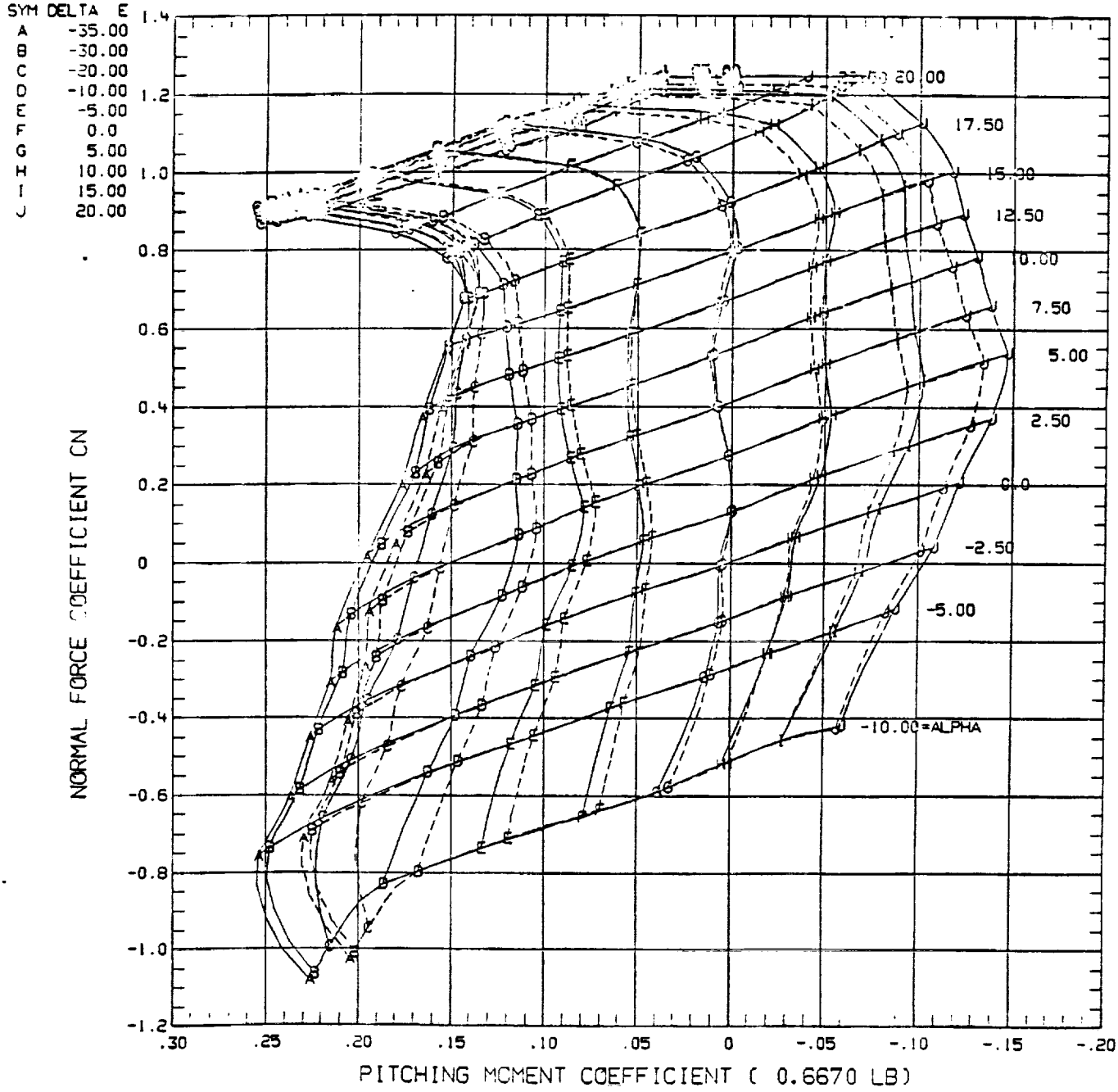


Figure A.3-5
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 0.90

DGD 6/79

OV102 AERO APR79 DATA DELE TRIM 04/26/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PS
0.980	-11.700	25.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

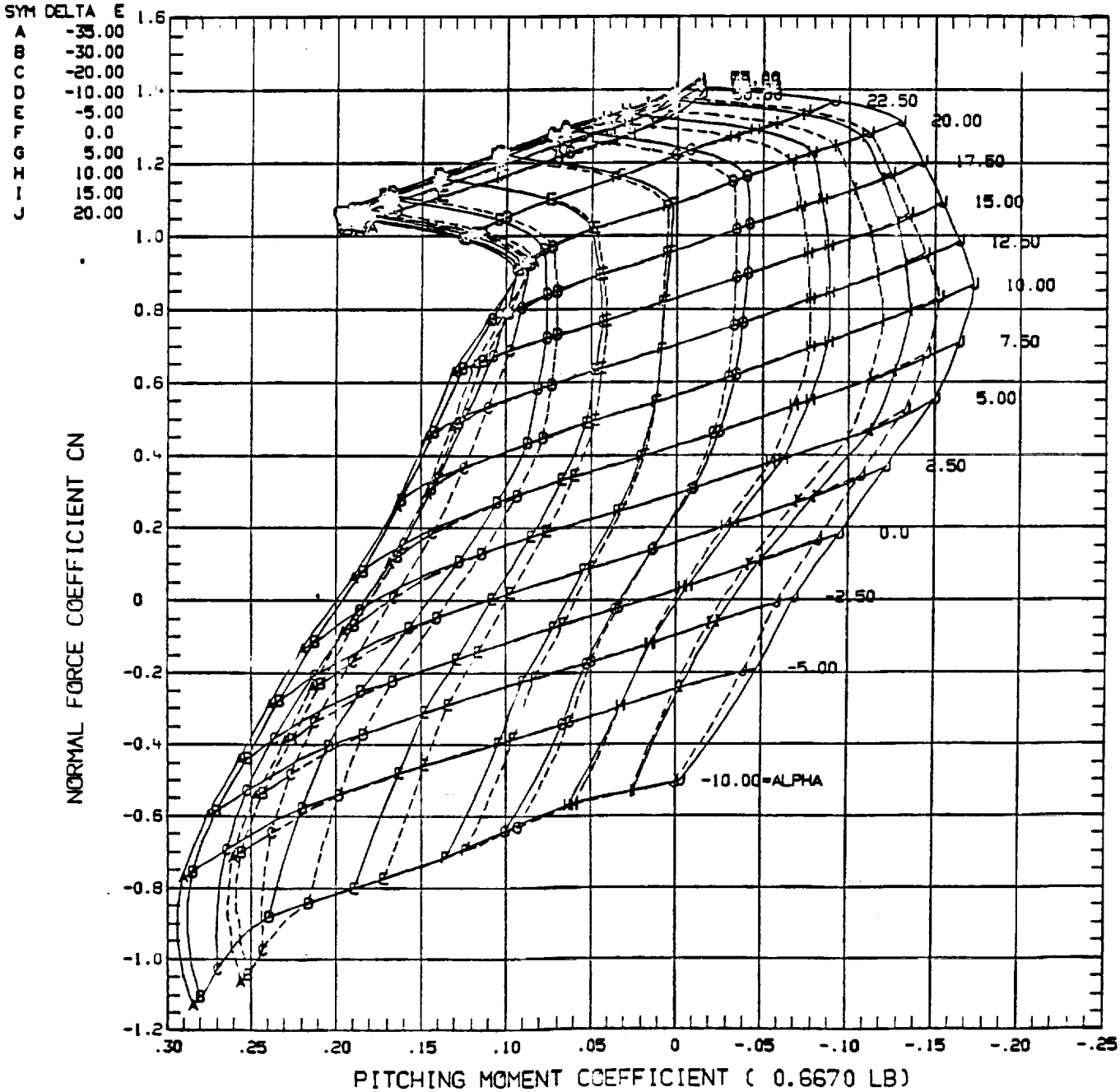


Figure A.3-6
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 0.98

DGJ 6/79

OV102 AERO APR79 DATA DELE TRIM 04/26/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
1.050	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

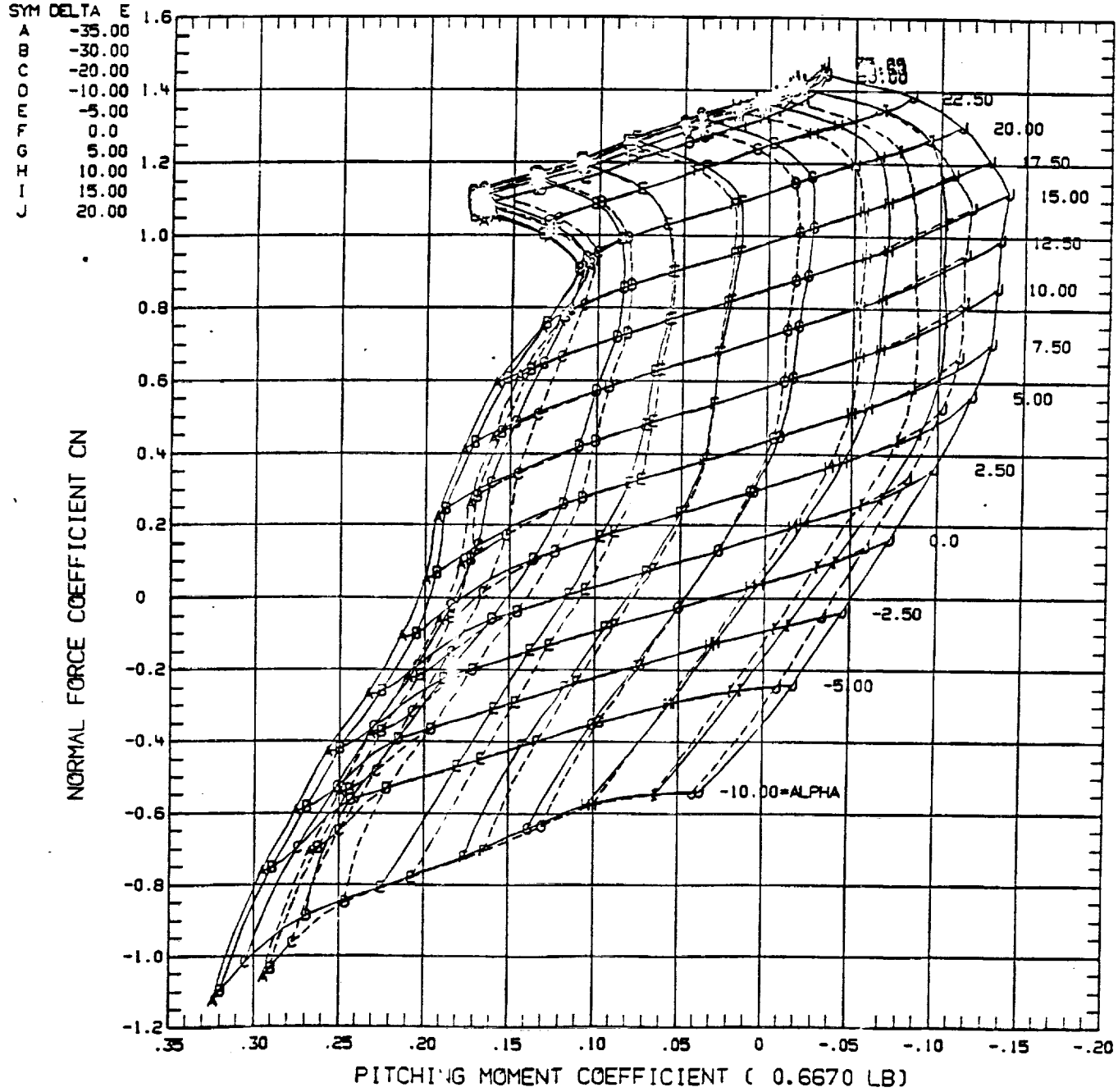


Figure A.3-7
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 1.05

DGD 6/79

0V102 AERO APR79 DATA DELE TRIM 04/26/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
1.100	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

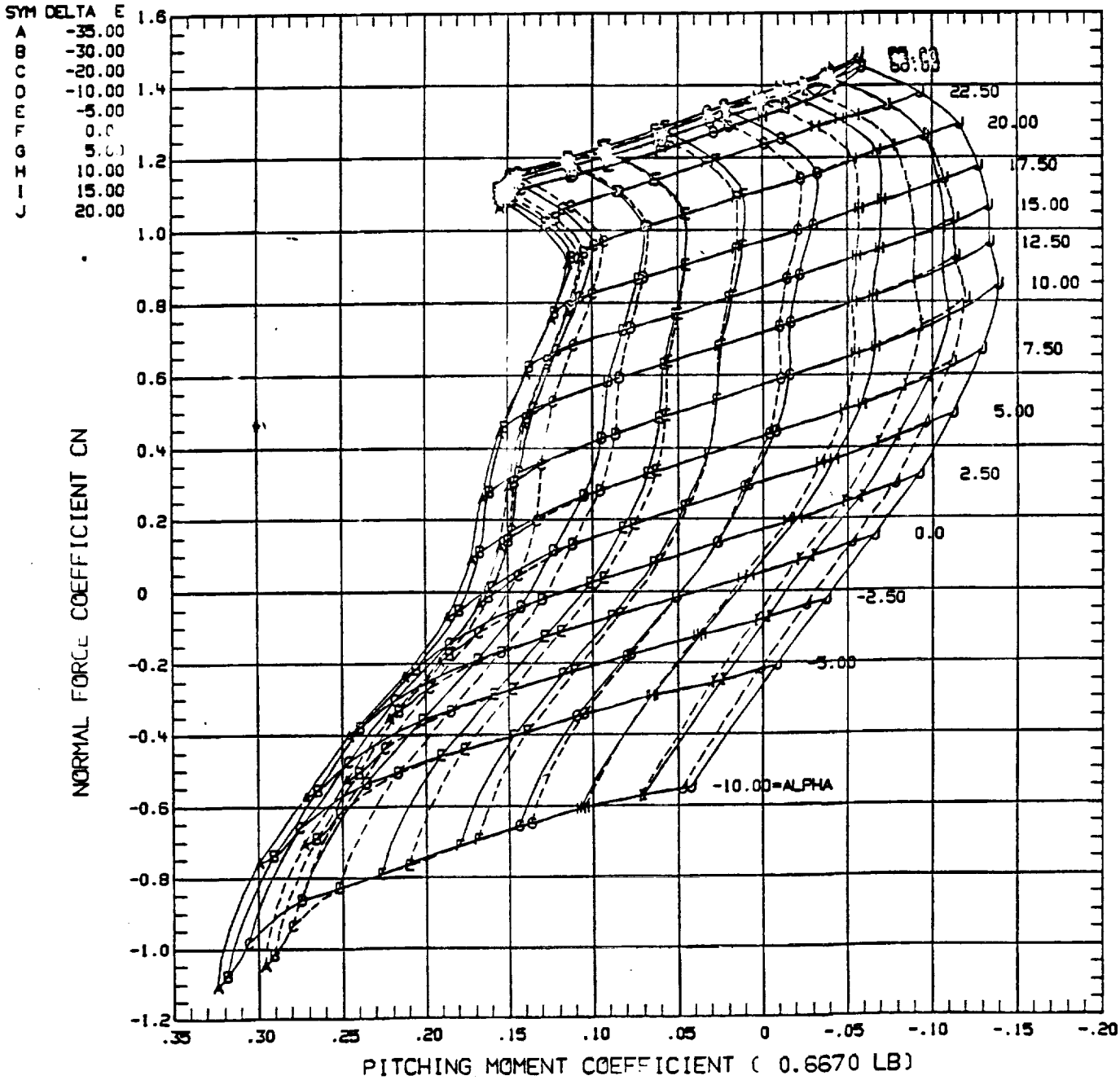


Figure A.3-8
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 1.10

OV102 AERO APR79 DATA DELE TRIM 04/26/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
1.200	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

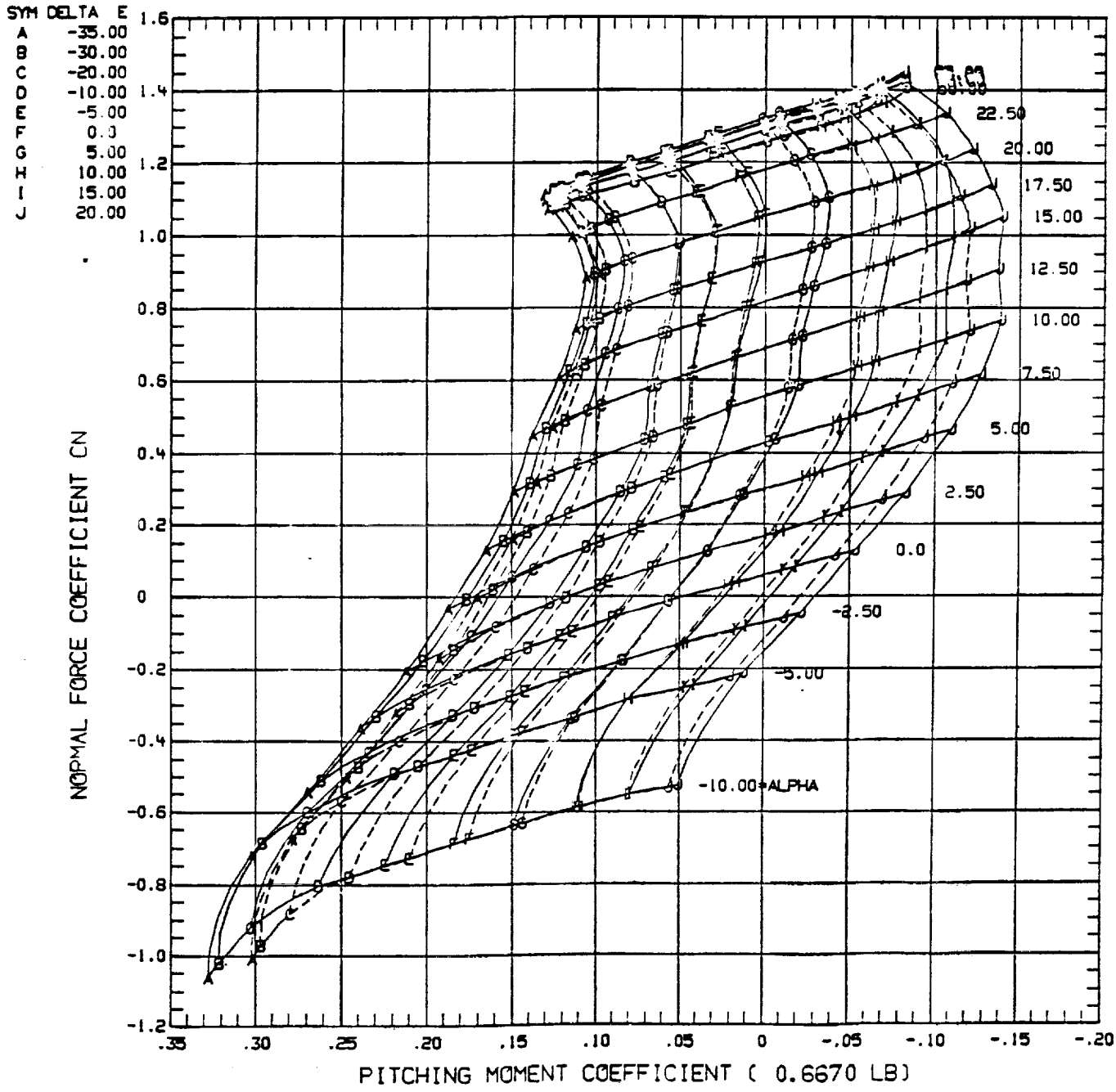


Figure A.3-9
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 1.20

OV102 AERO APR79 DATA DELE TRIM 04/26/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
1.300	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

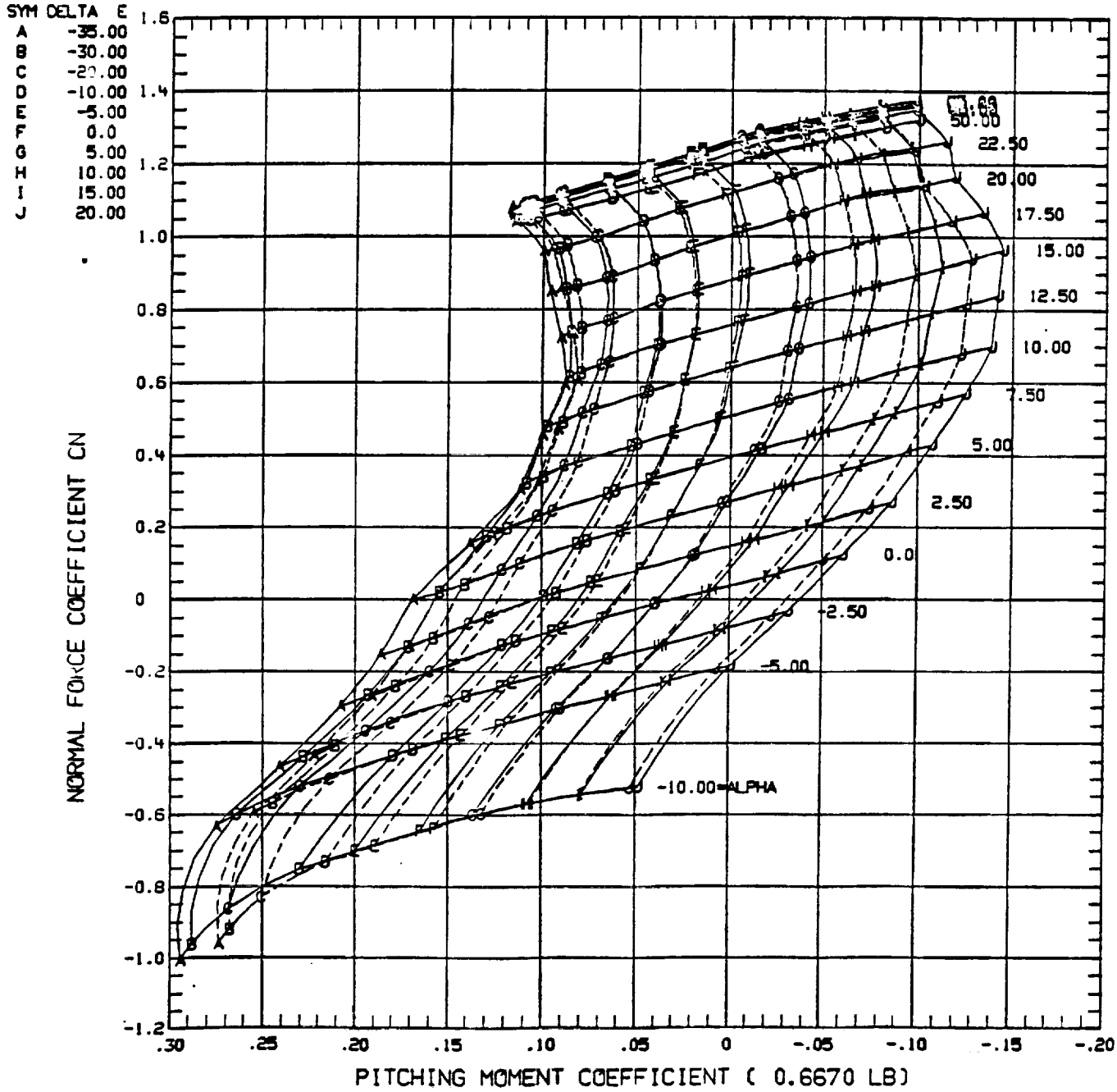


Figure A.3-10
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 1.3

DGD 6/79

OV102 AERO APR79 DATA DELE TRIM 04/26/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
1.500	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

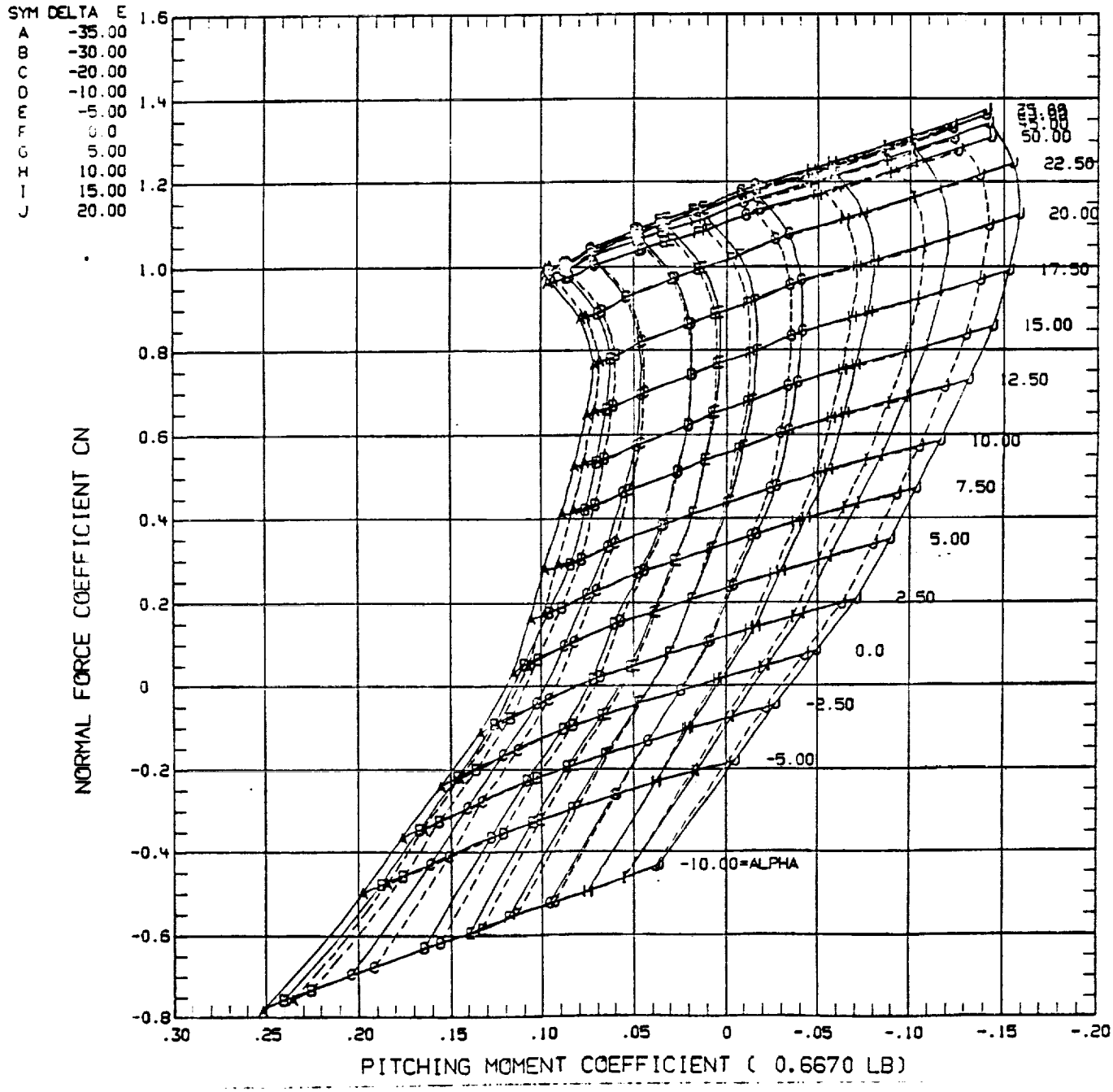


Figure A.3-11
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 1.5

DGD 6/79

OV102 AERO APR79 DATA DELE TRIM 04/26/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
2.000	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

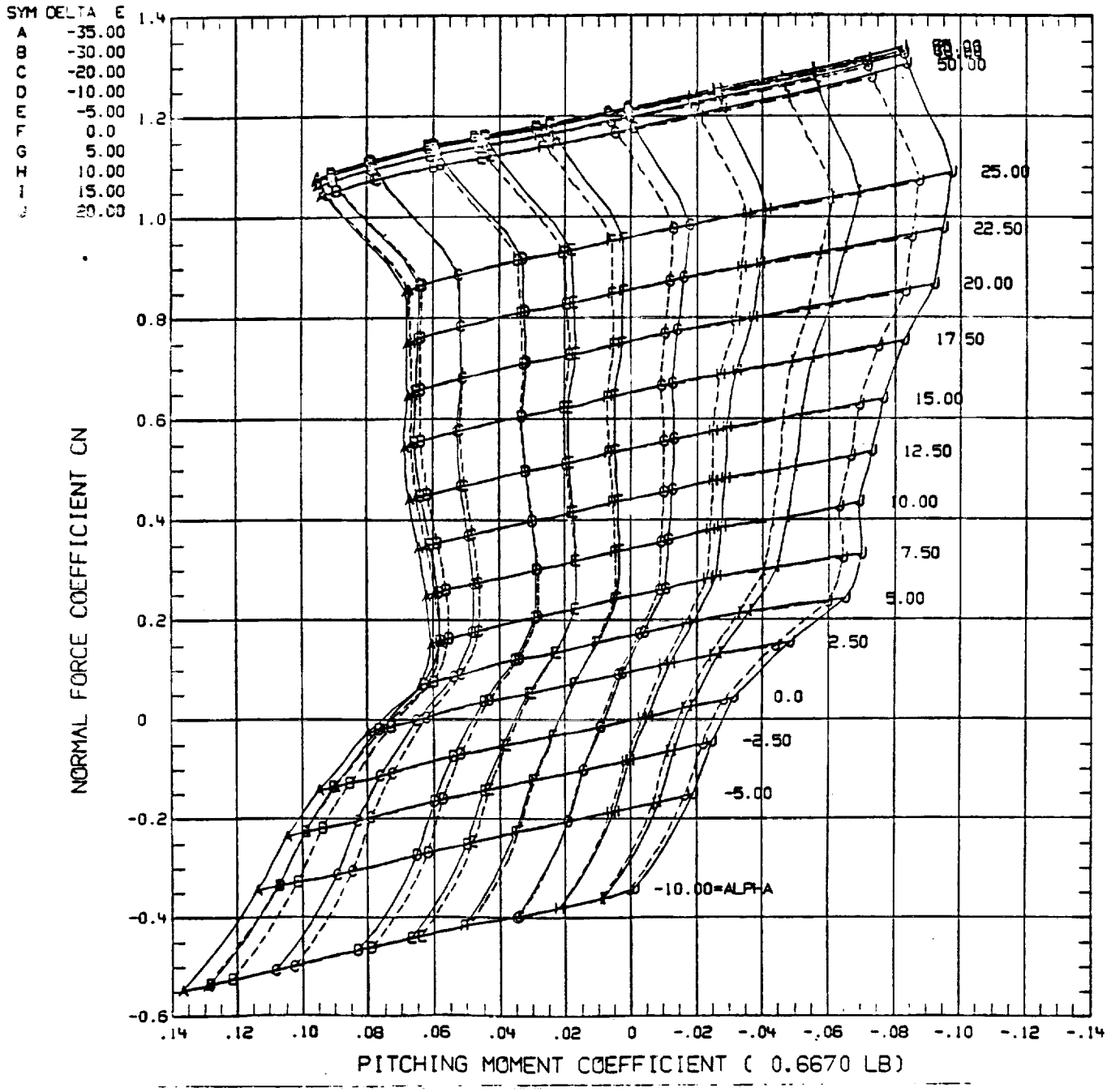


Figure A.3-12
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 2.0

OV102 AERO APR79 DATA DELE TRIM 04/26/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
2.500	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

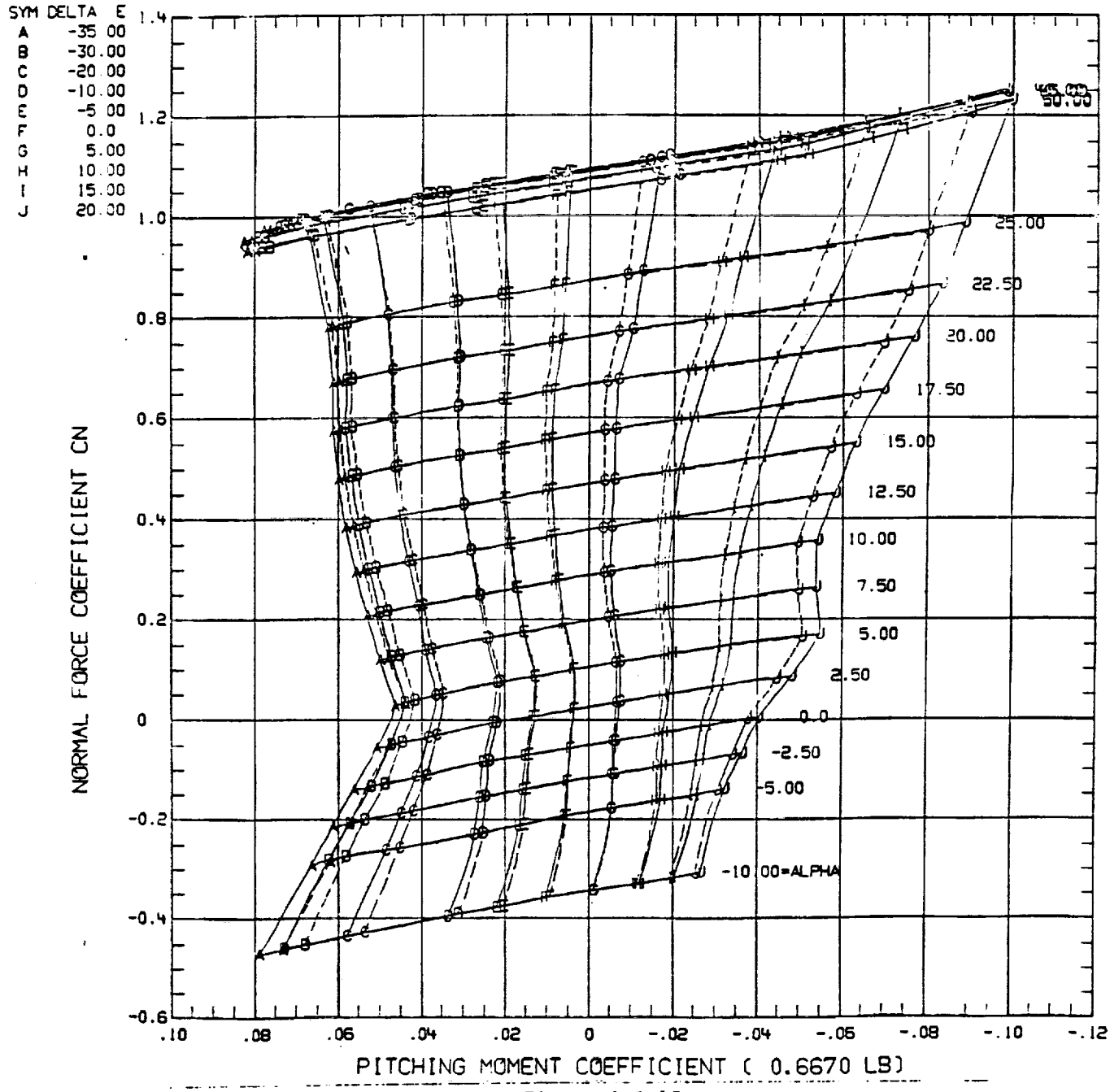


Figure A.3-13
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 2.5

DGD 6/79

	OV102 AERO APR79 DATA		DELE TRIM		04/30/79	
MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
3.000	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

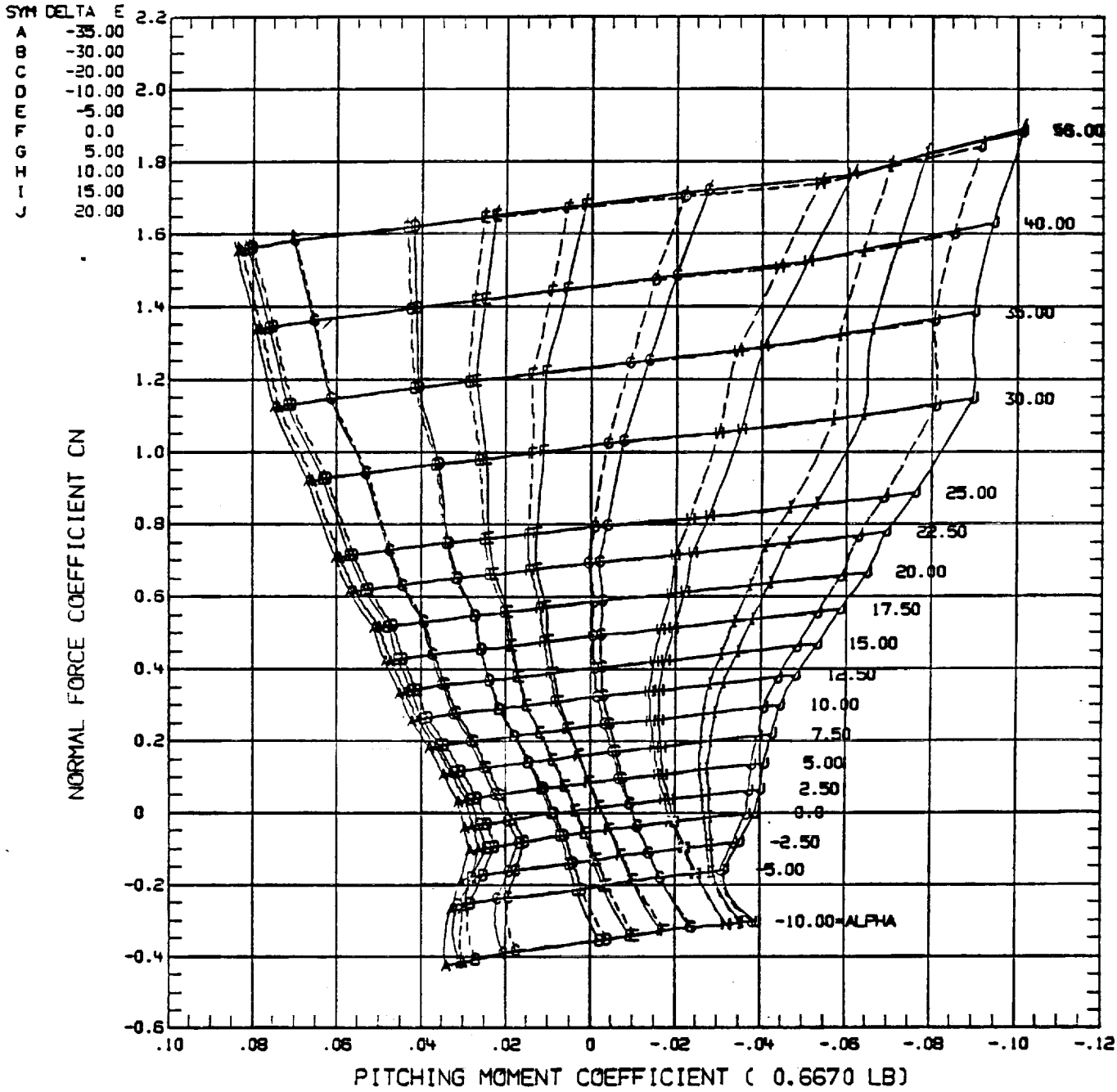


Figure A.3-14
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 3.0

OV102 AERO APR79 DATA DELE TRIM 04/30/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
4.000	-11.700	55.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

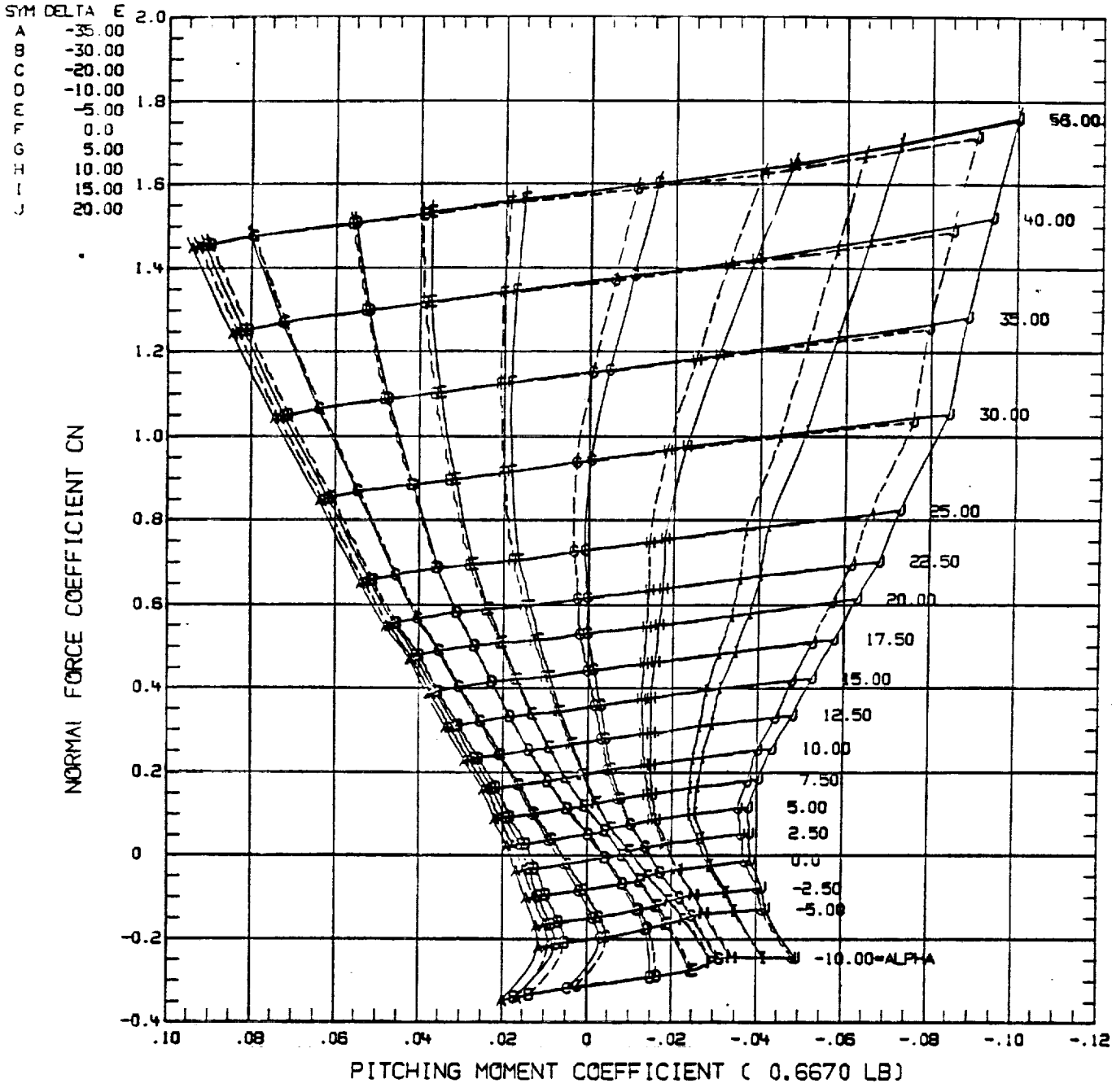


Figure A.3-15
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 4.0

SGD 6/79

OV102 AERO APR79 DATA DELE TRIM 04/30/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
5.000	-11.700	87.200	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

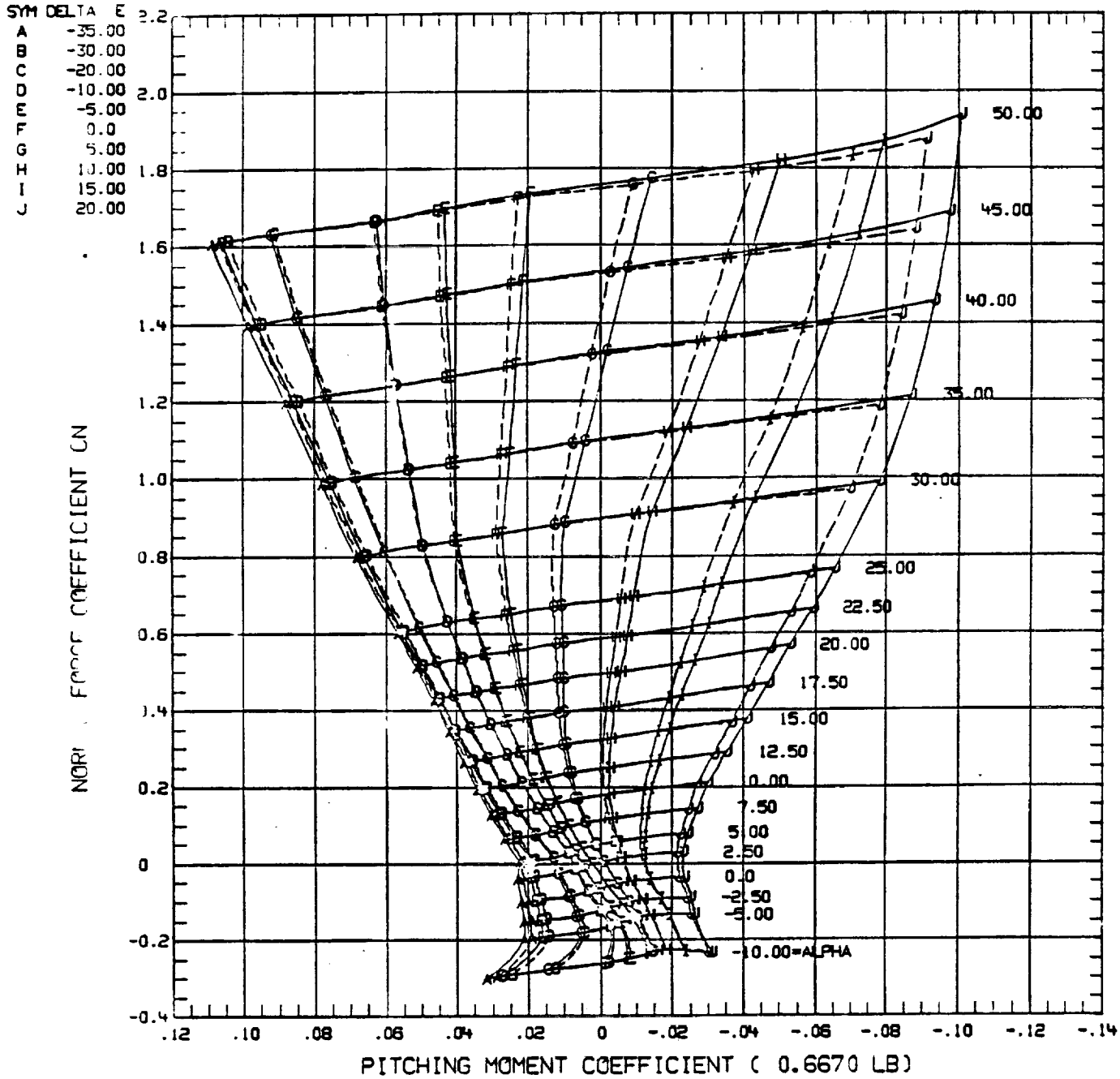


Figure A.3-16
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH = 5.0

DGJ 6/79

0V102 AERO APR79 DATA DELE TRIM 04/30/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
8.000	-11.700	87.200	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

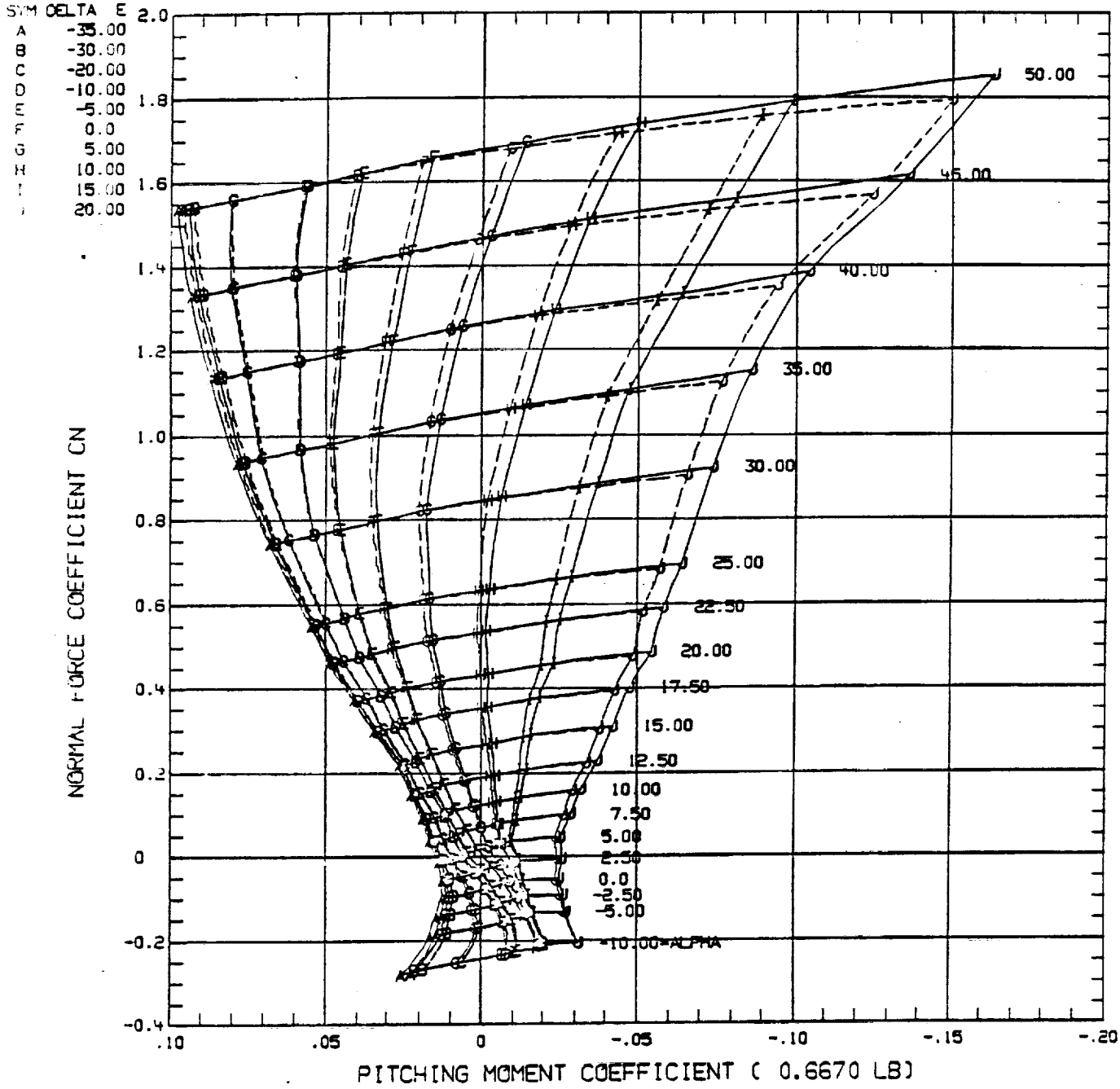


Figure A.3-17
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 8.0

DGD 6/79

OV102 AERO APR79 DATA DELE TRIM 04/30/79

MACH NO.	DEL BF	DEL SB	XCG (IN)	ZCG (IN)	QBAR1-PSF	QBAR2-PSF
10.000	-11.700	0.000	1098.630	375.000	0.0	300.000

QBAR1 = SOLID QBAR2 = DASH

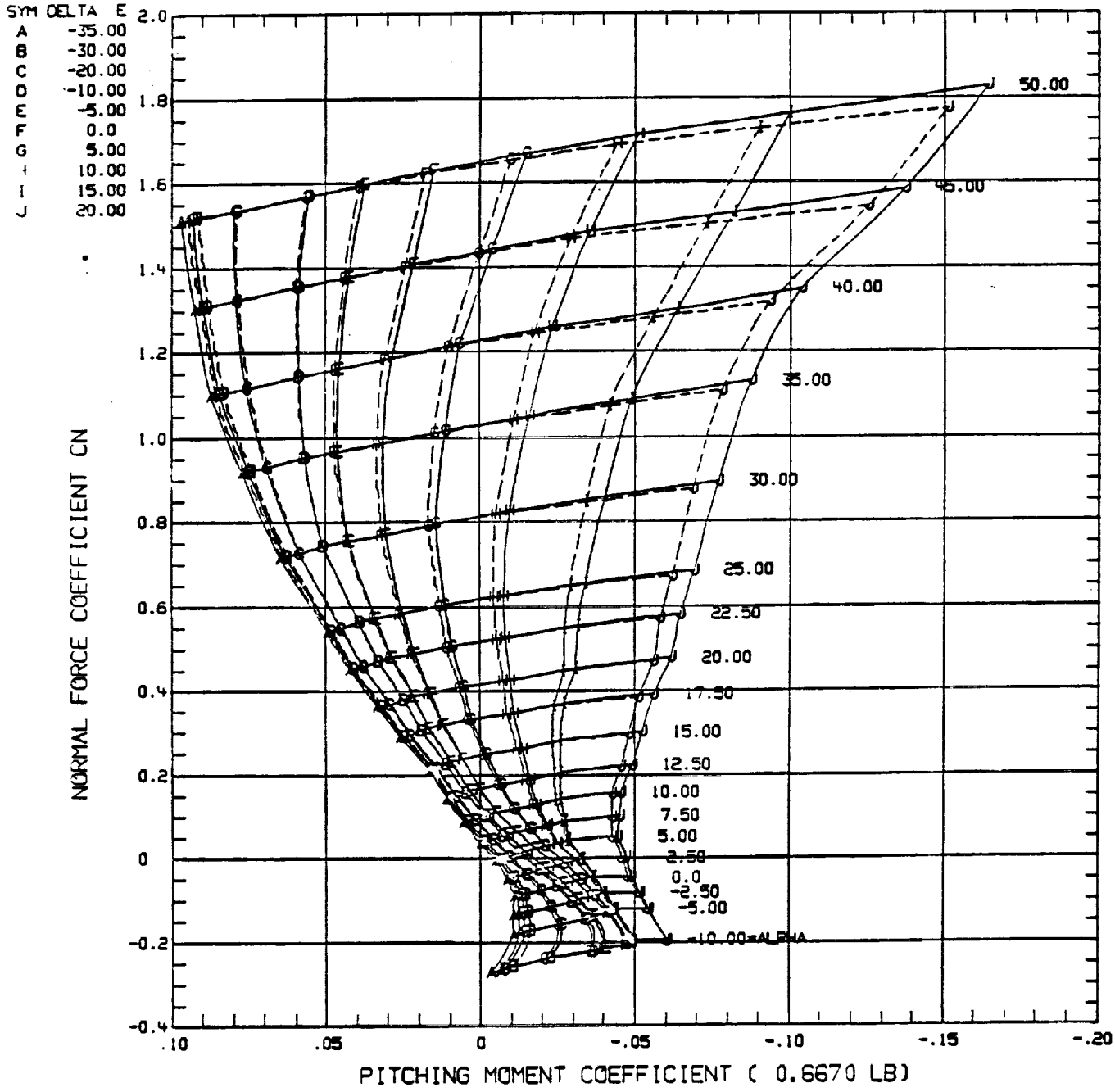


Figure A.3-18
RIGID/FLEX COMPARISON OF LONGITUDINAL STABILITY
MACH 10.0

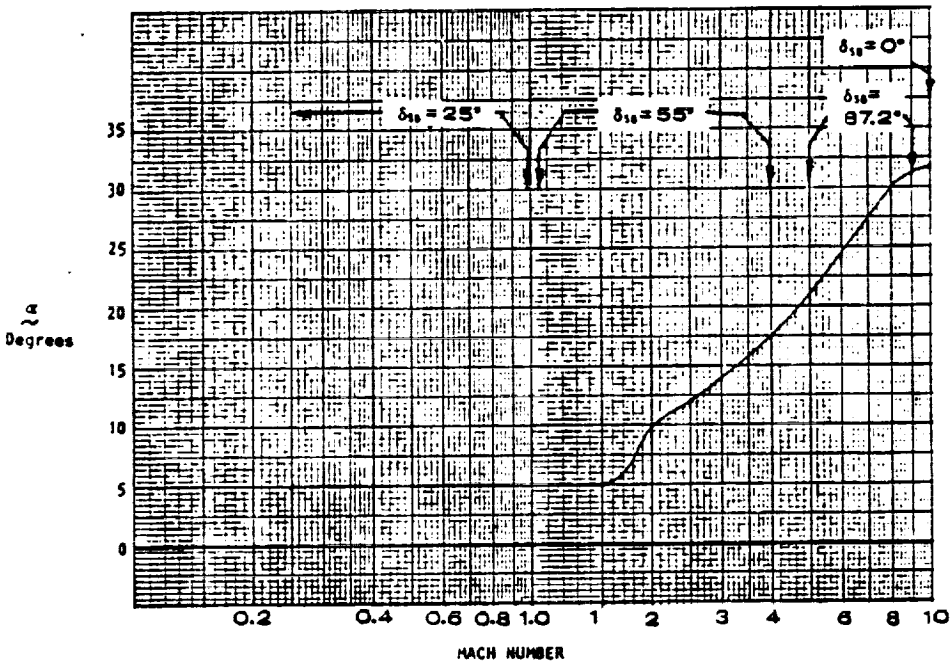


Figure A.3-19
HIGH DYNAMIC PRESSURE ENTRY TRAJECTORY

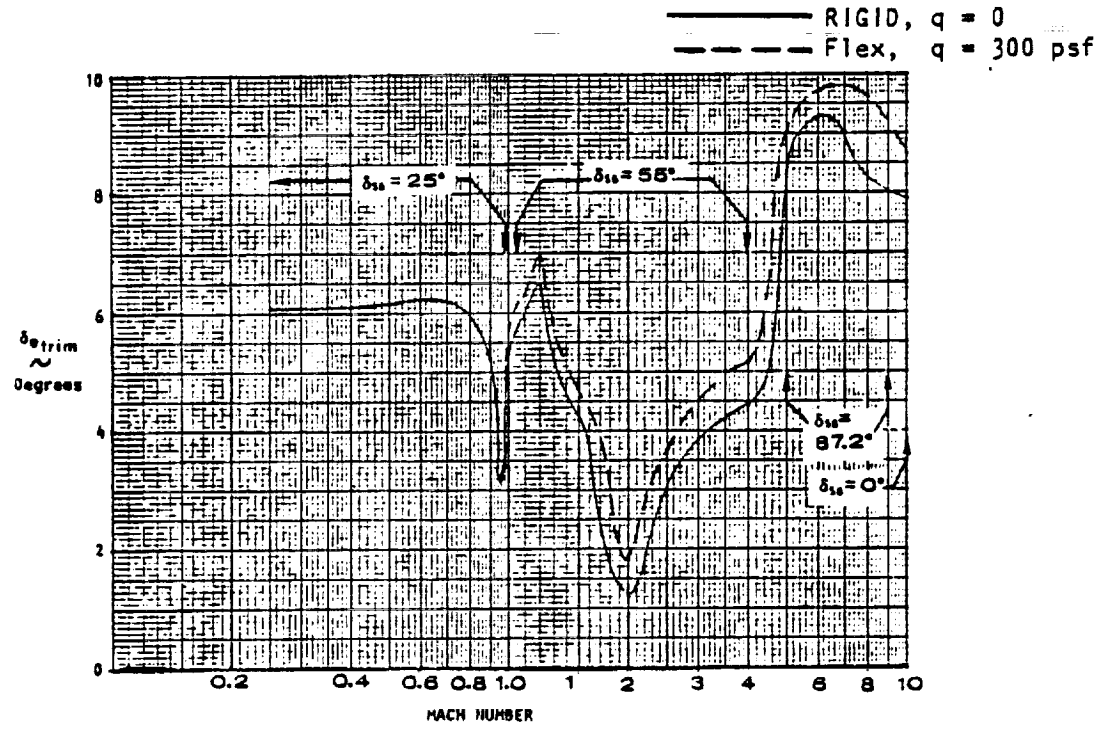


Figure A.3-20
RIGID/FLEX COMPARISON OF ELEVON TO TRIM

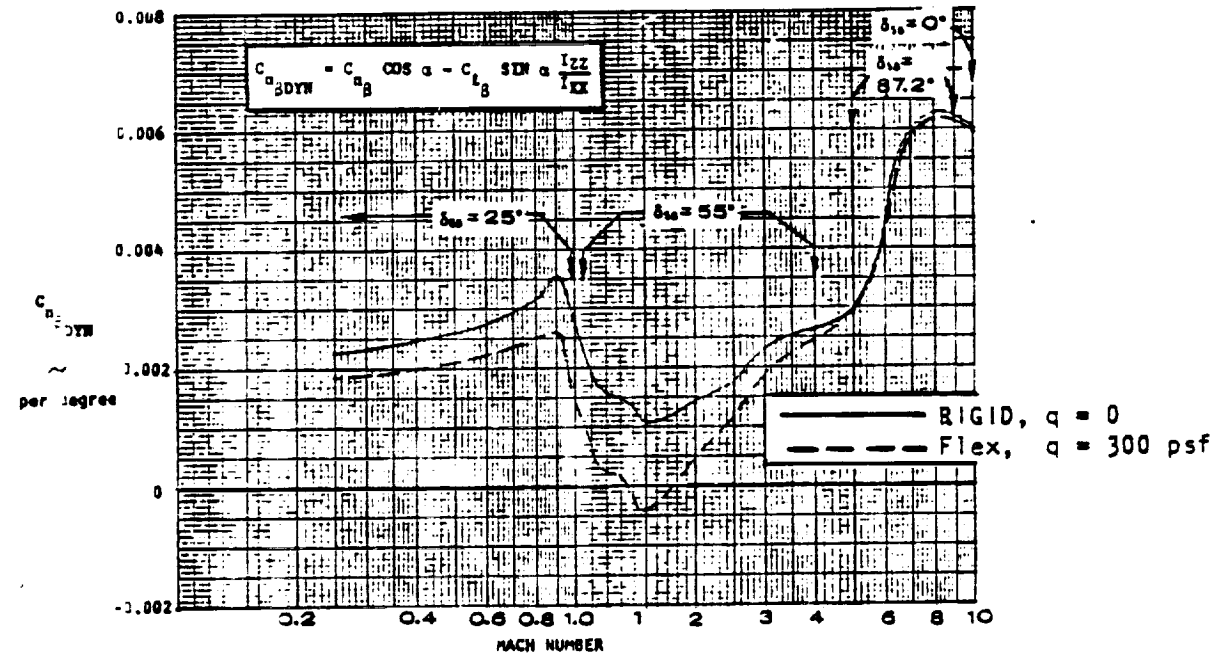


Figure A.3-21
RIGID/FLEX COMPARISON OF DYNAMIC DIRECTIONAL STABILITY

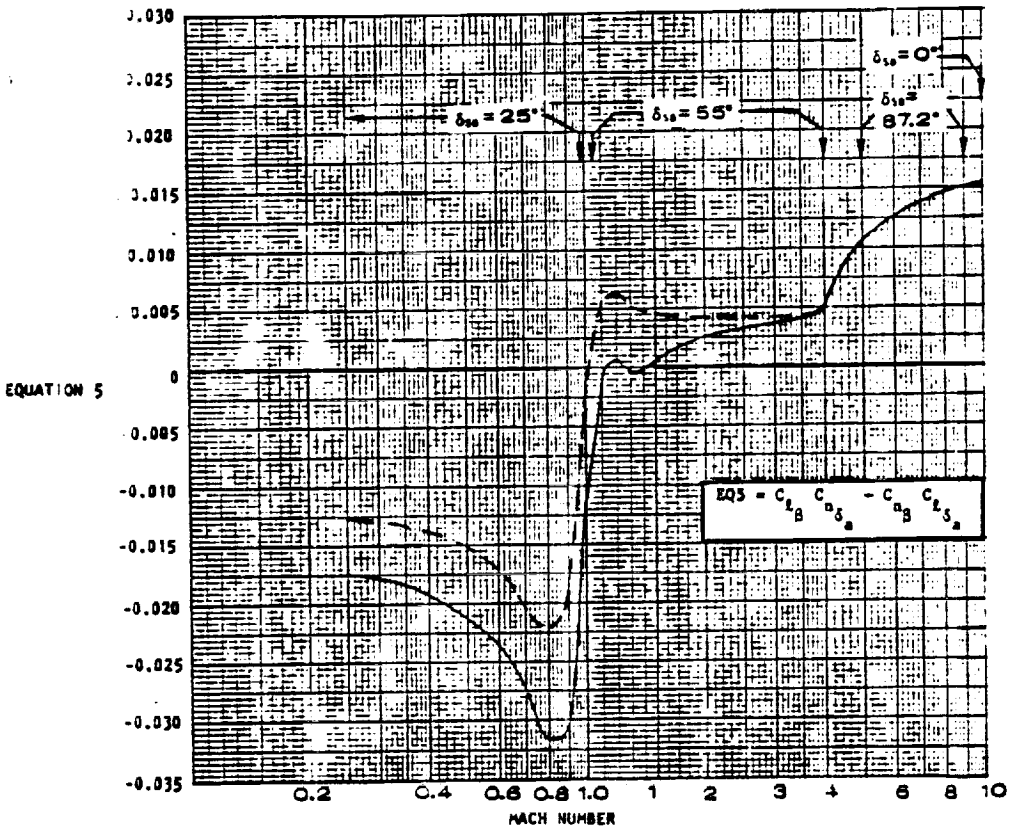


Figure A.3-22
RIGID/FLEX COMPARISON OF EQUATION 5

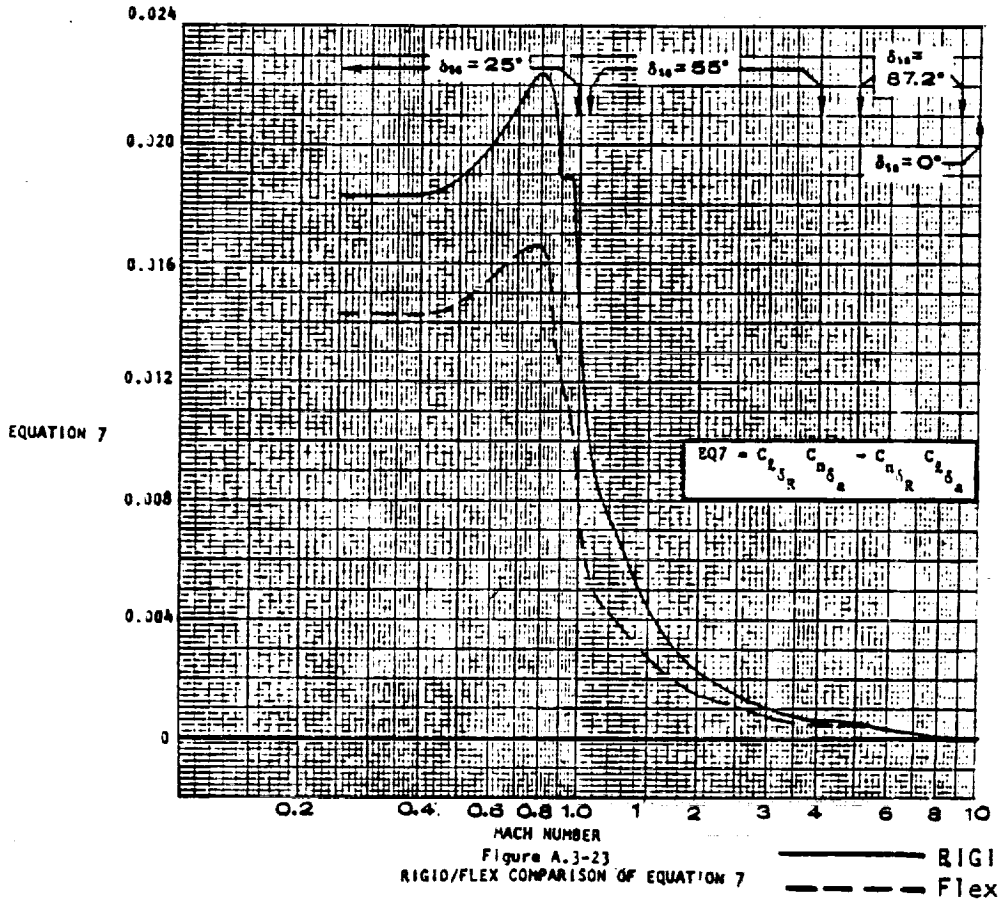


Figure A.3-23
RIGID/FLEX COMPARISON OF EQUATION 7

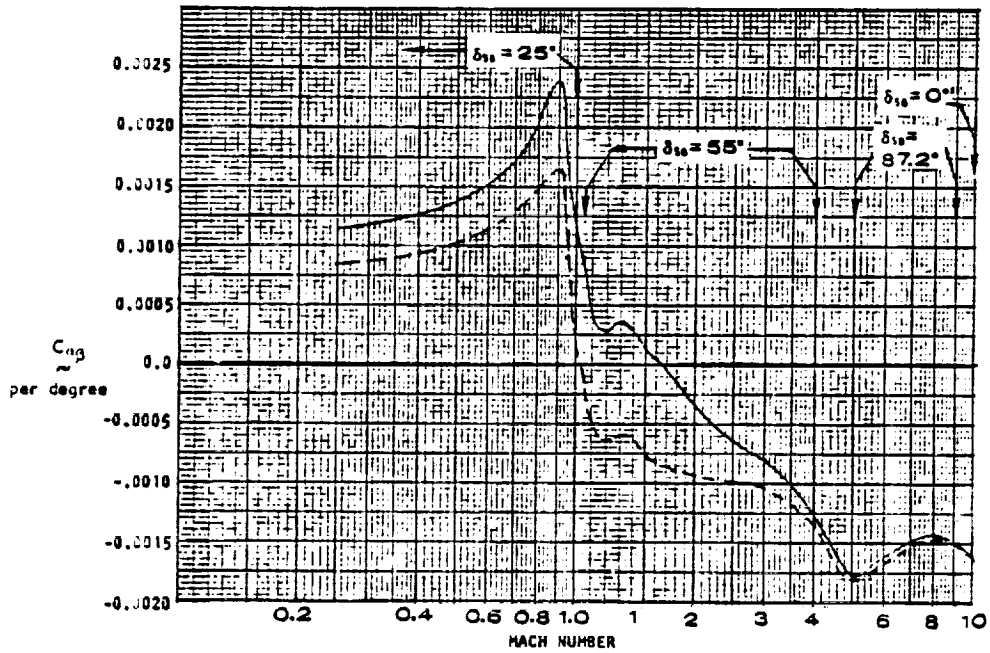


Figure A.3-24
RIGID/FLEX COMPARISON OF DIRECTIONAL STABILITY

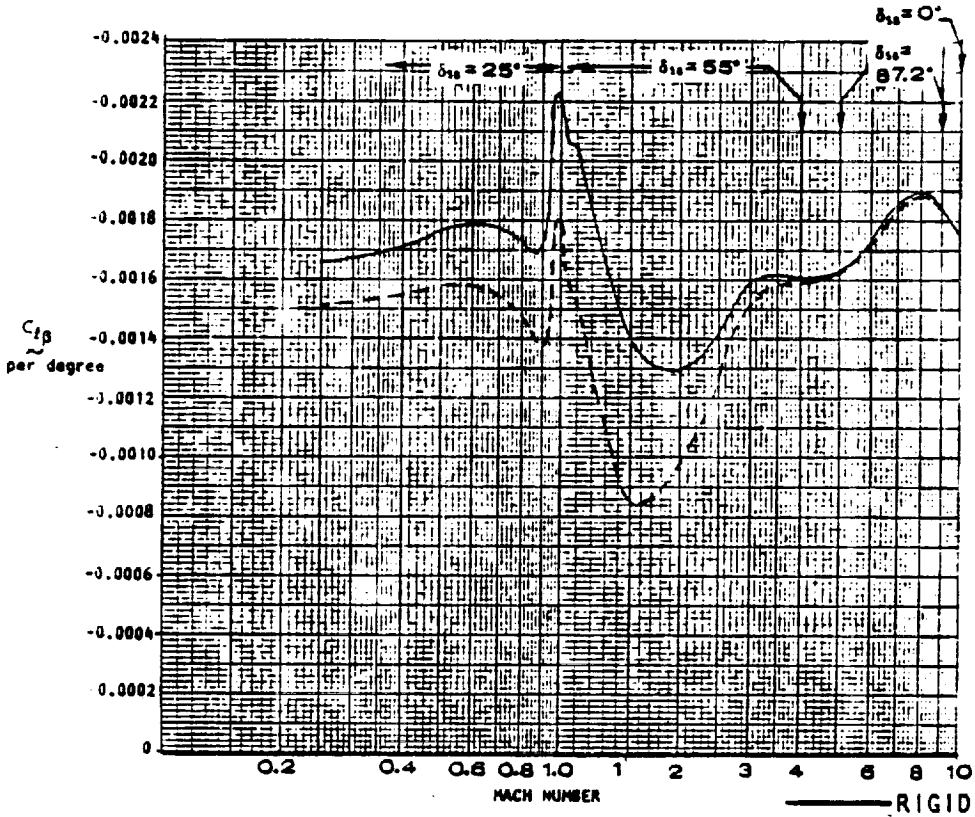


Figure A.3-25
RIGID/FLEX COMPARISON OF DIHEDRAL STABILITY

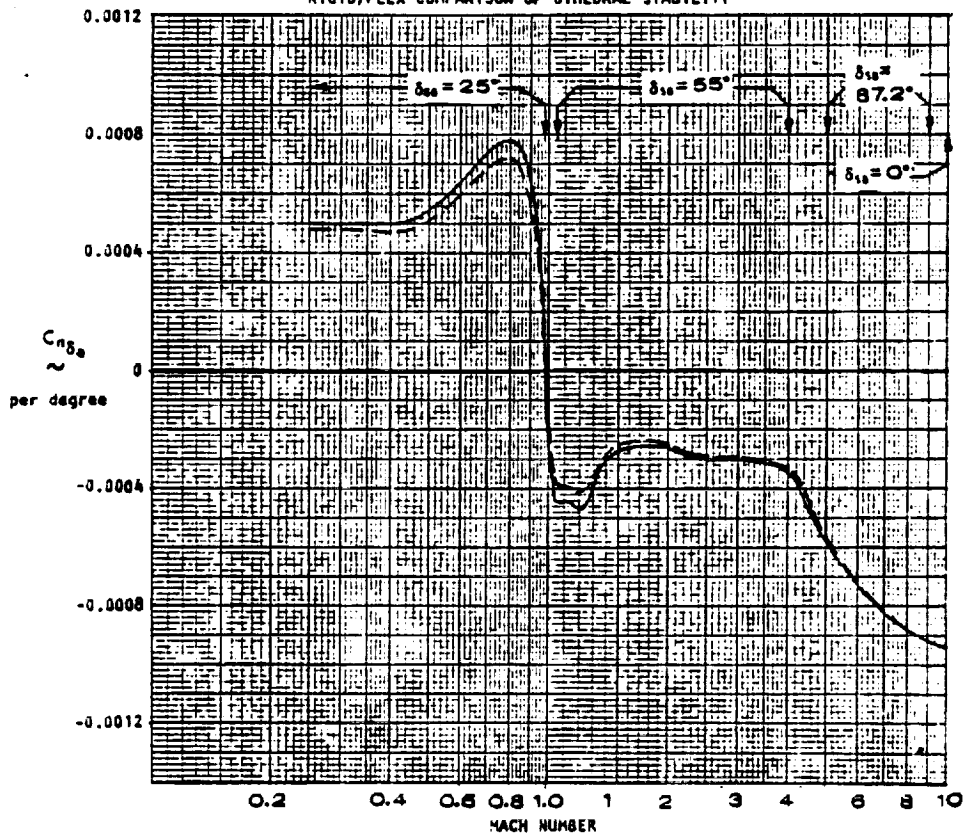


Figure A.3-26
RIGID/FLEX COMPARISON OF YAWING MOMENT DUE TO AILERON

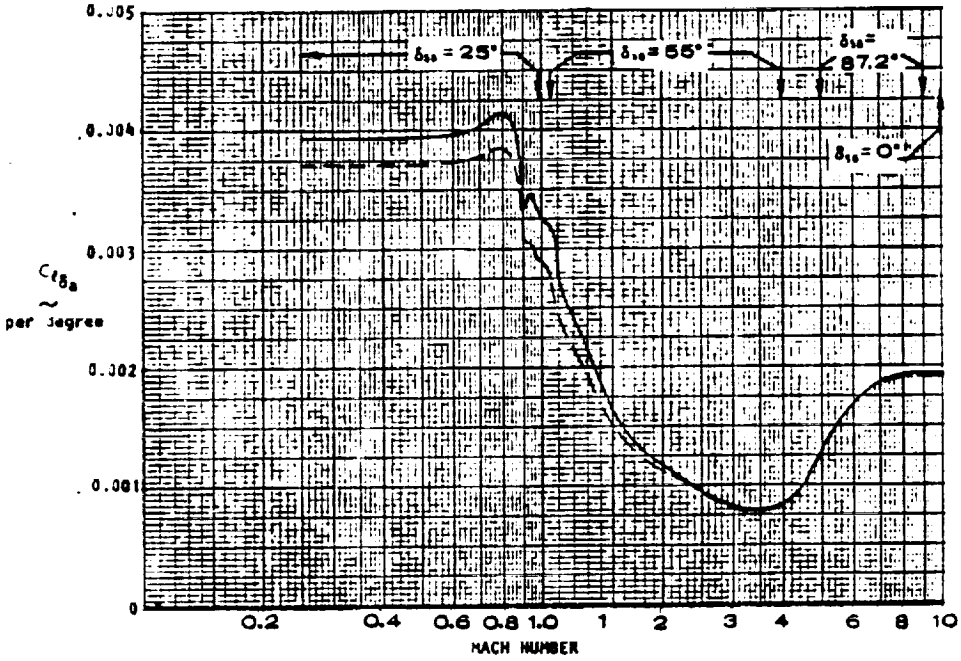


Figure A.3-27
RIGID/FLEX COMPARISON OF ROLLING MOMENT DUE TO AILERON

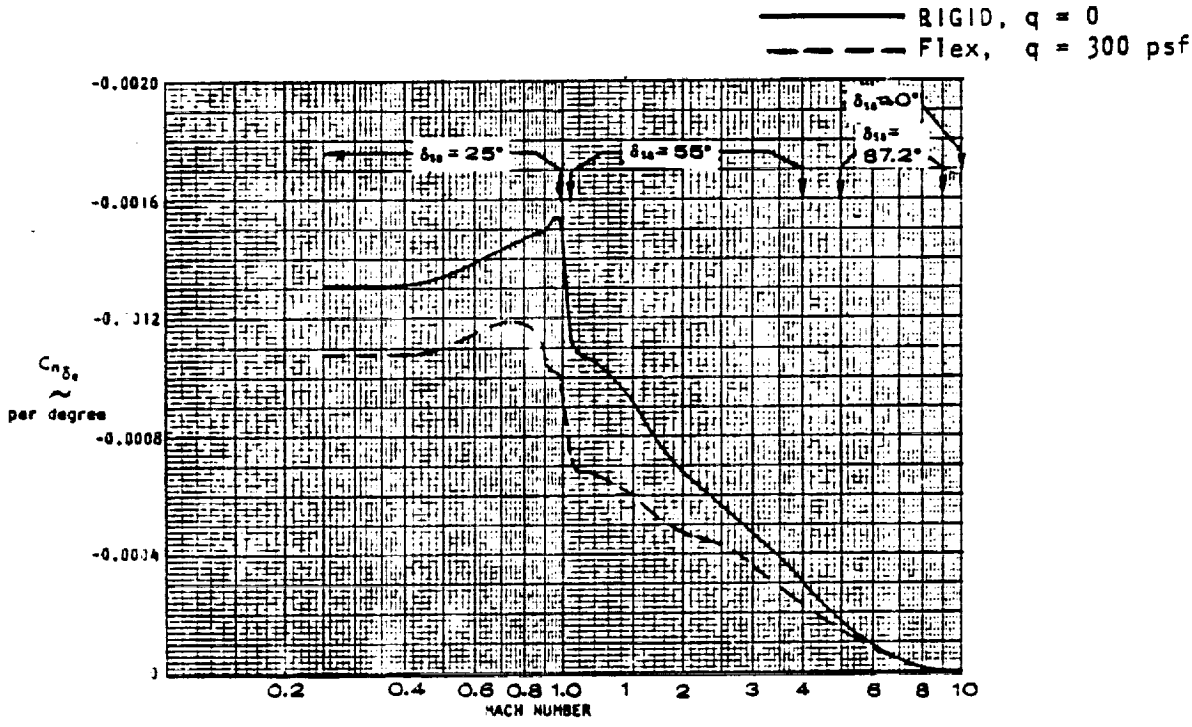


Figure A.3-28
RIGID/FLEX COMPARISON OF YAWING MOMENT DUE TO RUDDER

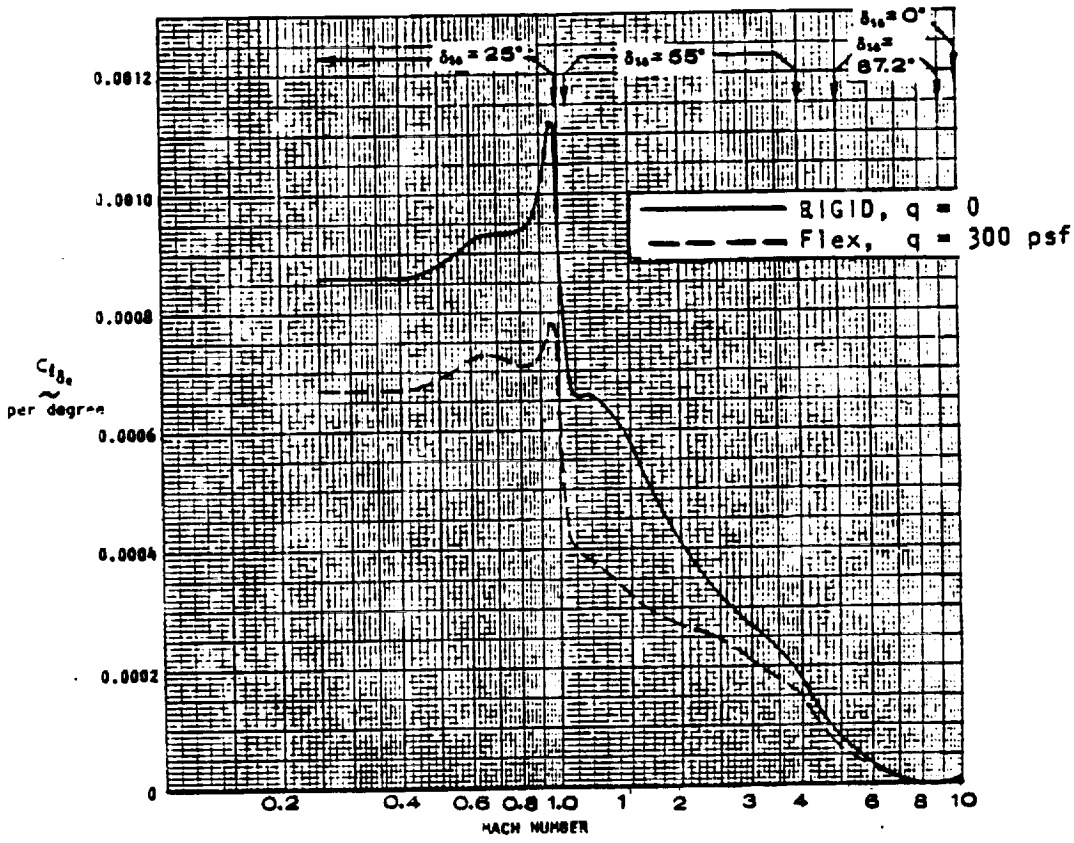
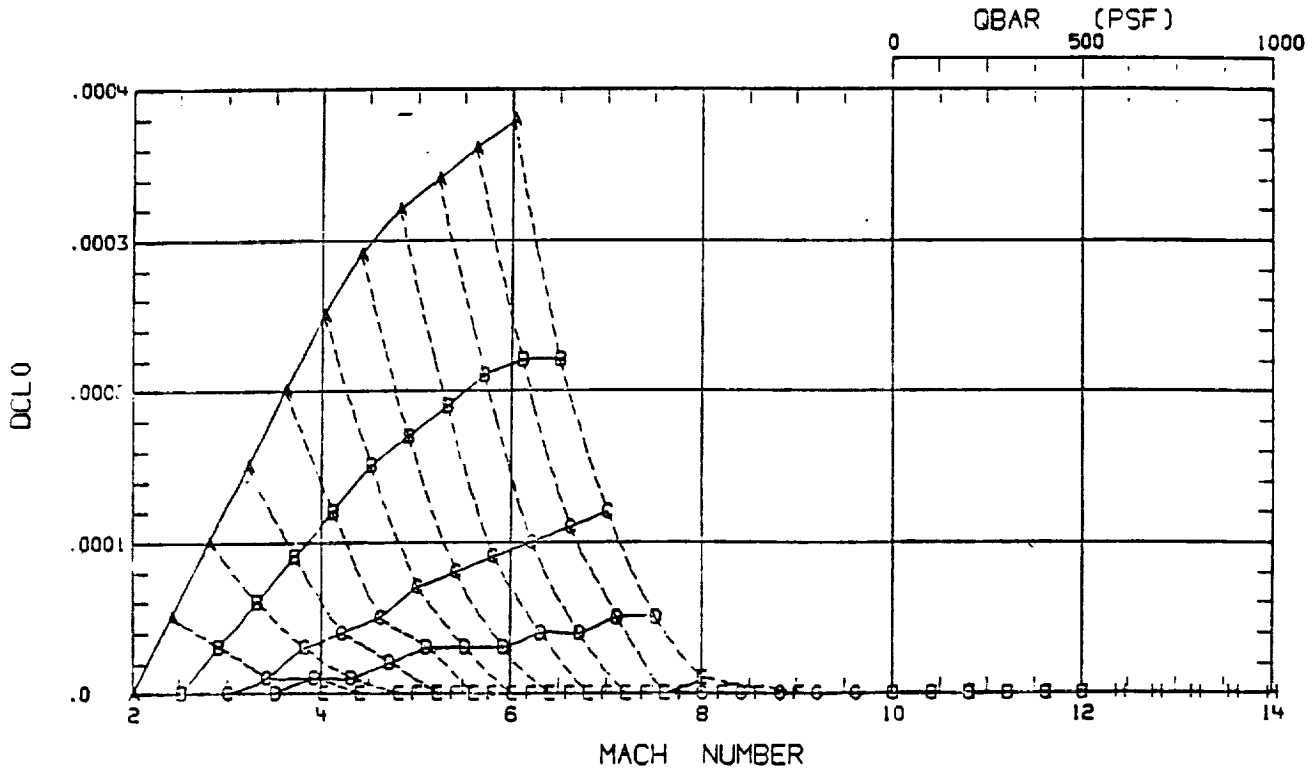


Figure A.3-29
RIGID/FLEX COMPARISON OF ROLLING MOMENT DUE TO RUDDER

A.4 CONTINGENCY ABORT AEROELASTICITY. Aeroelastic data presented in this Appendix (A.4) extend the data of the main sections of this report through a dynamic pressure of 1000 psf in the Mach regime between 2.0 and 10.0. These extended data are intended to support contingency abort studies.



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	FLEX LIFT INCREMENT AT ALPHA=0							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	0.00005	0.00003	0.00001	0.00001	0.0	0.0	0.0	0.0
200.000	0.00010	0.00006	0.00003	0.00001	0.0	0.0	0.0	0.0
300.000	0.00015	0.00009	0.00004	0.00002	0.0	0.0	0.0	0.0
400.000	0.00020	0.00012	0.00005	0.00003	0.0	0.0	0.0	0.0
500.000	0.00025	0.00015	0.00007	0.00003	0.0	0.0	0.0	0.0
600.000	0.00029	0.00017	0.00008	0.00003	0.0	0.0	0.0	0.0
700.000	0.00032	0.00019	0.00009	0.00004	0.0	0.0	0.0	0.0
800.000	0.00034	0.00021	0.00010	0.00004	0.0	0.0	0.0	0.0
900.000	0.00036	0.00022	0.00011	0.00005	0.0	0.0	0.0	0.0
1000.000	0.00038	0.00022	0.00012	0.00005	0.00001	0.0	0.0	0.0

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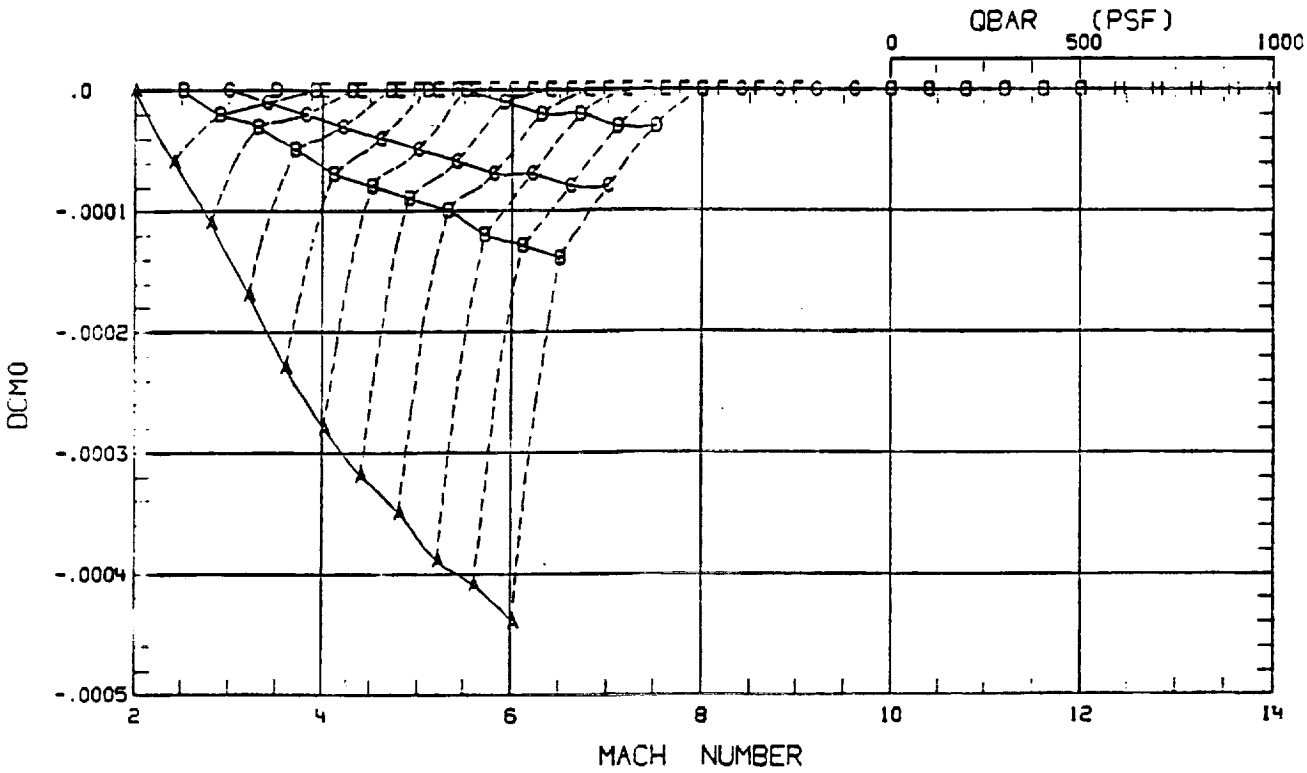
FIGURE A.4- 1
FLEXIBLE LIFT INCREMENT AT ZERO ANGLE OF ATTACK



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF	FLEX PITCH MOM INCR AT ALPHA=0							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.00006	-0.00002	-0.00001	0.0	0.0	0.0	0.0	0.0
200.000	-0.00011	-0.00003	-0.00002	0.0	0.0	0.0	0.0	0.0
300.000	-0.00017	-0.00005	-0.00003	0.0	0.0	0.0	0.0	0.0
400.000	-0.00023	-0.00007	-0.00004	0.0	0.0	0.0	0.0	0.0
500.000	-0.00028	-0.00008	-0.00005	0.0	0.0	0.0	0.0	0.0
600.000	-0.00032	-0.00009	-0.00006	-0.00001	0.0	0.0	0.0	0.0
700.000	-0.00035	-0.00010	-0.00007	-0.00002	0.0	0.0	0.0	0.0
800.000	-0.00039	-0.00012	-0.00007	-0.00002	0.0	0.0	0.0	0.0
900.000	-0.00041	-0.00013	-0.00008	-0.00003	0.0	0.0	0.0	0.0
1000.000	-0.00044	-0.00014	-0.00008	-0.00003	0.0	0.0	0.0	0.0

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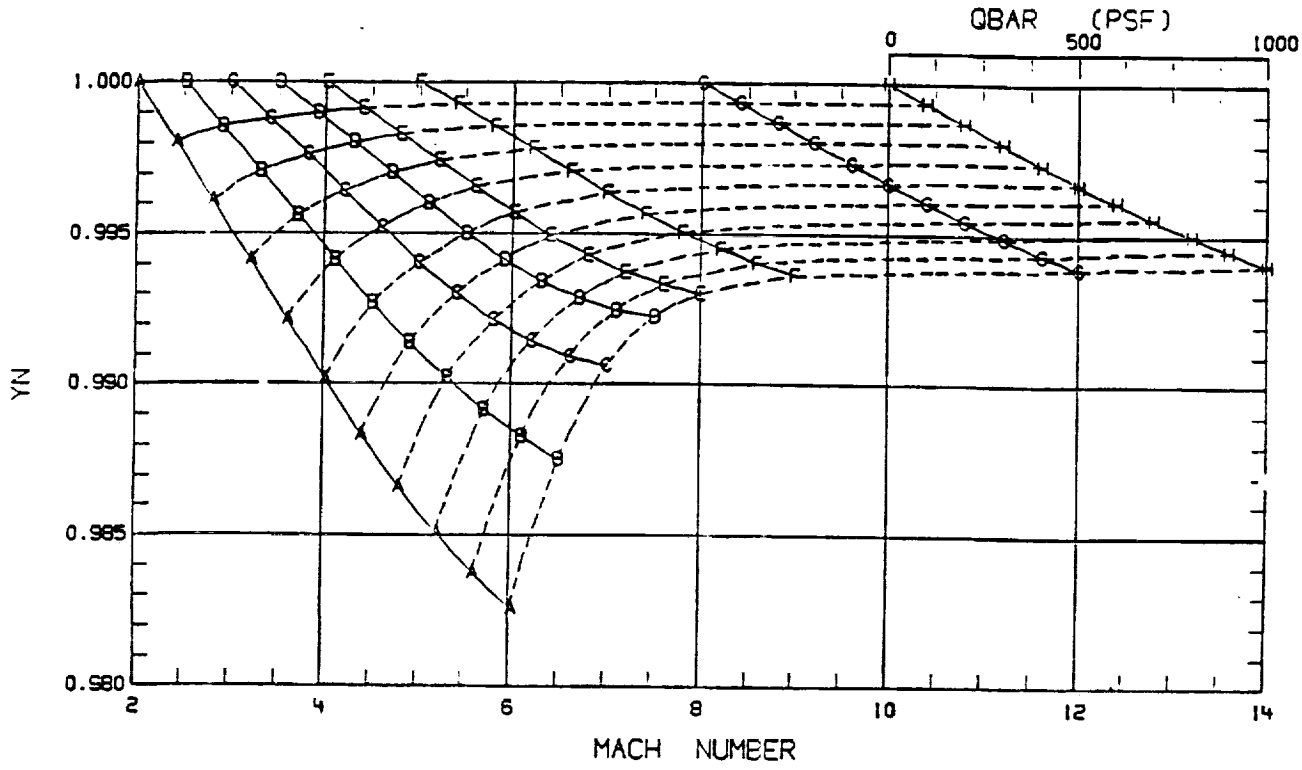
FIGURE A.4-2
FLEX PITCHING MOMENT INCR. AT ZERO ANGLE OF ATTACK



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	F/R NORMAL FORCE (OR LIFT) SLOPE							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99803	0.99853	0.99880	0.99900	0.99913	0.99927	0.99933	0.99933
200.000	0.99607	0.99707	0.99760	0.99800	0.99827	0.99853	0.99867	0.99867
300.000	0.99410	0.99560	0.99640	0.99700	0.99740	0.99780	0.99800	0.99800
400.000	0.99213	0.99413	0.99520	0.99600	0.99653	0.99707	0.99733	0.99733
500.000	0.99017	0.99267	0.99400	0.99500	0.99567	0.99633	0.99667	0.99667
600.000	0.98832	0.99135	0.99297	0.99413	0.99490	0.99565	0.99604	0.99607
700.000	0.98659	0.99018	0.99211	0.99340	0.99424	0.99503	0.99544	0.99552
800.000	0.98507	0.98915	0.99143	0.99285	0.99370	0.99449	0.99487	0.99499
900.000	0.98374	0.98826	0.99093	0.99246	0.99329	0.99401	0.99434	0.99448
1000.000	0.98260	0.98750	0.99060	0.99225	0.99300	0.99360	0.99385	0.99400

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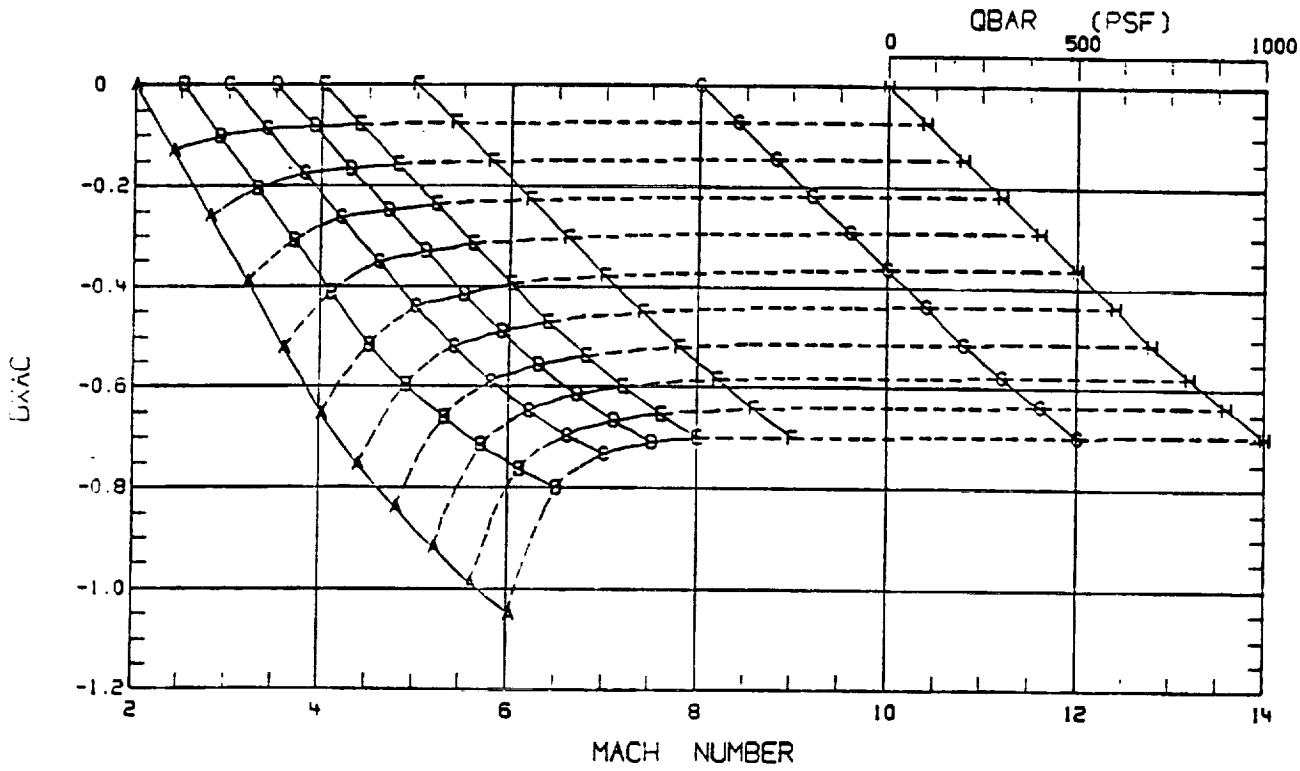
FIGURE A.4- 3
FLEX/RIGID NORMAL FORCE (OR LIFT) SLOPE WITH ALPHA



CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	FLEX A.C. SHIFT (□ MAC)							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.13067	-0.10333	-0.08833	-0.08333	-0.07933	-0.07600	-0.07333	-0.07333
200.000	-0.26133	-0.20667	-0.17667	-0.16667	-0.15867	-0.15200	-0.14667	-0.14667
300.000	-0.39200	-0.31000	-0.26500	-0.25000	-0.23800	-0.22800	-0.22000	-0.22000
400.000	-0.52267	-0.41333	-0.35333	-0.33333	-0.31733	-0.30400	-0.29333	-0.29333
500.000	-0.65333	-0.51667	-0.44167	-0.41667	-0.39667	-0.38000	-0.36667	-0.36667
600.000	-0.75583	-0.59666	-0.52041	-0.49137	-0.47058	-0.45178	-0.44000	-0.44000
700.000	-0.84174	-0.66094	-0.58936	-0.55773	-0.53861	-0.51953	-0.51333	-0.51333
800.000	-0.92045	-0.71707	-0.64807	-0.61635	-0.59956	-0.58356	-0.58000	-0.58000
900.000	-0.99008	-0.76360	-0.69660	-0.66712	-0.65358	-0.64382	-0.63800	-0.63800
1000.000	-1.05000	-0.80000	-0.73500	-0.71000	-0.70080	-0.70030	-0.69600	-0.69600

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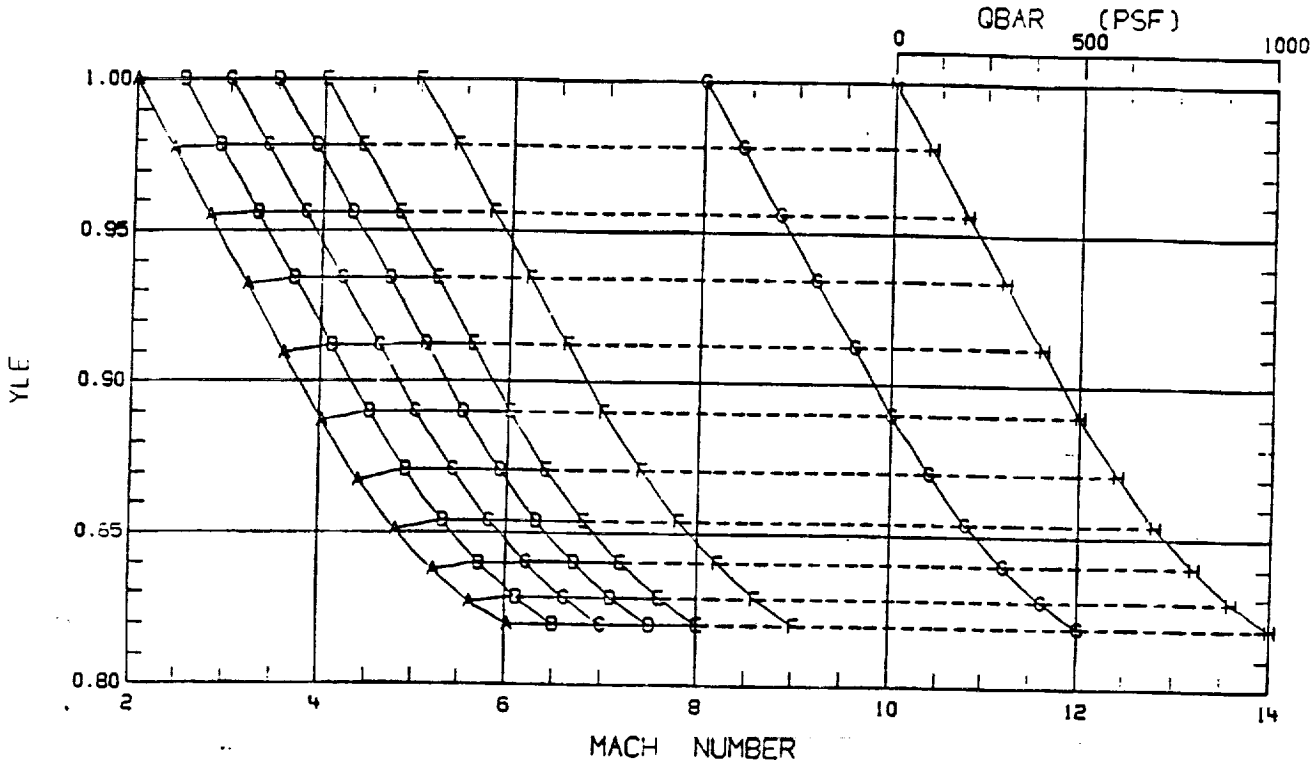
FIGURE A.4-5
FLEX AERODYNAMIC CENTER SHIFT (□ MAC, - = FWD SHIFT)



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R ELEVON LIFT EFFECTIVENESS							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97733	0.97793	0.97797	0.97800	0.97800	0.97800	0.97800	0.97800
200.000	0.95467	0.95587	0.95593	0.95600	0.95600	0.95600	0.95600	0.95600
300.000	0.93200	0.93380	0.93390	0.93400	0.93400	0.93400	0.93400	0.93400
400.000	0.90933	0.91173	0.91187	0.91200	0.91200	0.91200	0.91200	0.91200
500.000	0.88667	0.88967	0.88983	0.89000	0.89000	0.89000	0.89000	0.89000
600.000	0.86712	0.87032	0.87048	0.87067	0.87067	0.87067	0.87067	0.87067
700.000	0.85068	0.85368	0.85382	0.85400	0.85400	0.85400	0.85400	0.85400
800.000	0.83734	0.83974	0.83985	0.84000	0.84000	0.84000	0.84000	0.84000
900.000	0.82712	0.82852	0.82958	0.82967	0.82967	0.82967	0.82967	0.82967
1000.000	0.82000	0.82000	0.82000	0.82000	0.82000	0.82000	0.82000	0.82000

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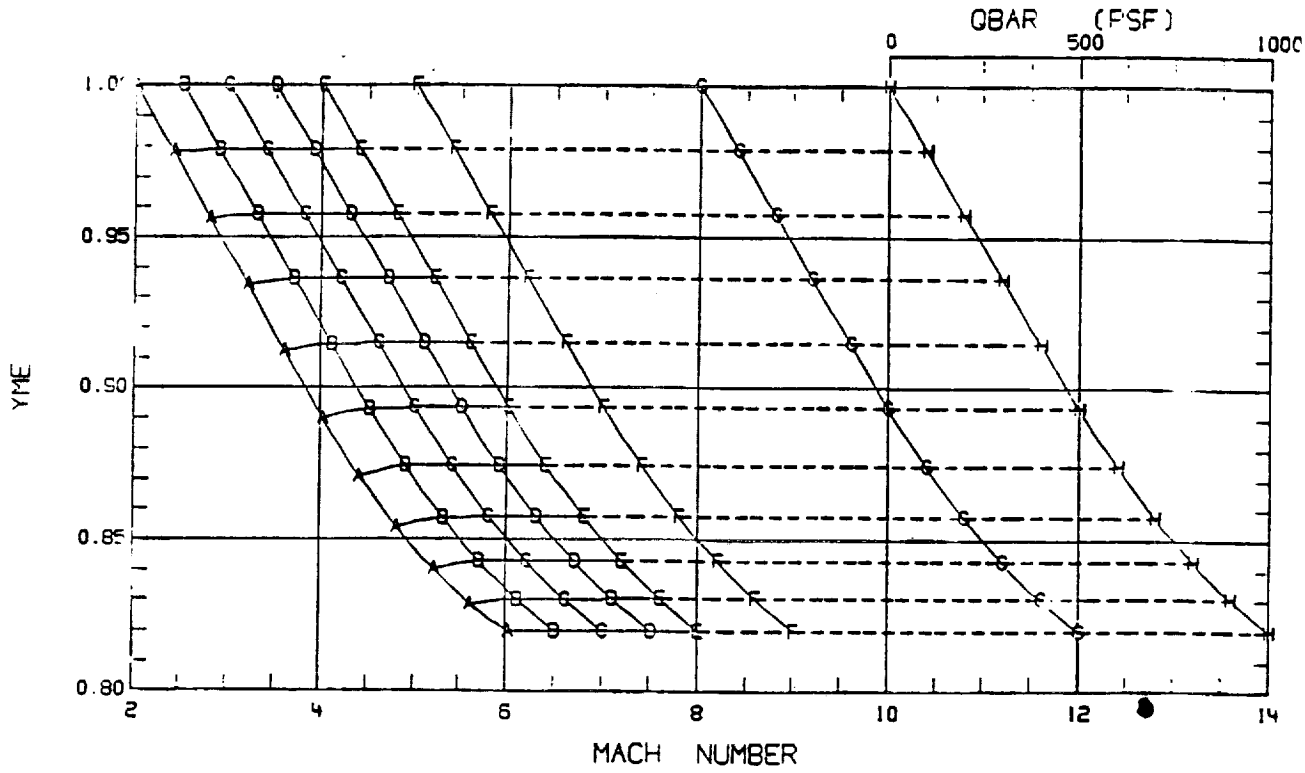
FIGURE A.4- 5
FLEXIBLE/RIGID ELEVON LIFT EFFECTIVENESS



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R ELEVON PITCHING MOM EFFECT							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97800	0.97860	0.97863	0.97867	0.97867	0.97867	0.97867	0.97867
200.000	0.95600	0.95720	0.95727	0.95733	0.95733	0.95733	0.95733	0.95733
300.000	0.93400	0.93580	0.93590	0.93600	0.93600	0.93600	0.93600	0.93600
400.000	0.91200	0.91440	0.91453	0.91467	0.91467	0.91467	0.91467	0.91467
500.000	0.89000	0.89300	0.89317	0.89333	0.89333	0.89333	0.89333	0.89333
600.000	0.87067	0.87387	0.87405	0.87421	0.87421	0.87421	0.87421	0.87421
700.000	0.85400	0.85700	0.85718	0.85732	0.85732	0.85732	0.85732	0.85732
800.000	0.84000	0.84240	0.84254	0.84266	0.84266	0.84266	0.84266	0.84266
900.000	0.82867	0.83007	0.83015	0.83021	0.83021	0.83021	0.83021	0.83021
1000.000	0.82000	0.82000	0.82000	0.82000	0.82000	0.82000	0.82000	0.82000

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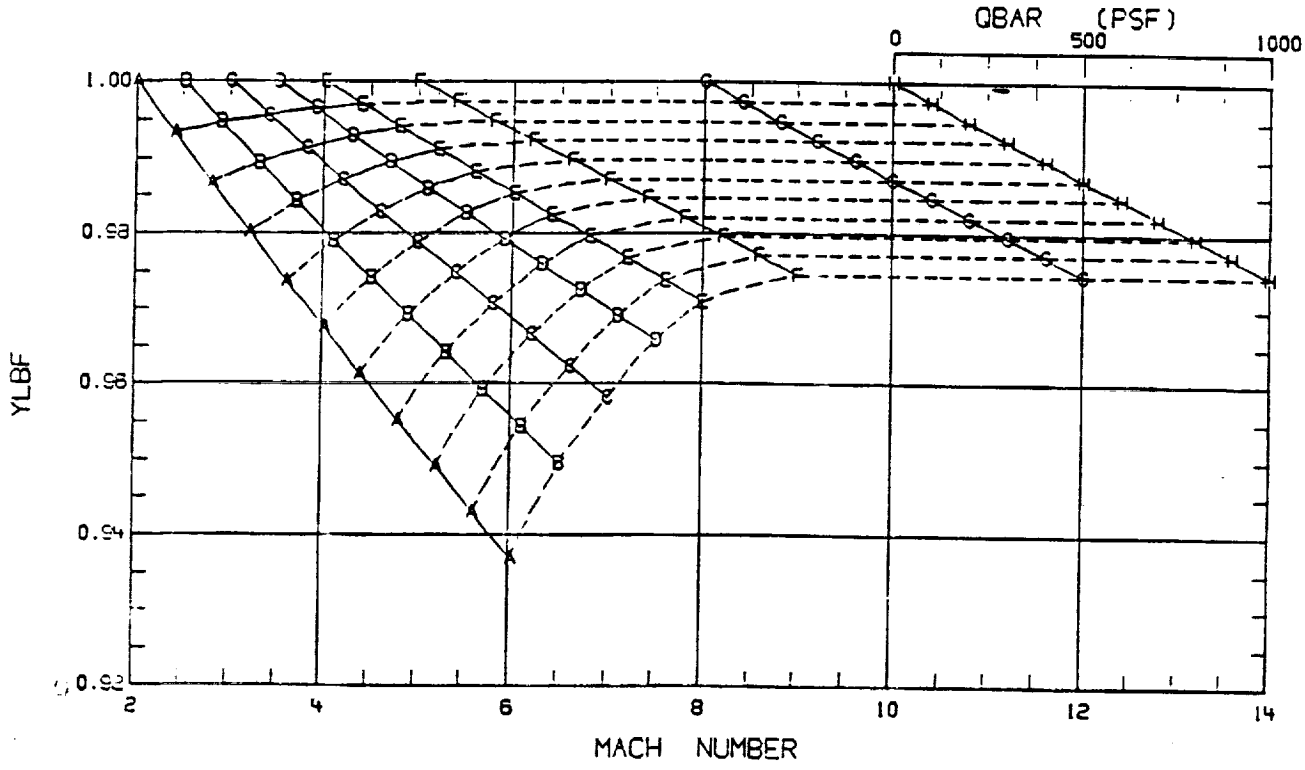
FIGURE A.4- 5
FLEXIBLE/RIGID ELEVON PITCHING MOMENT EFFECTIVENESS



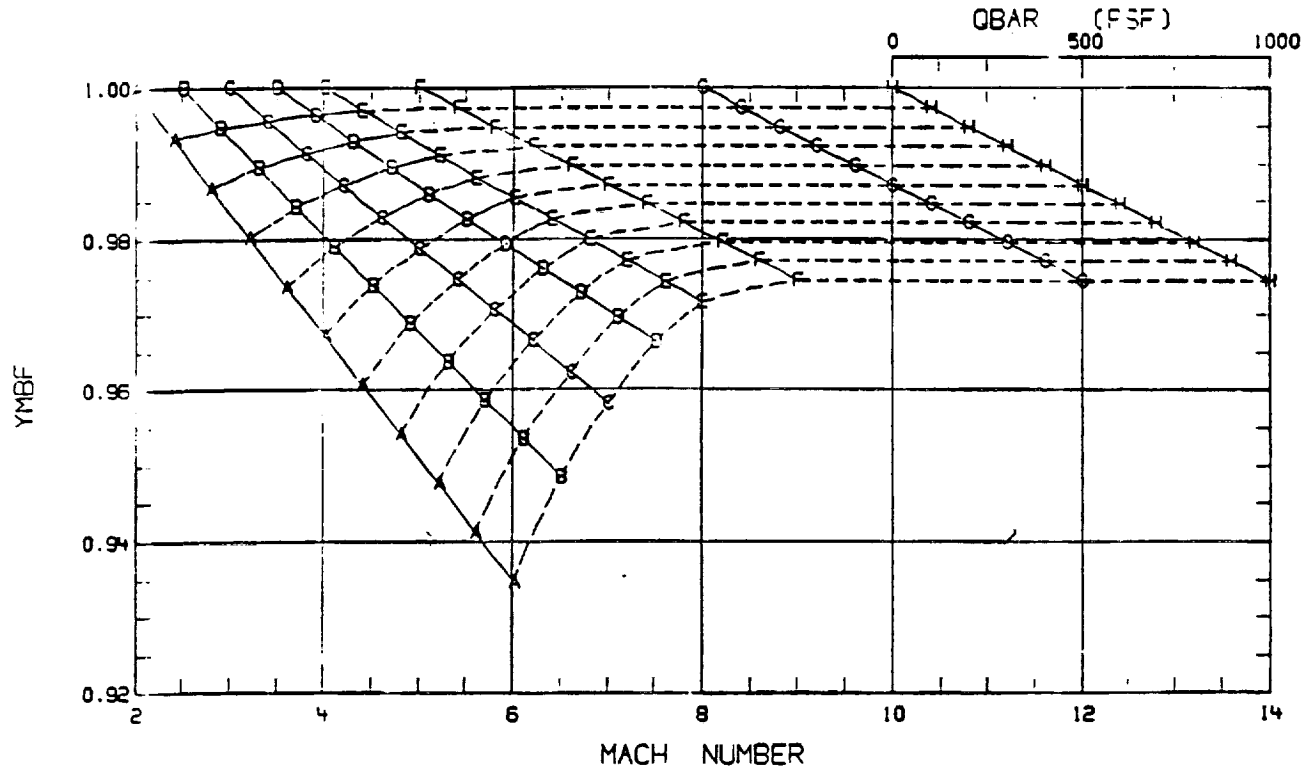
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R BODYFLAP LIFT EFFECTIVENESS							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99324	0.99464	0.99563	0.99645	0.99701	0.99738	0.99738	0.99738
200.000	0.98658	0.98934	0.99129	0.99290	0.99402	0.99478	0.99478	0.99478
300.000	0.98002	0.98410	0.98699	0.98938	0.99105	0.99219	0.99219	0.99219
400.000	0.97355	0.97892	0.98272	0.98587	0.98807	0.98961	0.98961	0.98961
500.000	0.96743	0.97400	0.97864	0.98250	0.98519	0.98708	0.98708	0.98708
600.000	0.96131	0.96908	0.97456	0.97913	0.98231	0.98455	0.98455	0.98455
700.000	0.95519	0.96416	0.97046	0.97576	0.97943	0.98202	0.98202	0.98202
800.000	0.94907	0.95924	0.96640	0.97239	0.97655	0.97949	0.97949	0.97949
900.000	0.94295	0.95432	0.96232	0.96902	0.97367	0.97696	0.97696	0.97696
1000.000	0.93683	0.94940	0.95824	0.96565	0.97079	0.97443	0.97443	0.97443

ENGINEER_____
DATE_____

FIGURE 4.4-7
FLEXIBLE/RIGID BODYFLAP LIFT EFFECTIVENESS



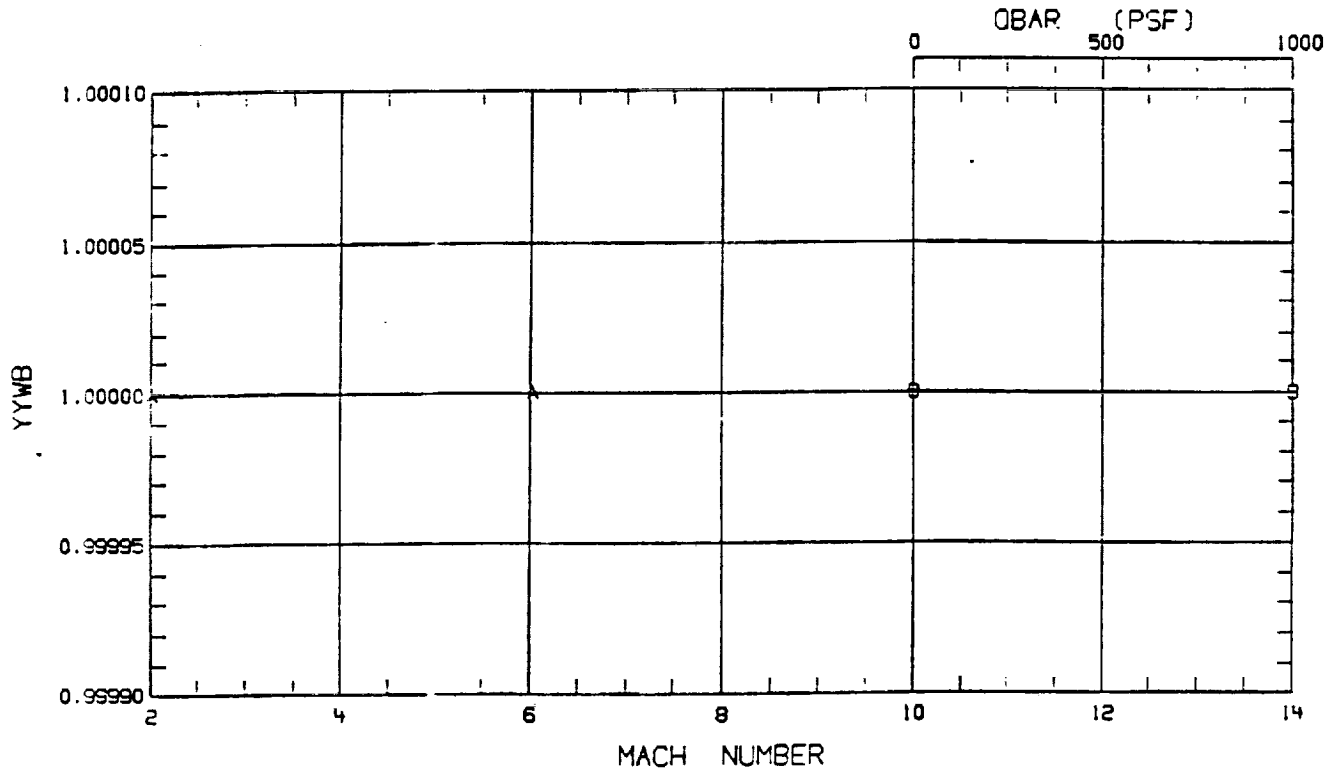
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000	10.000 H
QBAR (PSF	F/R BODYFLAP PITCH MOM EFFECT							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99325	0.99465	0.99563	0.99644	0.99701	0.99738	0.99738	0.99738
200.000	0.98659	0.98935	0.99129	0.99290	0.99402	0.99478	0.99478	0.99478
300.000	0.98002	0.98410	0.98699	0.98938	0.99105	0.99219	0.99219	0.99219
400.000	0.97352	0.97891	0.98272	0.98588	0.98808	0.98961	0.98961	0.98961
500.000	0.96704	0.97384	0.97864	0.98260	0.98532	0.98709	0.98709	0.98709
600.000	0.96056	0.96877	0.97456	0.97932	0.98256	0.98457	0.98457	0.98457
700.000	0.95408	0.96370	0.97048	0.97604	0.97980	0.98205	0.98205	0.98205
800.00	0.94760	0.95863	0.96640	0.97276	0.97704	0.97953	0.97953	0.97953
900.000	0.94112	0.95356	0.96232	0.96948	0.97428	0.97701	0.97701	0.97701
1000.000	0.93464	0.94849	0.95824	0.96620	0.97152	0.97449	0.97449	0.97449

ENGINEER
DATE

FIGURE A.4- 3
FLEXIBLE/RIGID BODYFLAP PITCHING MOMENT EFFECTIVENE

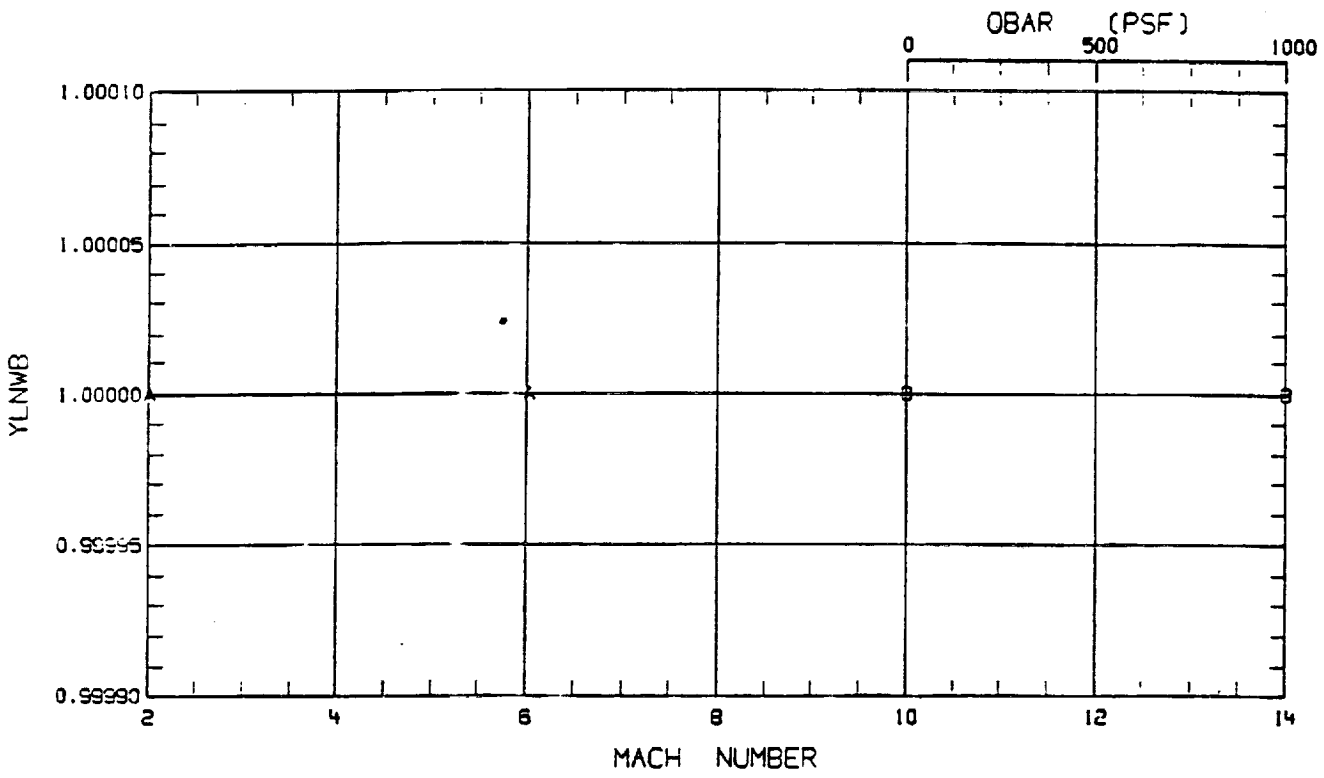


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER	
	2.000	10.000
	A	B
QBAR (PSF)	F/R WING-BODY SIDE FO	
0.0	1.00000	1.00000
1000.000	1.00000	1.00000

ENGINEER_____
DATE_____

FIGURE [illegible]
FLEXIBLE/RIGID WING-BODY SIDE FORCE DERIVATIVE



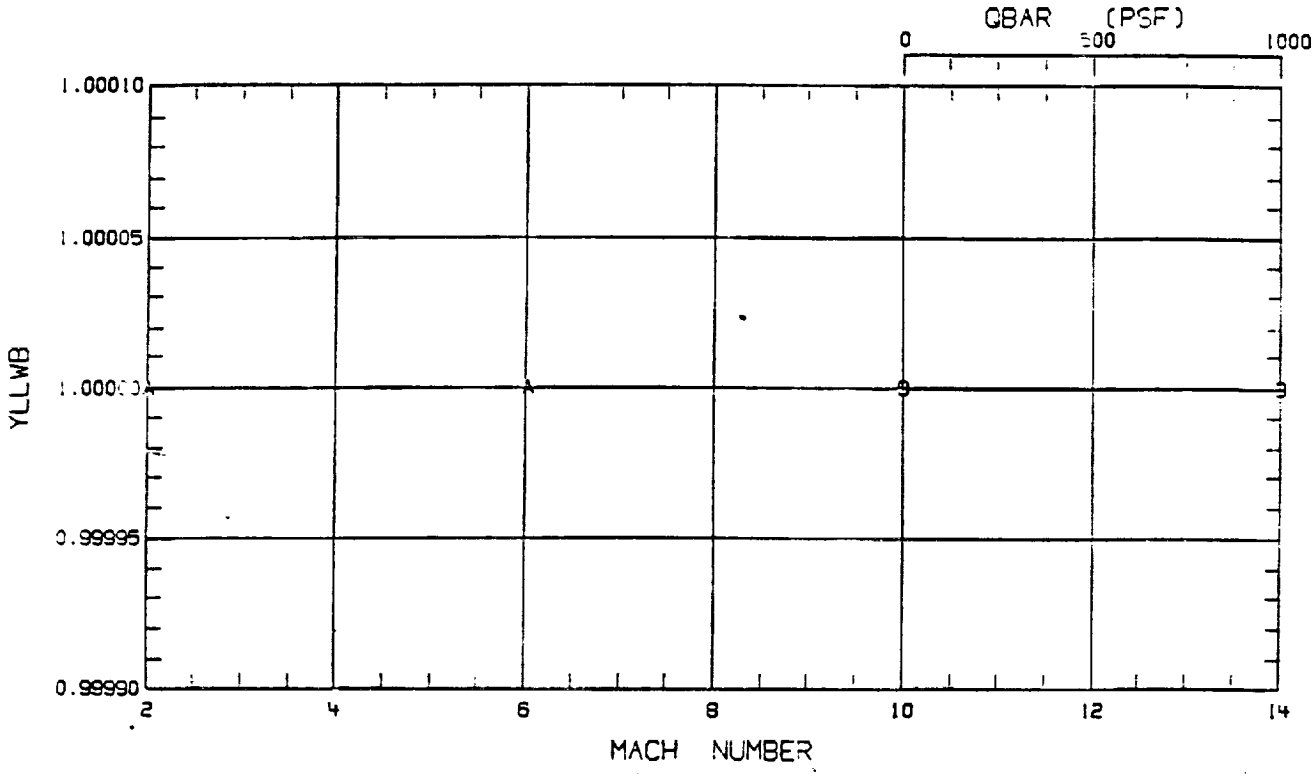
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER	
	2.000	10.000
	A	B
QBAR (PSF)	F/R WING-BODY YAWING	
0.0	1.00000	1.00000
1000.000	1.00000	1.00000

ENGINEER_____
DATE_____

FIGURE [illegible]
FLEXIBLE/RIGID WING-BODY YAWING MOMENT DERIVATIVE

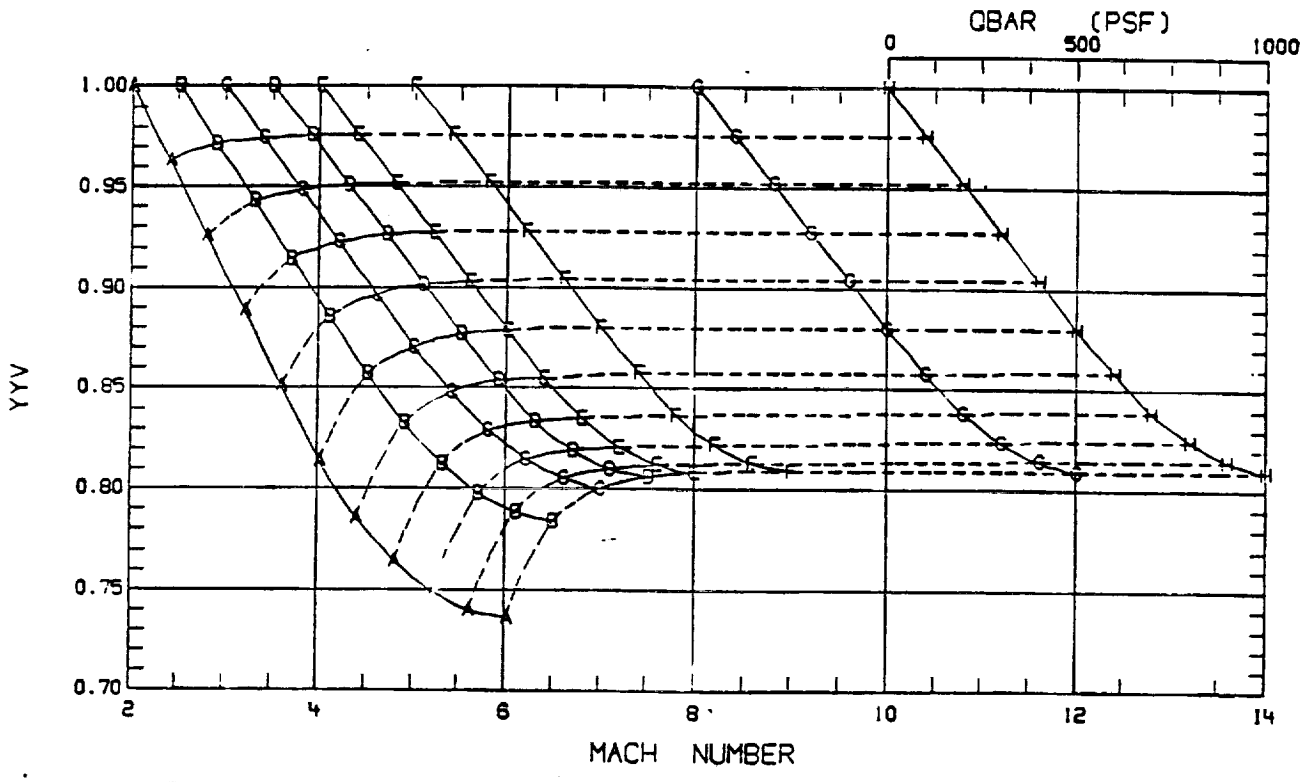


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	B.W = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	C.W = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER	
	2.000	10.000
	A	B
QBAR (PSF)	F/R WING-BODY ROLLING	
0.0	1.00000	1.00000
1000.000	1.00000	1.00000

ENGINEER_____
DATE_____

FIGURE A.4-11
FLEXIBLE/RIGID WING-BODY ROLLING MOMENT DERIVATIVE



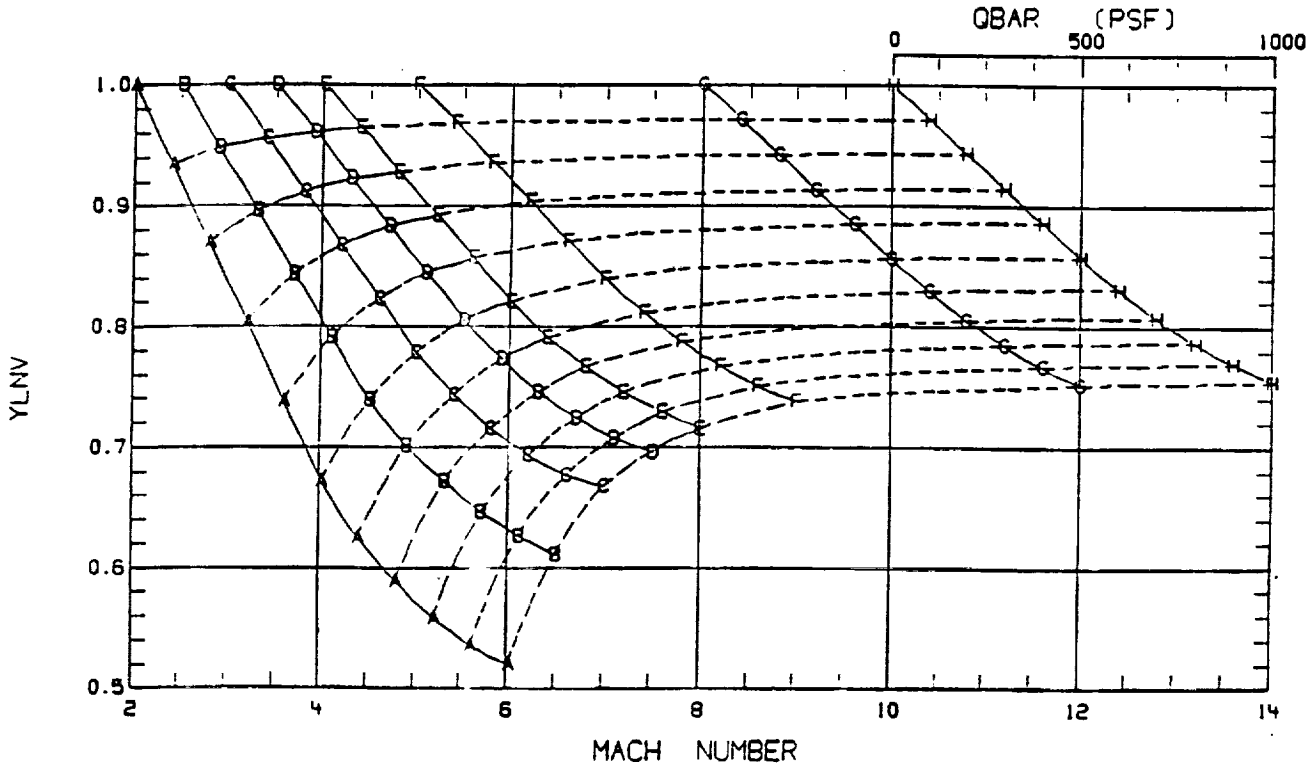
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R VERT. TAIL SIDE FORCE DERIV							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.96267	0.97133	0.97400	0.97533	0.97567	0.97600	0.97600	0.97600
200.000	0.92533	0.94267	0.94800	0.95067	0.95133	0.95200	0.95200	0.95200
300.000	0.88800	0.91400	0.92200	0.92600	0.92700	0.92800	0.92900	0.92800
400.000	0.85067	0.88533	0.89600	0.90133	0.90267	0.90400	0.90400	0.90400
500.000	0.81333	0.85667	0.87000	0.87667	0.87833	0.88000	0.88000	0.88000
600.000	0.76503	0.83211	0.84744	0.85379	0.85475	0.85734	0.85785	0.85814
700.000	0.76431	0.81202	0.82866	0.83326	0.83490	0.83648	0.83808	0.83891
800.000	0.74901	0.79739	0.81456	0.81859	0.82061	0.82156	0.82348	0.82444
900.000	0.73952	0.78808	0.80504	0.80968	0.81172	0.81264	0.81392	0.81455
1000.000	0.73600	0.78400	0.80000	0.80600	0.80800	0.80900	0.80900	0.80900

ENGINEER _____
DATE _____

FIGURE A.4-12
FLEXIBLE/RIGID VERTICAL TAIL SIDE FORCE DERIVATIVE



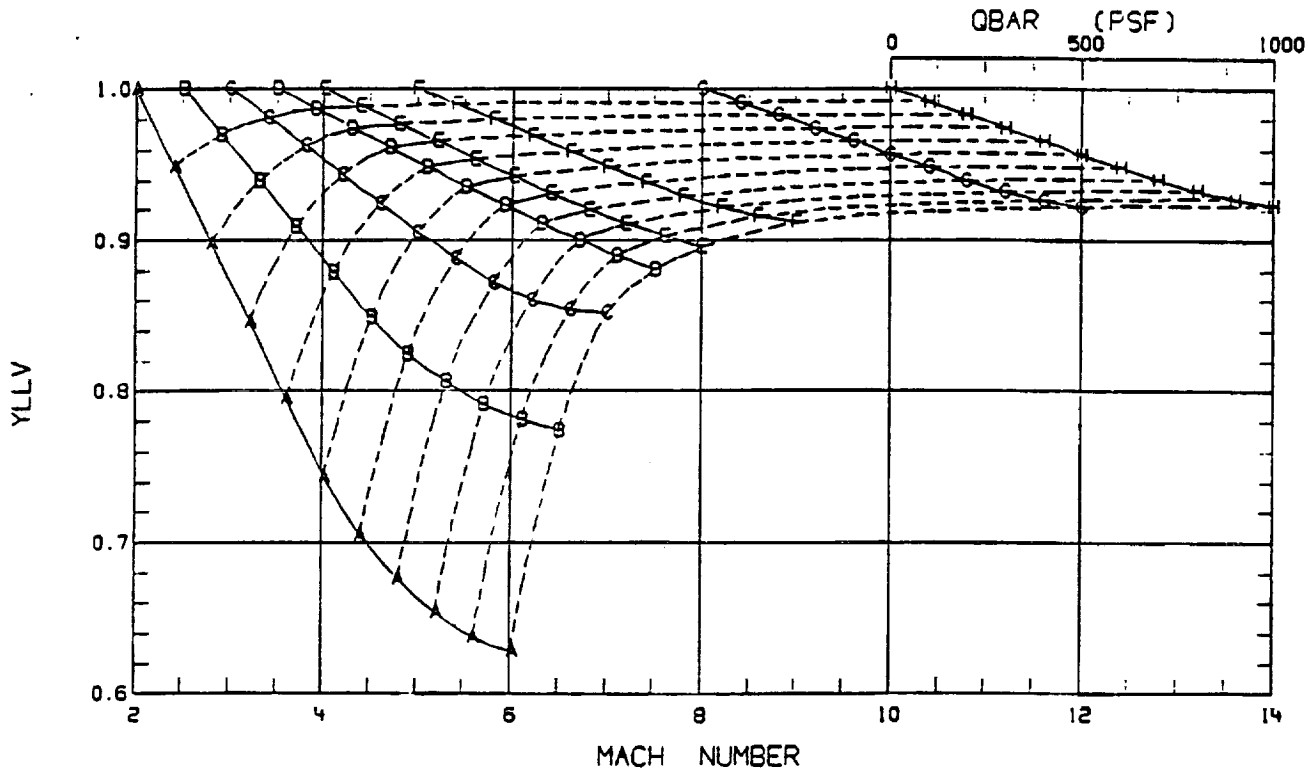
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	F/R VERT. TAIL YAWING MOM DERIV							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.93433	0.94767	0.95567	0.96100	0.96400	0.96767	0.97100	0.97133
200.000	0.86867	0.89533	0.91133	0.92200	0.92800	0.93533	0.94200	0.94267
300.000	0.80300	0.84300	0.86700	0.88300	0.89200	0.90300	0.91300	0.91400
400.000	0.73733	0.79067	0.82267	0.84400	0.85600	0.87067	0.88400	0.88533
500.000	0.67167	0.73833	0.77833	0.80500	0.82000	0.83833	0.85500	0.85667
600.000	0.62429	0.70029	0.74274	0.77231	0.79034	0.81038	0.82856	0.83039
700.000	0.58866	0.67108	0.71477	0.74549	0.76587	0.78655	0.80479	0.80669
800.000	0.55875	0.64593	0.69265	0.72376	0.74500	0.76633	0.78396	0.78611
900.000	0.53572	0.62580	0.67668	0.70724	0.72800	0.74980	0.76604	0.76855
1000.000	0.52000	0.61100	0.66700	0.69600	0.71500	0.73700	0.75100	0.75400

ENGINEER_____
DATE_____

FIGURE A.4-13
FLEXIBLE/RIGID VERTICAL TAIL YAWING MOMENT DERIVATI



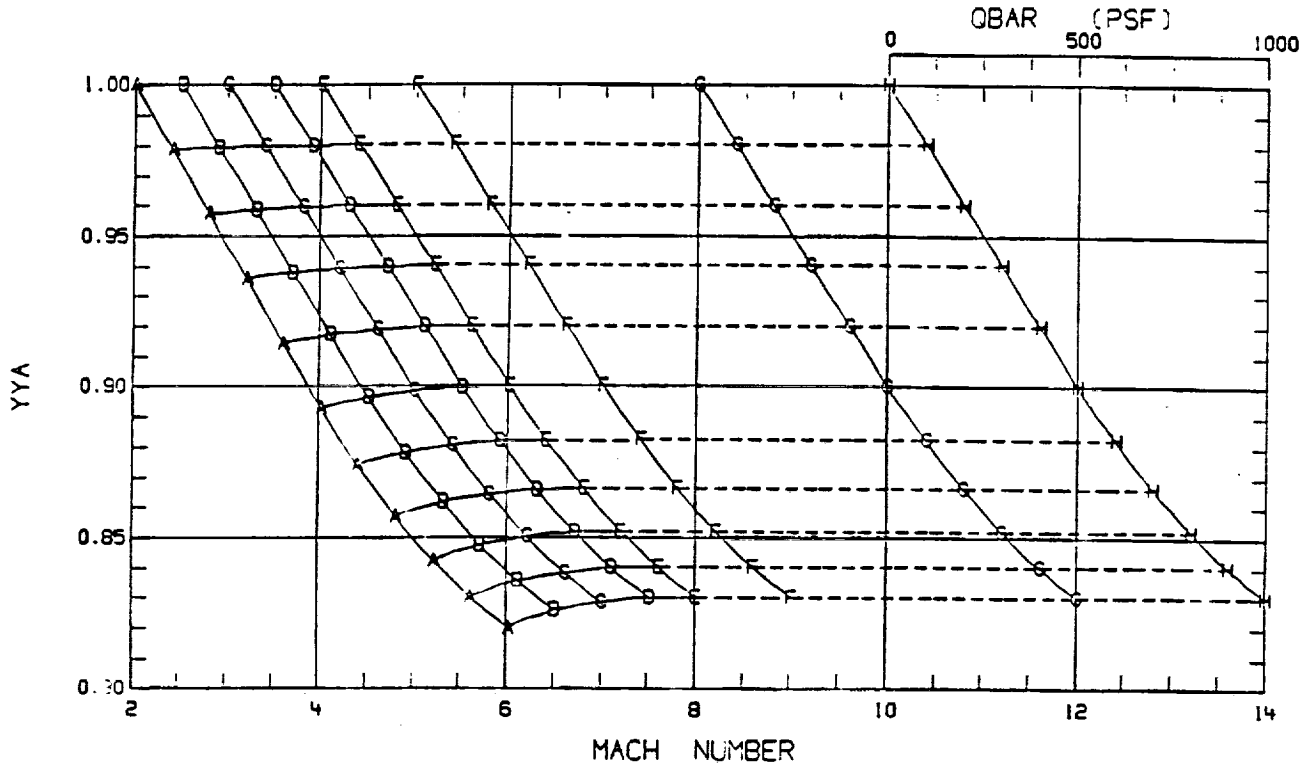
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	F/R VERT. TAIL ROLLING MOM DERIV							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.94867	0.96967	0.98100	0.98700	0.98833	0.98967	0.99133	0.99133
200.000	0.89733	0.93933	0.96200	0.97400	0.97667	0.97933	0.98267	0.98267
300.000	0.84600	0.90900	0.94300	0.96100	0.96500	0.96900	0.97400	0.97400
400.000	0.79467	0.87867	0.92400	0.94800	0.95333	0.95667	0.96533	0.96533
500.000	0.74333	0.84833	0.90500	0.93500	0.94167	0.94833	0.95667	0.95667
600.000	0.70486	0.82441	0.88730	0.92252	0.93048	0.93841	0.94800	0.94815
700.000	0.67611	0.80584	0.87134	0.91063	0.91988	0.92906	0.93933	0.93981
800.000	0.65333	0.79109	0.86024	0.89960	0.91047	0.92157	0.93171	0.93279
900.000	0.63720	0.78044	0.85396	0.88940	0.90220	0.91596	0.92616	0.92726
1000.000	0.62900	0.77400	0.85200	0.88000	0.89500	0.91200	0.92200	0.92300

ENGINEER _____
DATE _____

FIGURE A.4-14
FLEXIBLE/RIGID VERTICAL TAIL ROLLING MOMENT DERIVAT



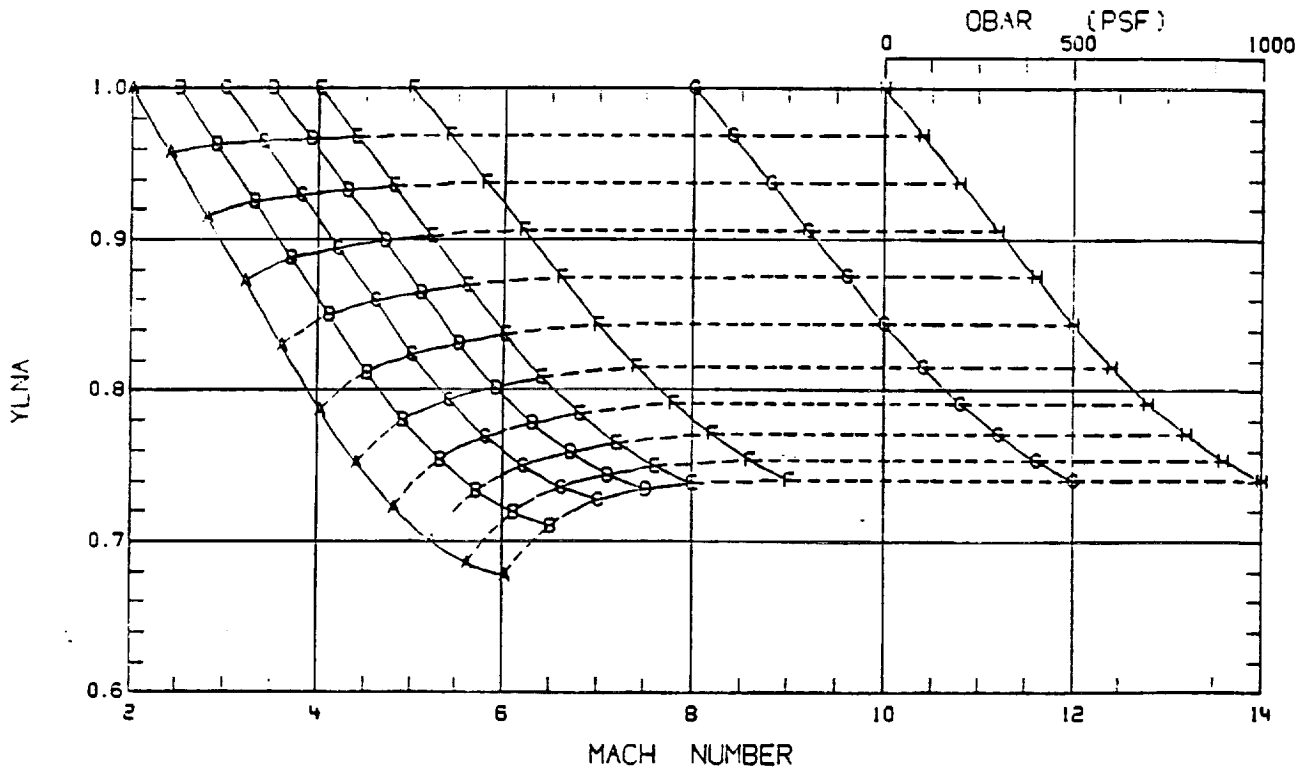
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	F/R AILERON SIDE FORCE DERIV.							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97857	0.97927	0.97967	0.97993	0.97997	0.98000	0.98000	0.98000
200.000	0.95713	0.95853	0.95933	0.95987	0.95993	0.96000	0.96000	0.96000
300.000	0.93570	0.93780	0.93900	0.93980	0.93990	0.94000	0.94000	0.94000
400.000	0.91427	0.91707	0.91867	0.91973	0.91987	0.92000	0.92000	0.92000
500.000	0.89283	0.89633	0.89833	0.89967	0.89983	0.90000	0.90000	0.90000
600.000	0.87369	0.87780	0.88011	0.88165	0.88181	0.88200	0.88200	0.88200
700.000	0.85682	0.86147	0.86401	0.86567	0.86583	0.86600	0.86600	0.86600
800.000	0.84225	0.84734	0.85002	0.85174	0.85186	0.85200	0.85200	0.85200
900.000	0.82998	0.83542	0.83815	0.83985	0.83992	0.84000	0.84000	0.84000
1000.000	0.82000	0.82570	0.82840	0.83000	0.83000	0.83000	0.83000	0.83000

ENGINEER
DATE

FIGURE A.4-15
FLEXIBLE/RIGID AILERON SIDE FORCE DERIVATIVE



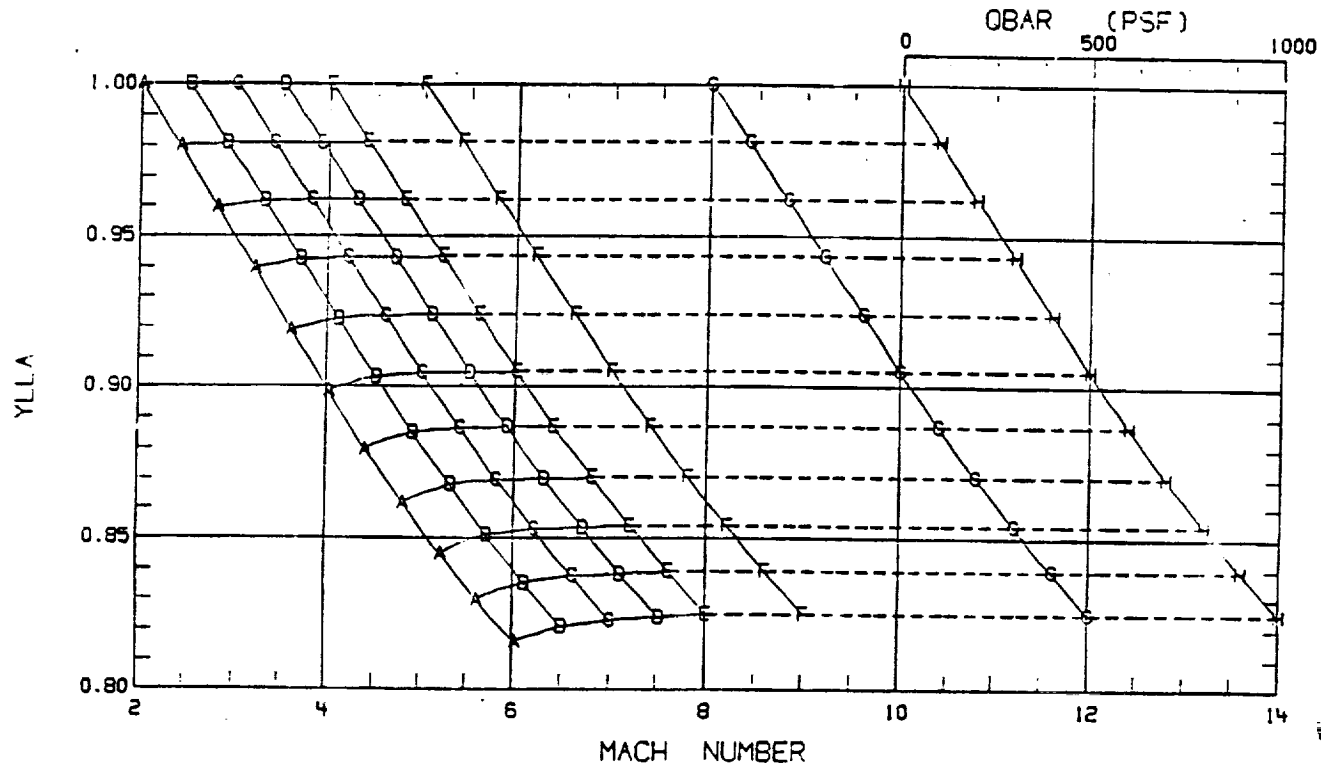
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	F/R AILERON YAWING MOMENT DERIV.							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.95733	0.96233	0.96460	0.96610	0.96727	0.96857	0.96867	0.96867
200.000	0.91467	0.92467	0.92920	0.93220	0.93453	0.93713	0.93733	0.93733
300.000	0.87200	0.88700	0.89380	0.89830	0.90180	0.90570	0.90600	0.90600
400.000	0.82933	0.84933	0.85840	0.86440	0.86907	0.87427	0.87467	0.87467
500.000	0.78667	0.81167	0.82300	0.83050	0.83633	0.84283	0.84333	0.84333
600.000	0.75092	0.77979	0.79300	0.80147	0.80796	0.81502	0.81555	0.81555
700.000	0.72208	0.75368	0.76840	0.77730	0.78396	0.79083	0.79133	0.79133
800.000	0.70015	0.73334	0.74920	0.75800	0.76433	0.77026	0.77066	0.77066
900.000	0.68512	0.71879	0.73540	0.74357	0.74908	0.75332	0.75355	0.75355
1000.000	0.67700	0.71000	0.72700	0.73400	0.73820	0.74000	0.74000	0.74000

ENGINEER_____
DATE_____

FIGURE A.4-16
FLEXIBLE/RIGID AILERON YAWING MOMENT DERIVATIVE



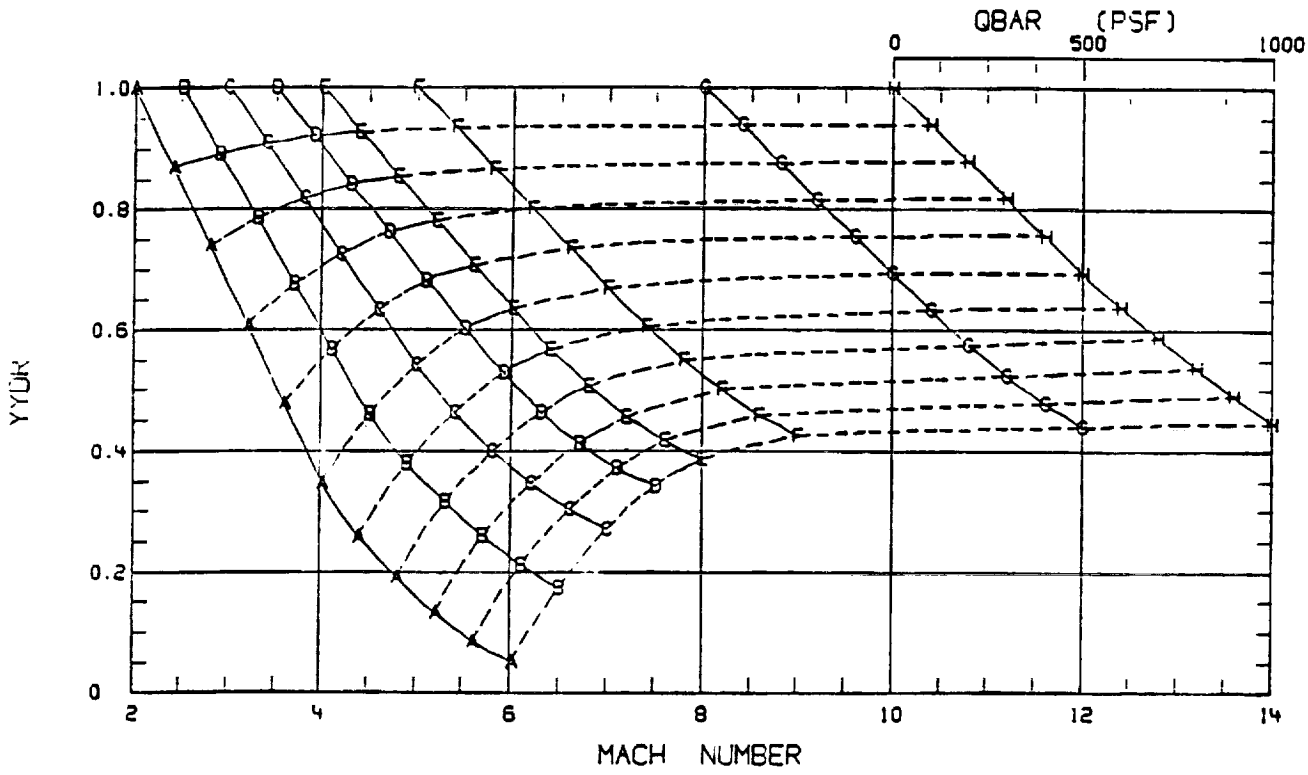
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	F/R AILERON ROLLING MOM DERIV							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.97967	0.98063	0.98087	0.98093	0.98097	0.98100	0.98100	0.98100
200.000	0.95933	0.96127	0.96173	0.96187	0.96193	0.96200	0.96200	0.96200
300.000	0.93900	0.94190	0.94260	0.94280	0.94290	0.94300	0.94300	0.94300
400.000	0.91867	0.92253	0.92347	0.92373	0.92387	0.92400	0.92400	0.92400
500.000	0.89833	0.90317	0.90433	0.90467	0.90483	0.90500	0.90500	0.90500
600.000	0.87925	0.88476	0.88615	0.88659	0.88681	0.88700	0.88700	0.88700
700.000	0.86142	0.86730	0.86892	0.86948	0.86982	0.87000	0.87000	0.87000
800.000	0.84485	0.85078	0.85266	0.85334	0.85386	0.85400	0.85400	0.85400
900.000	0.82955	0.83522	0.83735	0.83819	0.83891	0.83900	0.83900	0.83900
1000.000	0.81550	0.82060	0.82300	0.82400	0.82500	0.82500	0.82500	0.82500

ENGINEER _____
DATE _____

FIGURE A.4-17
FLEXIBLE/RIGID AILERON ROLLING MOMENT DERIVATIVE

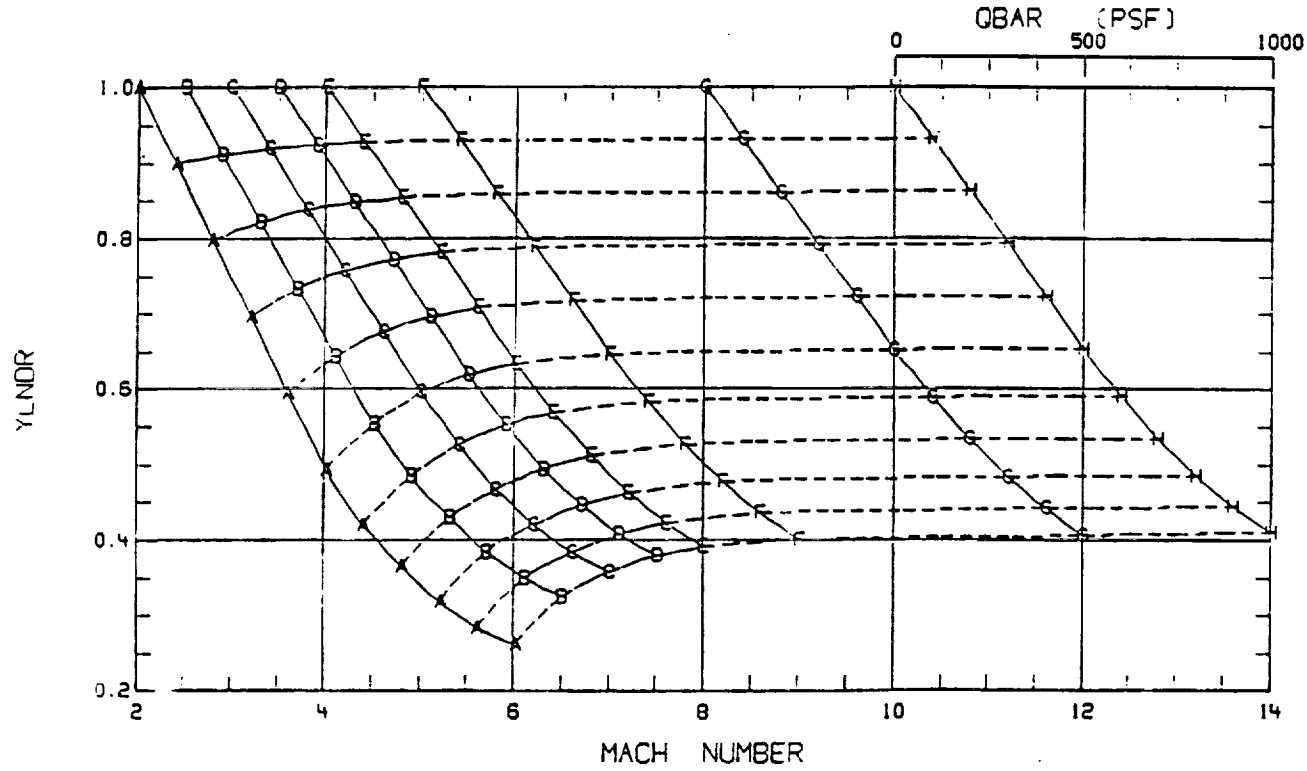


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	F/R RUDDER SIDE FORCE DERIV							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.96900	0.89167	0.90800	0.92033	0.92667	0.93333	0.93833	0.93867
200.000	0.73800	0.78333	0.81600	0.84067	0.85333	0.86667	0.87667	0.87733
300.000	0.60700	0.67500	0.72400	0.76100	0.78000	0.80000	0.81500	0.81600
400.000	0.47600	0.56667	0.63200	0.68133	0.70667	0.73333	0.75333	0.75467
500.000	0.34500	0.45833	0.54000	0.60167	0.63333	0.66667	0.69167	0.69333
600.000	0.25651	0.37792	0.46256	0.52849	0.56591	0.60444	0.63162	0.63719
700.000	0.19013	0.31414	0.39819	0.46311	0.50544	0.54748	0.57371	0.58509
800.000	0.13200	0.25769	0.34440	0.41039	0.45537	0.49879	0.52359	0.53553
900.000	0.08500	0.21044	0.30160	0.36968	0.41536	0.45808	0.47828	0.48880
1000.000	0.05000	0.17300	0.27000	0.34100	0.38500	0.42500	0.44000	0.44500

ENGINEER _____
DATE _____

FIGURE A.4-18
FLEXIBLE/RIGID RUDDER SIDE FORCE DERIVATIVE



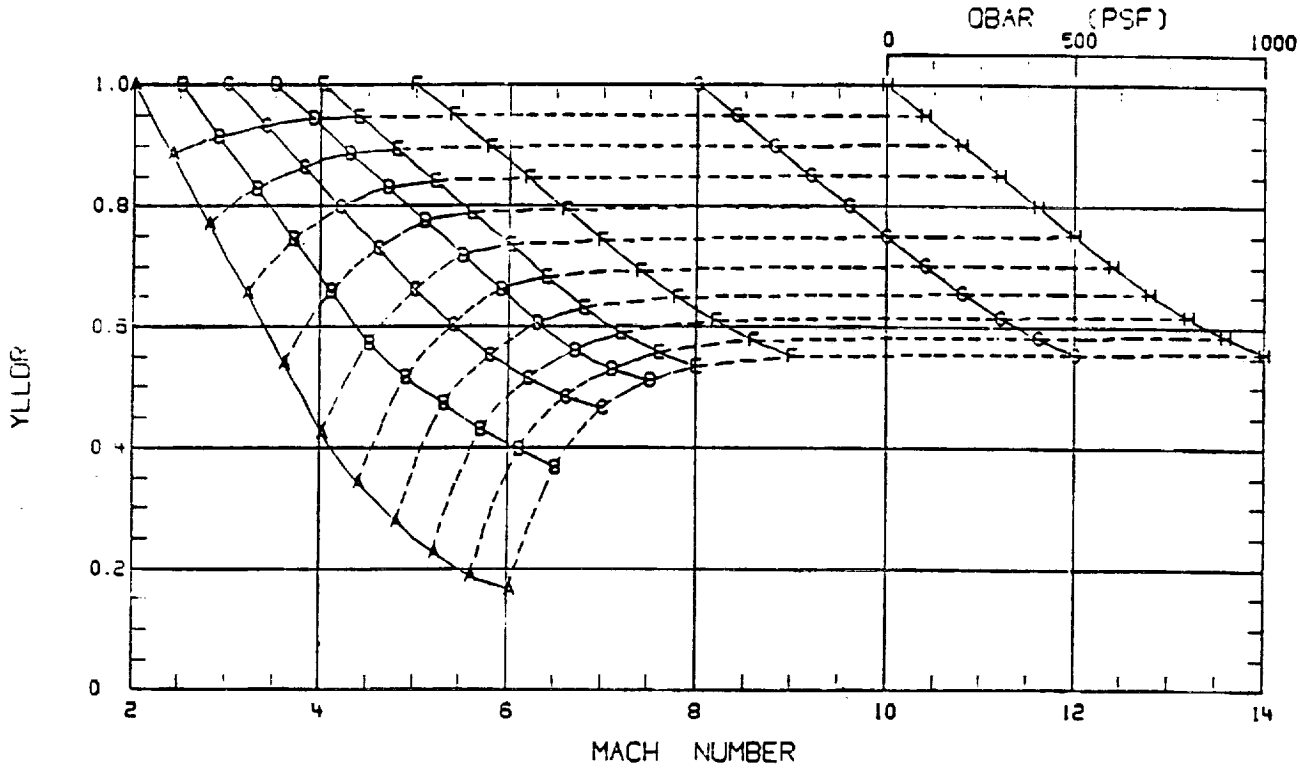
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R RUDDER YAWING MOM DERIV							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.89867	0.91067	0.91900	0.92367	0.92867	0.92900	0.93033	0.93067
200.000	0.79733	0.82133	0.83800	0.84733	0.85333	0.85800	0.86067	0.86133
300.000	0.69600	0.73200	0.75700	0.77100	0.78000	0.78700	0.79100	0.79200
400.000	0.59467	0.64267	0.67600	0.69467	0.70667	0.71600	0.72133	0.72267
500.000	0.49333	0.55333	0.59500	0.61833	0.63333	0.64500	0.65167	0.65333
600.000	0.41957	0.48360	0.52505	0.55114	0.56784	0.58150	0.58872	0.59008
700.000	0.36417	0.42935	0.46621	0.49329	0.51046	0.52538	0.53253	0.53341
800.000	0.31813	0.38341	0.41860	0.44517	0.46173	0.47640	0.48319	0.48461
900.000	0.28320	0.34832	0.38220	0.40676	0.42160	0.43460	0.44068	0.44352
1000.000	0.25000	0.32400	0.35700	0.37800	0.39000	0.40000	0.40500	0.41000

ENGINEER _____
DATE _____

FIGURE A.4-19
FLEXIBLE/RIGID RUDDER YAWING MOMENT DERIVATIVE



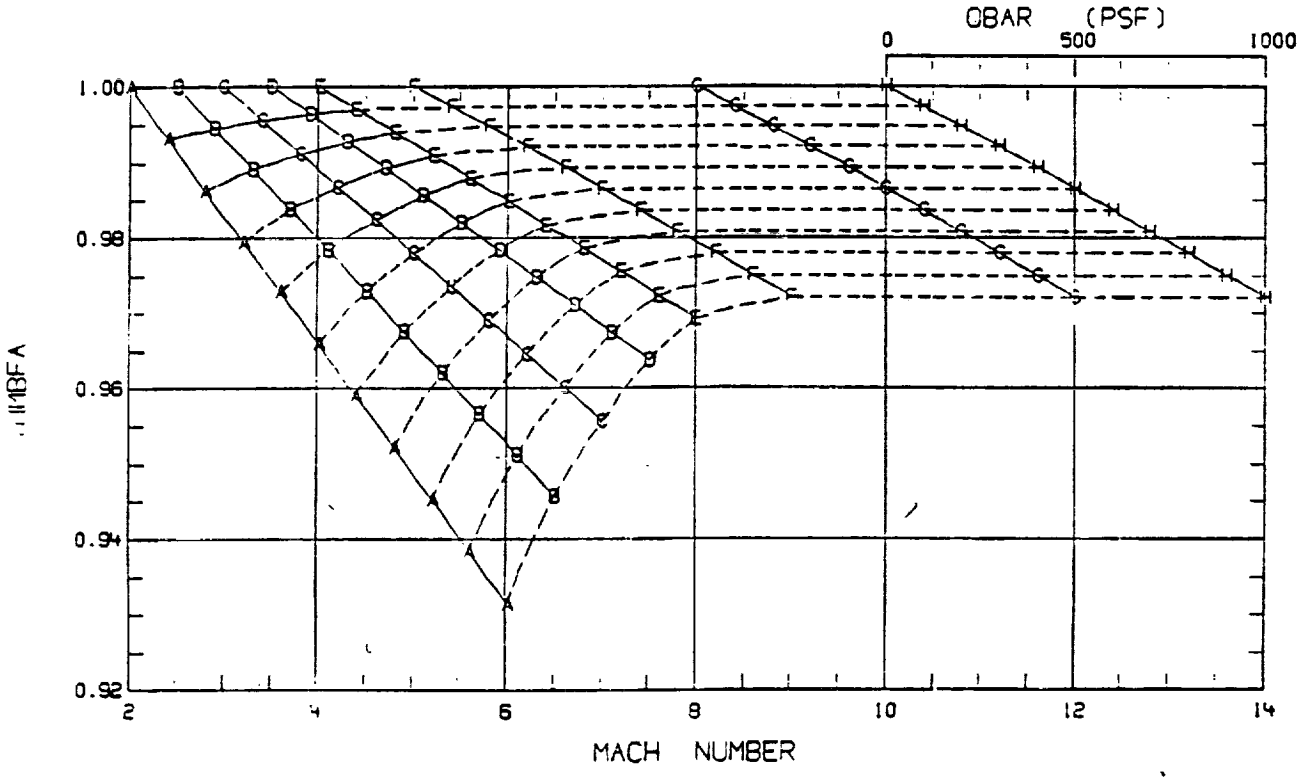
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)	F/R RUDDER ROLLING MOM DERIV							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.88467	0.91433	0.93200	0.94333	0.94667	0.94800	0.94967	0.95000
200.000	0.76933	0.82867	0.86400	0.88667	0.89333	0.89600	0.89933	0.90000
300.000	0.65400	0.74300	0.79600	0.83000	0.84000	0.84400	0.84900	0.85000
400.000	0.53867	0.65733	0.72800	0.77333	0.78667	0.79200	0.79867	0.80000
500.000	0.42333	0.57167	0.66000	0.71667	0.73333	0.74000	0.74833	0.75000
600.000	0.33933	0.51509	0.60121	0.66038	0.68102	0.69145	0.70010	0.70174
700.000	0.27688	0.47082	0.55190	0.60437	0.63001	0.64697	0.65461	0.65579
800.000	0.23593	0.43019	0.51264	0.55863	0.58789	0.60872	0.61525	0.61632
900.000	0.18640	0.39508	0.47336	0.52924	0.55584	0.57648	0.58188	0.58328
1000.000	0.16500	0.36600	0.46400	0.50900	0.53200	0.55000	0.55400	0.55600

ENGINEER _____
DATE _____

FIGURE A.4-20
FLEXIBLE/RIGID RUDDER ROLLING MOMENT DERIVATIVE



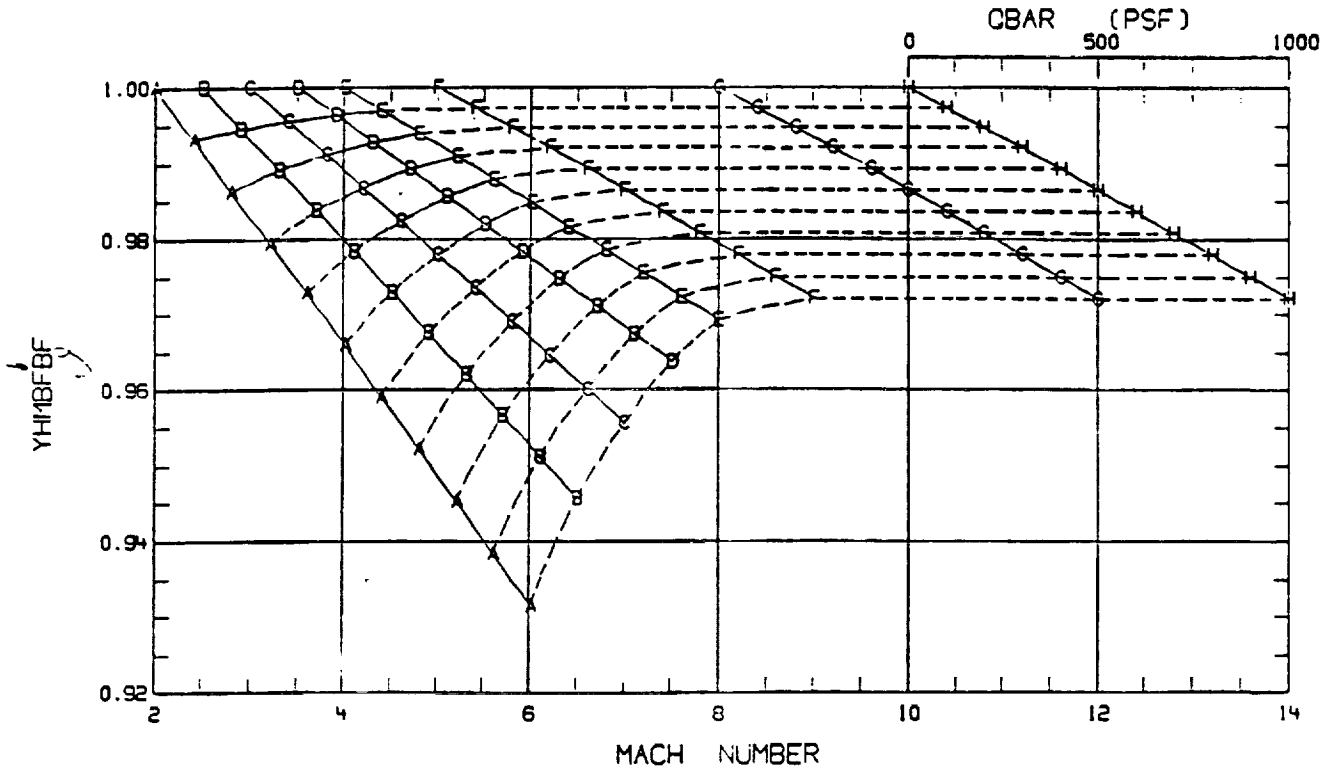
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R CHBF SLOPE DUE TO ALPHA							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99303	0.99449	0.99552	0.99637	0.99695	0.99731	0.99731	0.99731
200.000	0.98616	0.98905	0.99108	0.99275	0.99391	0.99464	0.99464	0.99464
300.000	0.97939	0.98366	0.98667	0.98915	0.99087	0.99198	0.99198	0.99198
400.000	0.97273	0.97834	0.98230	0.98557	0.98783	0.98933	0.98933	0.98933
500.000	0.96585	0.97289	0.97785	0.98192	0.98471	0.98644	0.98644	0.98644
600.000	0.95897	0.96744	0.97340	0.97827	0.98159	0.98355	0.98355	0.98355
700.000	0.95209	0.96199	0.96895	0.97462	0.97847	0.98066	0.98066	0.98066
800.000	0.94521	0.95654	0.96450	0.97097	0.97535	0.97777	0.97777	0.97777
900.000	0.93833	0.95109	0.96005	0.96732	0.97223	0.97488	0.97488	0.97488
1000.000	0.93145	0.94564	0.95560	0.96367	0.96911	0.97199	0.97199	0.97199

ENGINEER_____
DATE_____

FIGURE A.4-21
FLEXIBLE/RIGID BODYFLAP HINGE MOMENT SLOPE DUE TO A

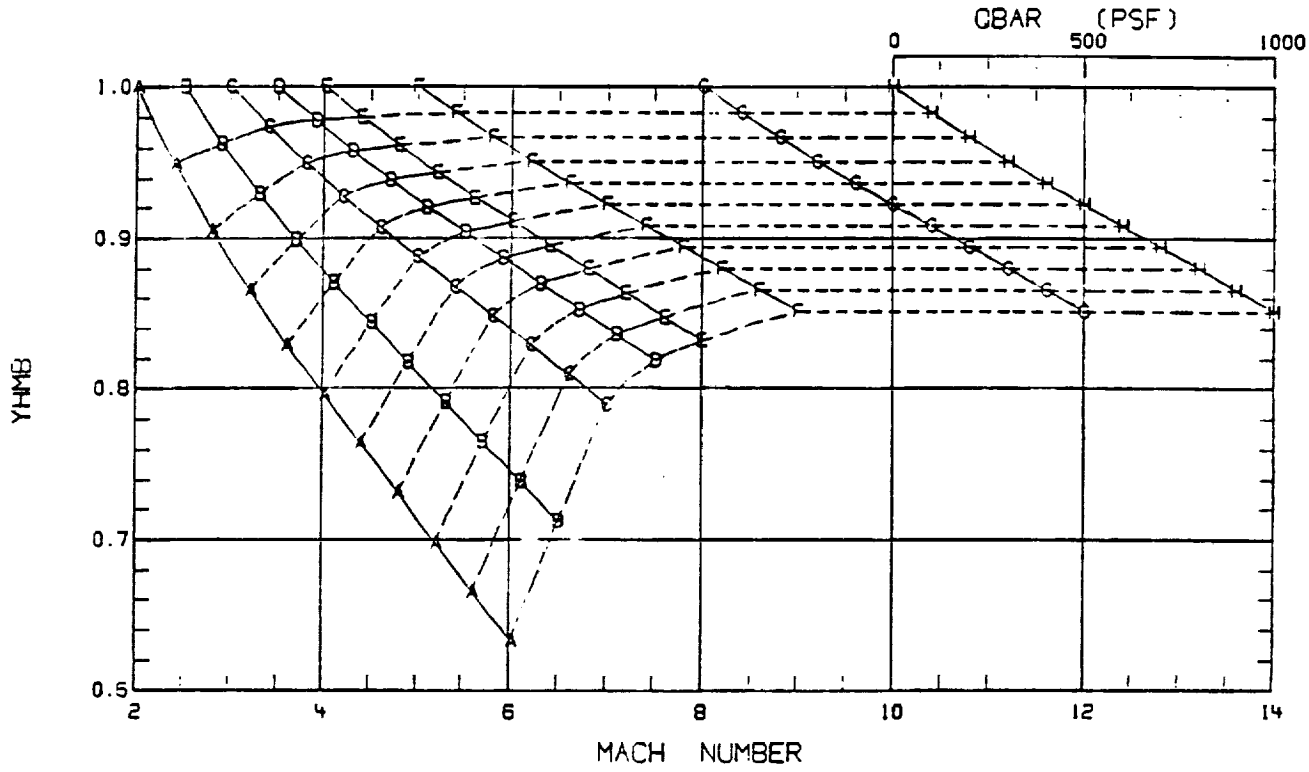


CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
CBAR (PSF)	F/R CHBF SLOPE DUE TO DELEF							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99303	0.99449	0.99552	0.99637	0.99695	0.99731	0.99731	0.99731
200.000	0.98516	0.98905	0.99108	0.99275	0.99391	0.99464	0.99464	0.99464
300.000	0.97939	0.98366	0.98667	0.98915	0.99087	0.99198	0.99198	0.99198
400.000	0.97273	0.97834	0.98230	0.98557	0.98783	0.98933	0.98933	0.98933
500.000	0.96585	0.97289	0.97785	0.98192	0.98471	0.98644	0.98644	0.98644
600.000	0.95897	0.96744	0.97340	0.97827	0.98159	0.98355	0.98355	0.98355
700.000	0.95209	0.96199	0.96895	0.97462	0.97847	0.98066	0.98066	0.98066
800.000	0.94521	0.95654	0.96450	0.97097	0.97535	0.97777	0.97777	0.97777
900.000	0.93833	0.95109	0.96005	0.96732	0.97223	0.97488	0.97488	0.97488
1000.000	0.93145	0.94564	0.95560	0.96367	0.96911	0.97199	0.97199	0.97199

ENGINEER_____
DATE_____

FIGURE A.1-22
FLEXIBLE/RIGID BODYFLAP HINGE MOMENT SLOPE DUE TO D

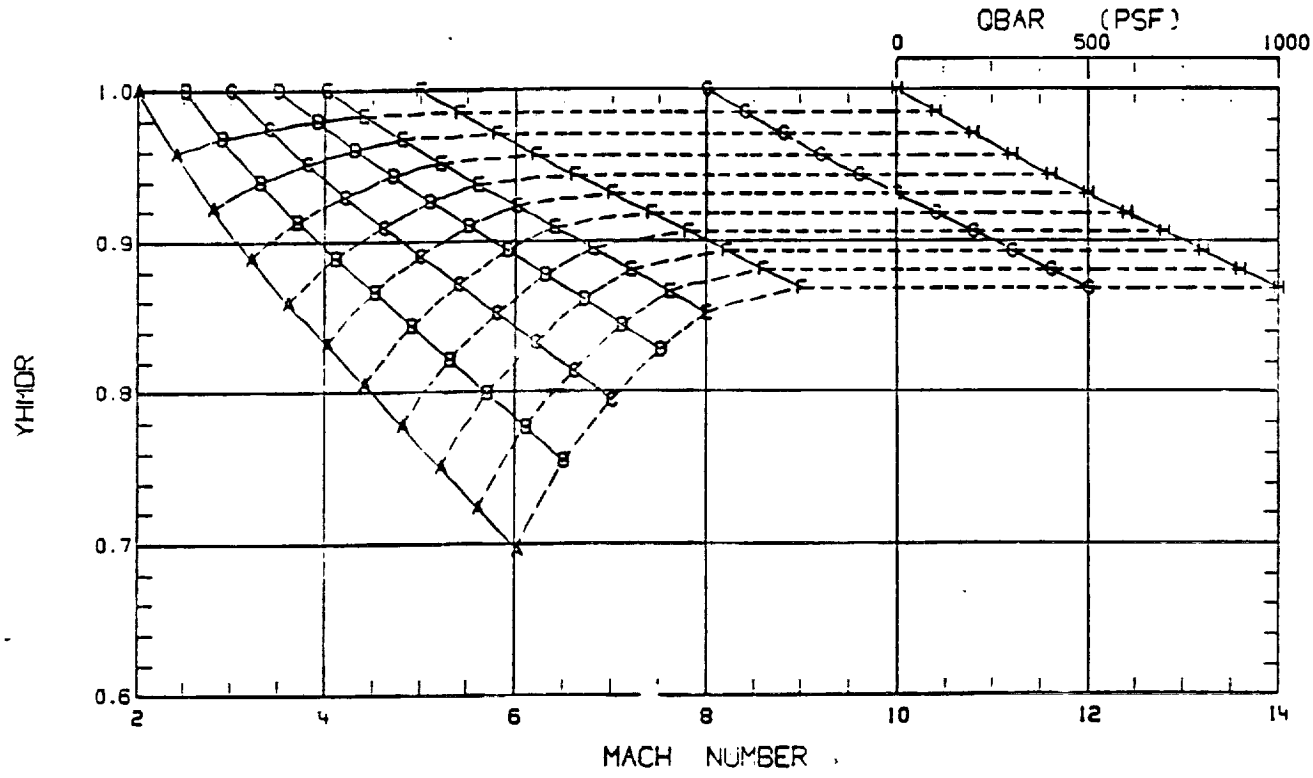


CONFIGURATION					
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT	
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.	
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.	
			BODY LENGTH	LB = 1290.3 IN.	

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R RUDDER H.M. DUE TO SIDESLIP							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.95959	0.96285	0.97389	0.97803	0.97989	0.98274	0.98274	0.98274
200.000	0.90466	0.92899	0.94969	0.95746	0.96095	0.96630	0.96630	0.96630
300.000	0.86470	0.89814	0.92729	0.93623	0.94313	0.95066	0.95066	0.95066
400.000	0.82873	0.86978	0.90651	0.92023	0.92636	0.93579	0.93579	0.93579
500.000	0.79600	0.84343	0.88694	0.90321	0.91049	0.92168	0.92168	0.92168
600.000	0.76327	0.81708	0.86737	0.88619	0.89462	0.90757	0.90757	0.90757
700.000	0.73054	0.79073	0.84780	0.86918	0.87875	0.89346	0.89346	0.89346
800.000	0.69781	0.76438	0.82823	0.85216	0.86288	0.87935	0.87935	0.87935
900.000	0.66506	0.73803	0.80866	0.83515	0.84701	0.86524	0.86524	0.86524
1000.000	0.63235	0.71168	0.78909	0.81813	0.83114	0.85113	0.85113	0.85113

ENGINEER _____
DATE _____

FIGURE A.1-23
FLEXIBLE/RIGID RUDDER HINGE MOMENT DUE TO SIDESLIP



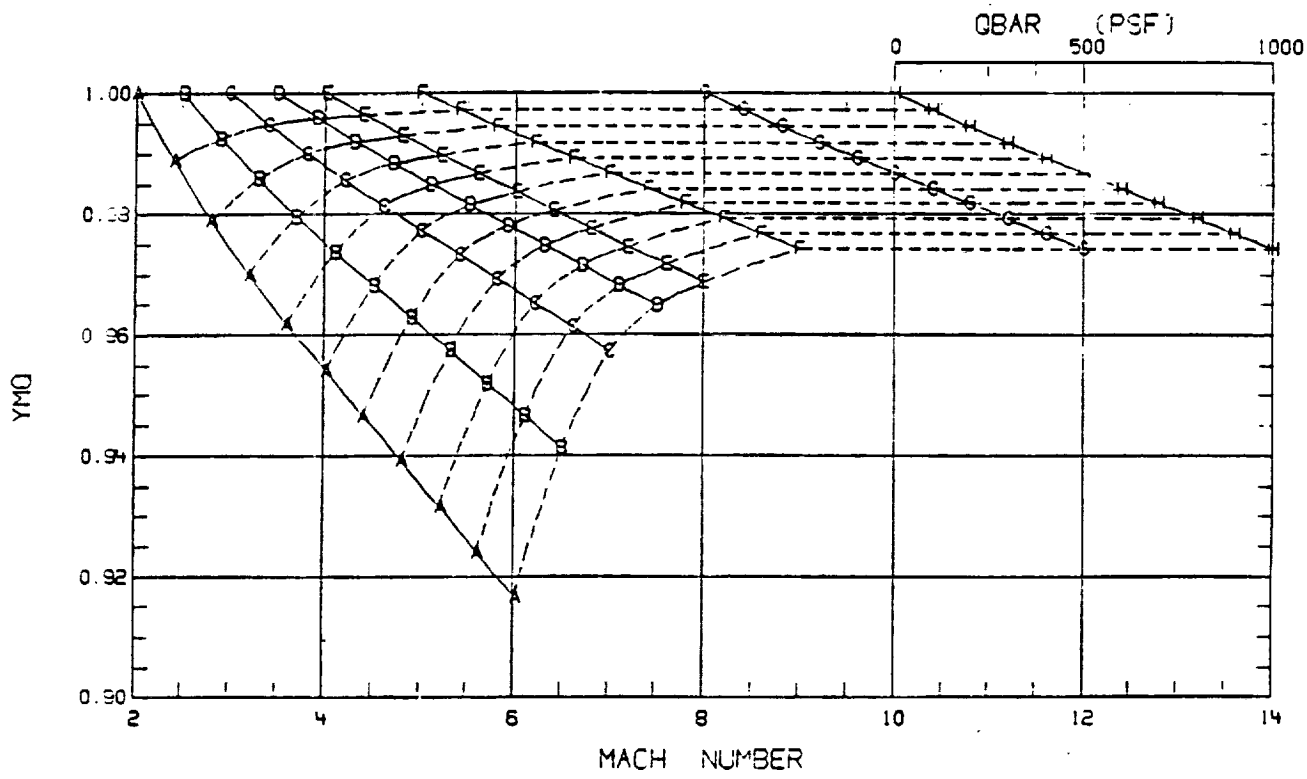
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR (PSF)			F/R	RUDDER H.M. DUE TO RUDDER				
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.95872	0.96814	0.97451	0.97973	0.93317	0.98471	0.98471	0.98471
200.000	0.92178	0.93919	0.95100	0.96069	0.95710	0.97009	0.97009	0.97009
300.000	0.88830	0.91287	0.92935	0.94274	0.95172	0.95617	0.95617	0.95617
400.000	0.85903	0.88863	0.90891	0.92565	0.93691	0.94304	0.94304	0.94304
500.000	0.83194	0.86616	0.88978	0.90935	0.92267	0.93050	0.93050	0.93050
600.000	0.80465	0.84369	0.87065	0.89305	0.90943	0.91796	0.91796	0.91796
700.000	0.77746	0.82122	0.85152	0.87675	0.89413	0.90542	0.90542	0.90542
800.000	0.75027	0.79875	0.83339	0.86045	0.87995	0.89288	0.89288	0.89288
900.000	0.72308	0.77628	0.81326	0.84415	0.86571	0.88034	0.88034	0.88034
1000.000	0.69589	0.75381	0.79413	0.82785	0.85147	0.86780	0.86780	0.86780

ENGINEER _____
DATE _____

FIGURE A.4-24
FLEXIBLE/RIGID RUDDER HINGE MOMENT DUE TO RUDDER DE



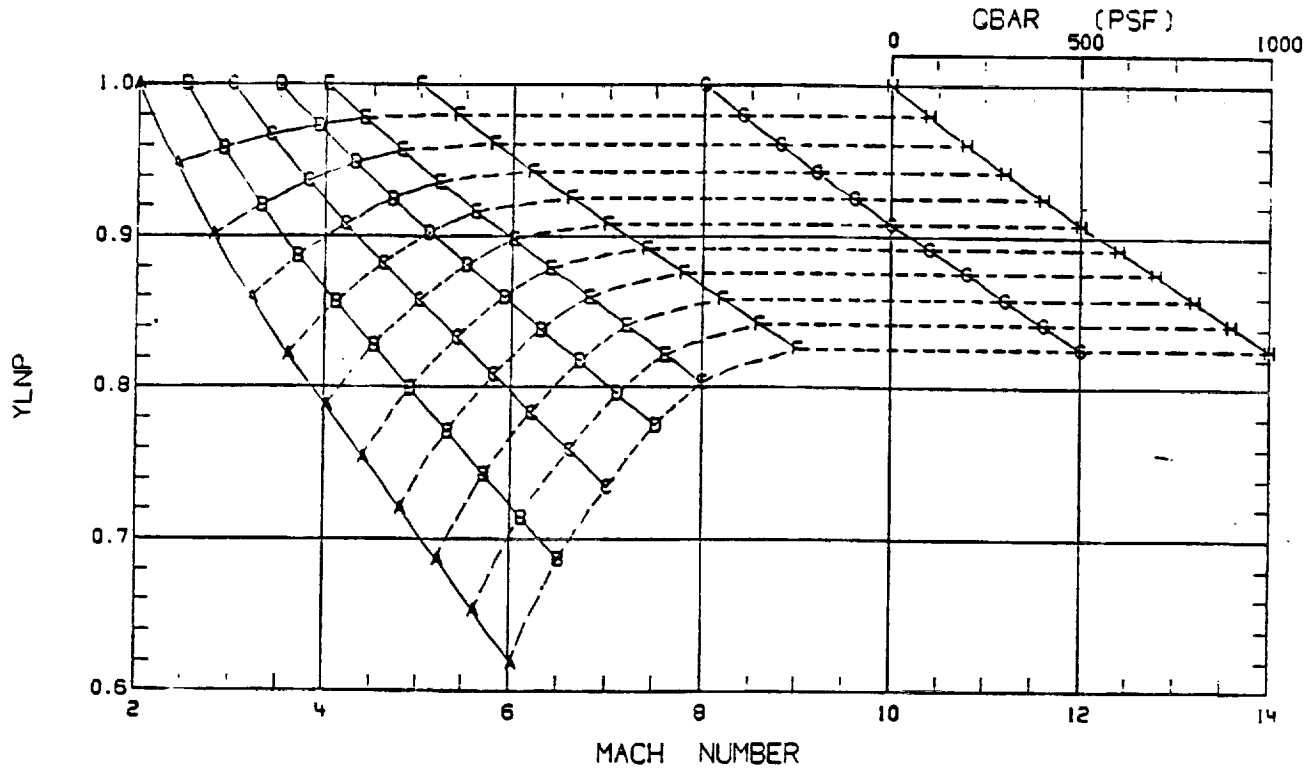
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR PSF)	F/R DAMPING-IN-PITCH							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98894	0.99251	0.99478	0.99583	0.99635	0.99713	0.99713	0.99713
200.000	0.97892	0.98566	0.98996	0.99193	0.99291	0.99436	0.99436	0.99436
300.000	0.96986	0.97938	0.98547	0.98825	0.98963	0.99168	0.99168	0.99168
400.000	0.96164	0.97356	0.98121	0.98474	0.98650	0.98910	0.98910	0.98910
500.000	0.95410	0.96814	0.97718	0.98138	0.98349	0.98660	0.98660	0.98660
600.000	0.94656	0.96272	0.97315	0.97802	0.98048	0.98410	0.98410	0.98410
700.000	0.93902	0.95730	0.96912	0.97467	0.97747	0.98160	0.98160	0.98160
800.000	0.93148	0.95188	0.96509	0.97131	0.97447	0.97910	0.97910	0.97910
900.000	0.92394	0.94646	0.96106	0.96796	0.97146	0.97660	0.97660	0.97660
1000.000	0.91640	0.94104	0.95703	0.96461	0.96845	0.97410	0.97410	0.97410

ENGINEER_____
DATE_____

FIGURE A.4-25
FLEXIBLE/RIGID DAMPING-IN-PITCH



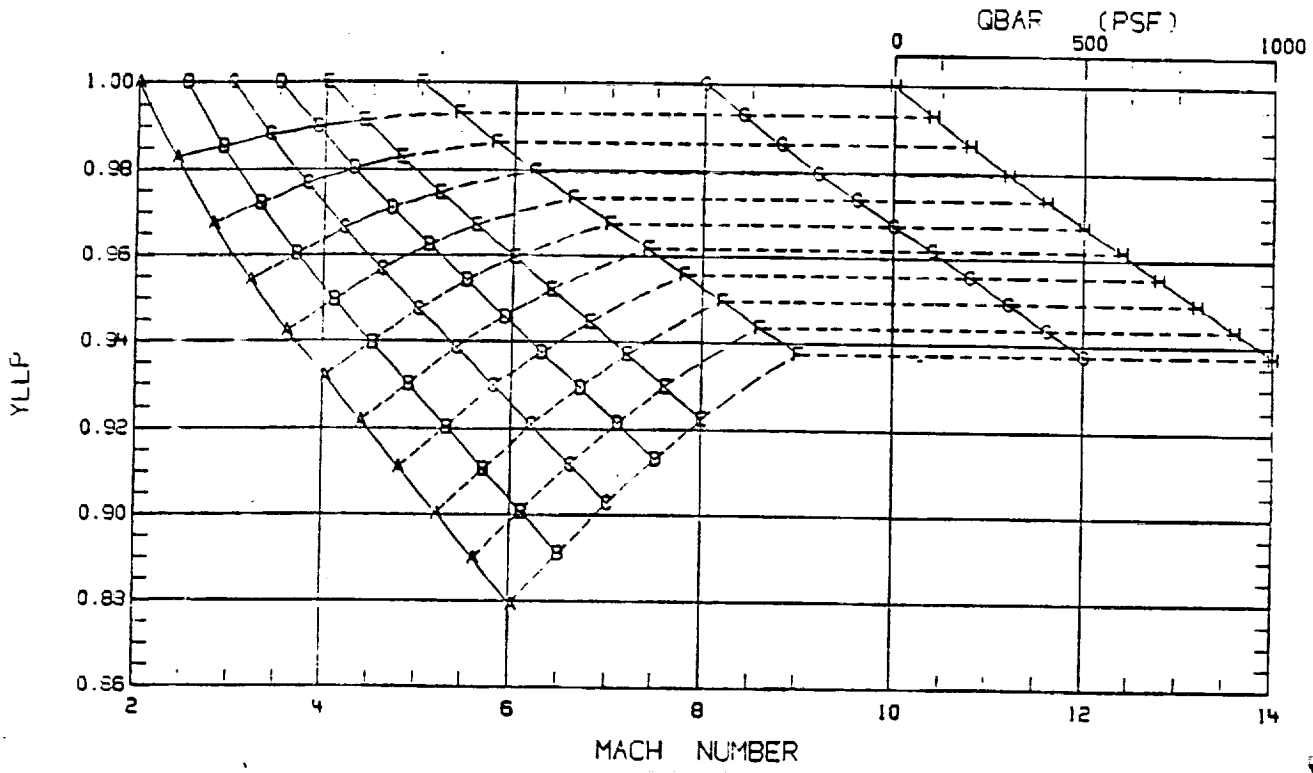
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R CLN DUE TO ROLL RATE							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.94706	0.95785	0.96649	0.97300	0.97738	0.97972	0.97972	0.97972
200.000	0.90005	0.92003	0.93574	0.94775	0.95586	0.96041	0.96041	0.96041
300.000	0.85842	0.88613	0.90752	0.92411	0.93539	0.94204	0.94204	0.94204
400.000	0.82117	0.85543	0.88140	0.90186	0.91587	0.92459	0.92459	0.92459
500.000	0.78742	0.82717	0.85684	0.88059	0.89703	0.90798	0.90798	0.90798
600.000	0.75367	0.79891	0.83228	0.85932	0.87819	0.89137	0.89137	0.89137
700.000	0.71992	0.77065	0.80772	0.83805	0.85935	0.87476	0.87476	0.87476
800.000	0.68617	0.74239	0.78316	0.81678	0.84051	0.85815	0.85815	0.85815
900.000	0.65242	0.71413	0.75860	0.79551	0.82167	0.84154	0.84154	0.84154
1000.000	0.61967	0.68587	0.73404	0.77424	0.80283	0.82493	0.82493	0.82493

ENGINEER_____
DATE_____

FIGURE A.2-26
FLEX/RIGID YAWING MOMENT DUE TO ROLL RATE



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.500	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R CLL DUE TO ROLL RATE							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98268	0.98523	0.98778	0.98969	0.99117	0.99294	0.99284	0.99294
200.000	0.96742	0.97195	0.97649	0.97995	0.98269	0.98602	0.98602	0.98602
300.000	0.95408	0.96009	0.96610	0.97078	0.97459	0.97954	0.97954	0.97954
400.000	0.94239	0.94948	0.95657	0.96222	0.96690	0.97339	0.97339	0.97339
500.000	0.93186	0.93972	0.94758	0.95399	0.95943	0.96742	0.96742	0.96742
600.000	0.92133	0.92996	0.93859	0.94576	0.95196	0.96145	0.96145	0.96145
700.000	0.91080	0.92020	0.92960	0.93753	0.94449	0.95548	0.95548	0.95548
800.000	0.90026	0.91044	0.92061	0.92930	0.93702	0.94951	0.94951	0.94951
900.000	0.88974	0.90068	0.91162	0.92107	0.92955	0.94354	0.94354	0.94354
1000.000	0.87921	0.89092	0.90263	0.91284	0.92208	0.93757	0.93757	0.93757

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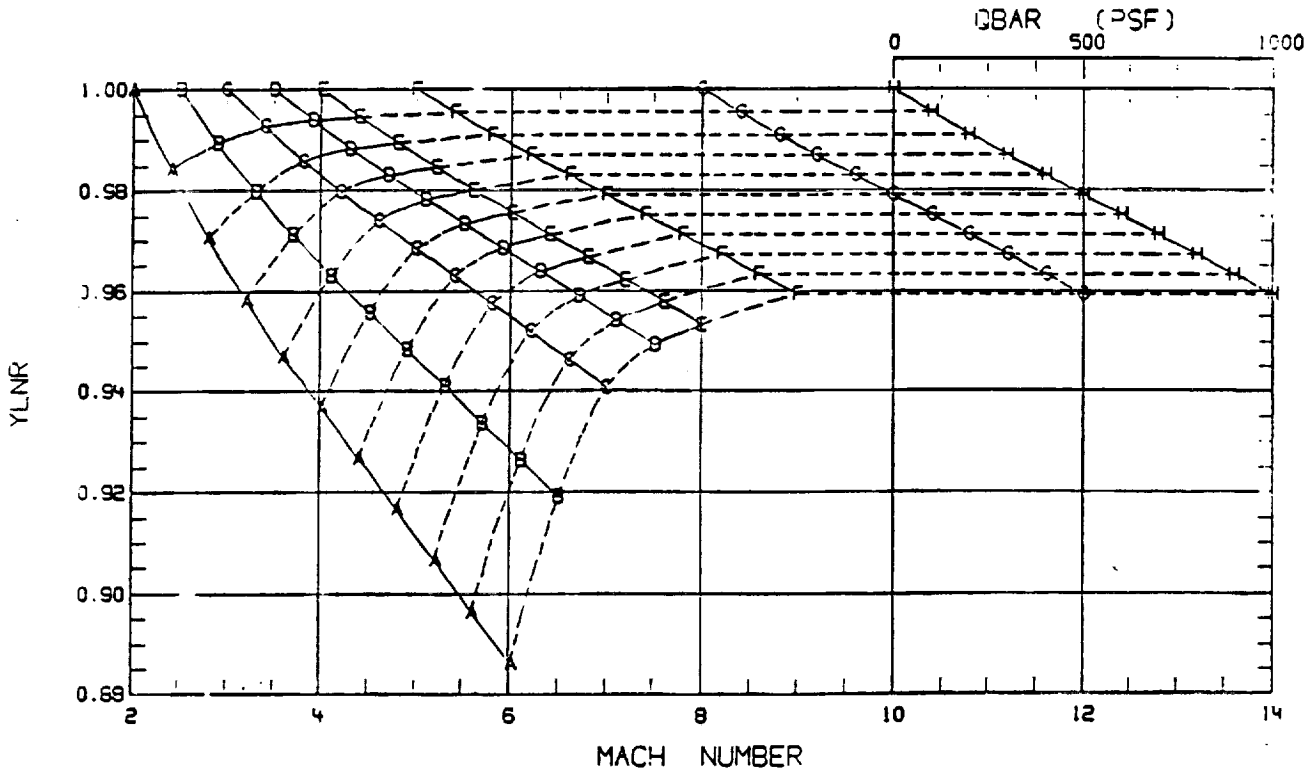
FIGURE A.1-27
FLEX/RIGID ROLLING MOMENT DUE TO ROLL RATE



CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
OMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.500 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.300 G	10.000 H
QBAR (PSF)	F/R CLN DUE TO YAW RATE							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98427	0.98924	0.99257	0.99387	0.99446	0.99536	0.99536	0.99536
200.000	0.97033	0.97960	0.98579	0.98820	0.98929	0.99097	0.99097	0.99097
300.000	0.95798	0.97092	0.97957	0.98293	0.98447	0.98681	0.98681	0.98681
400.000	0.94681	0.96297	0.97377	0.97798	0.97990	0.98283	0.98283	0.98283
500.000	0.93670	0.95563	0.96826	0.97319	0.97544	0.97888	0.97888	0.97888
600.000	0.92659	0.94829	0.96275	0.96840	0.97098	0.97493	0.97493	0.97493
700.000	0.91648	0.94095	0.95724	0.96361	0.96653	0.97098	0.97098	0.97098
800.000	0.90637	0.93361	0.95173	0.95883	0.96207	0.96703	0.96703	0.96703
900.000	0.89626	0.92627	0.94622	0.95404	0.95762	0.96308	0.96308	0.96308
1000.000	0.88615	0.91893	0.94071	0.94926	0.95317	0.95913	0.95913	0.95913

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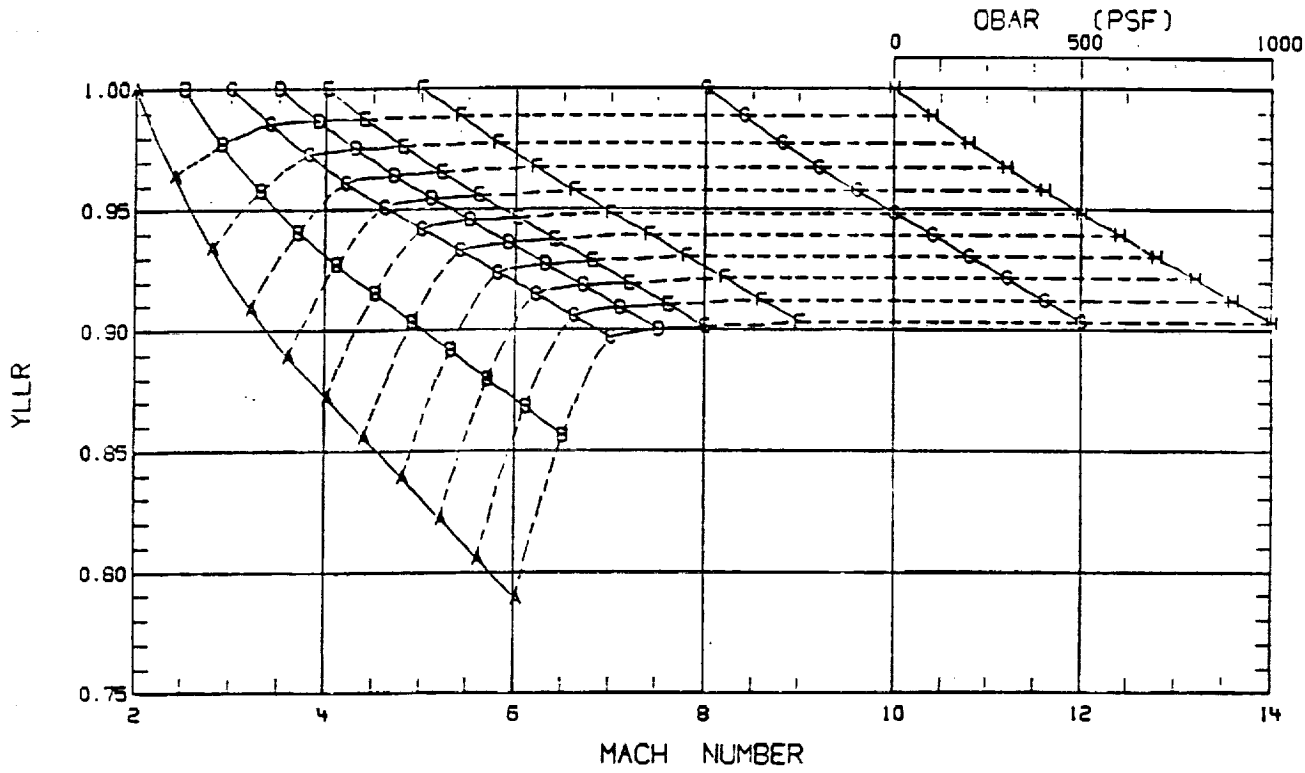
FIGURE A.1-28
FLEX/RIGID YAWING MOMENT DUE TO YAW RATE



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000 A	2.500 B	3.000 C	3.500 D	4.000 E	5.000 F	8.000 G	10.000 H
QBAR PSF	F/R CLL DUE TO YAW RATE							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.96396	0.97694	0.98542	0.98691	0.98742	0.98832	0.98832	0.98832
200.000	0.93370	0.95723	0.97241	0.97494	0.97580	0.97732	0.97732	0.97732
300.000	0.90986	0.94064	0.96089	0.96405	0.96512	0.96700	0.96700	0.96700
400.000	0.88266	0.92577	0.95075	0.95418	0.95532	0.95735	0.95735	0.95735
500.000	0.87196	0.91496	0.94168	0.94513	0.94626	0.94828	0.94828	0.94828
600.000	0.85530	0.90315	0.93261	0.93607	0.93720	0.93921	0.93921	0.93921
700.000	0.83362	0.89134	0.92354	0.92702	0.92813	0.93014	0.93014	0.93014
800.000	0.82194	0.87953	0.91447	0.91796	0.91907	0.92107	0.92107	0.92107
900.000	0.80526	0.86772	0.90540	0.90890	0.90999	0.91200	0.91200	0.91200
1000.000	0.78658	0.85591	0.89633	0.89984	0.90092	0.90293	0.90293	0.90293

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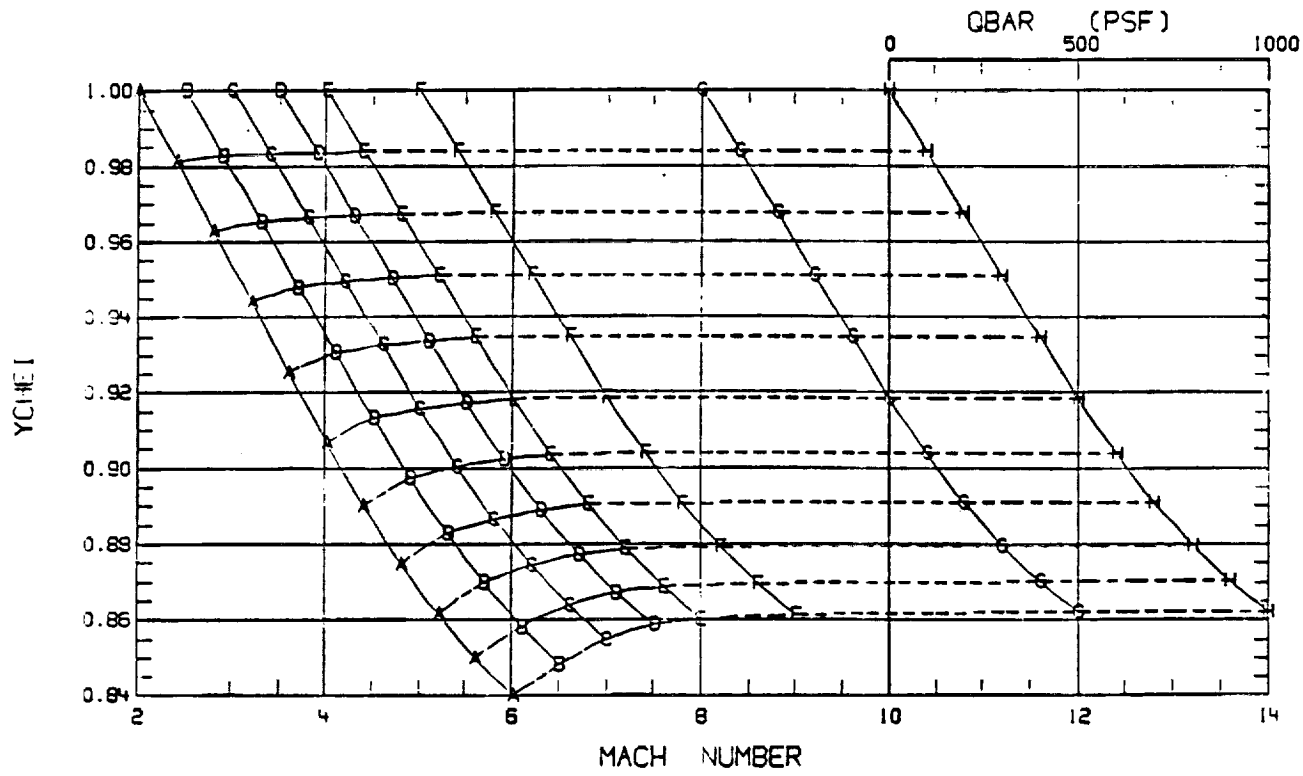
FIGURE A.1-29
FLEX/RIGID ROLLING MOMENT DUE TO YAW RATE



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR (PSF)	F/R INBD ELEVON HINGE MOMENT							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98133	0.98260	0.98310	0.98340	0.98363	0.98367	0.98367	0.98367
200.000	0.96267	0.96520	0.96620	0.96680	0.96727	0.96733	0.96733	0.96733
300.000	0.94400	0.94780	0.94930	0.95020	0.95090	0.95100	0.95100	0.95100
400.000	0.92533	0.93040	0.93240	0.93360	0.93453	0.93467	0.93467	0.93467
500.000	0.90667	0.91300	0.91550	0.91700	0.91817	0.91833	0.91833	0.91833
600.000	0.88979	0.89707	0.90018	0.90203	0.90338	0.90361	0.90368	0.90368
700.000	0.87468	0.88260	0.88644	0.88870	0.89017	0.89053	0.89072	0.89072
800.000	0.86134	0.86960	0.87428	0.87700	0.87854	0.87906	0.87946	0.87946
900.000	0.84979	0.85907	0.86370	0.86694	0.86848	0.86922	0.86968	0.86988
1000.000	0.84000	0.84800	0.85470	0.85850	0.86000	0.86100	0.86200	0.86200

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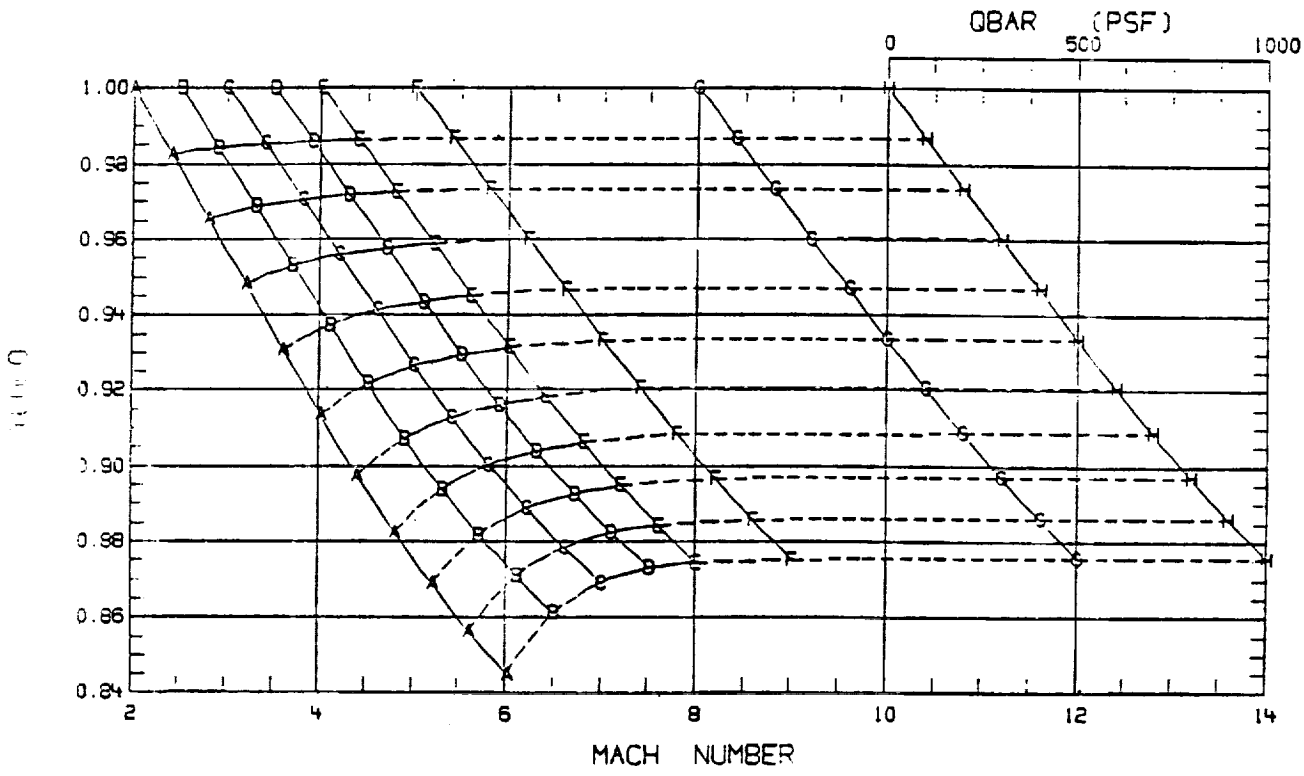
FIGURE A.4-30
FLEXIBLE/RIGID INBOARD ELEVON HINGE MOMENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	MACH NUMBER							
	2.000	2.500	3.000	3.500	4.000	5.000	8.000	10.000
	A	B	C	D	E	F	G	H
QBAR PSF	F/R OUTBD ELEVON HINGE MOMENT							
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.98267	0.98430	0.98527	0.98583	0.98623	0.98663	0.98667	0.98667
200.000	0.96533	0.96860	0.97053	0.97167	0.97247	0.97327	0.97333	0.97333
300.000	0.94800	0.95290	0.95580	0.95750	0.95870	0.95990	0.96000	0.96000
400.000	0.93067	0.93720	0.94107	0.94333	0.94493	0.94653	0.94667	0.94667
500.000	0.91333	0.92150	0.92633	0.92917	0.93117	0.93317	0.93333	0.93333
600.000	0.89721	0.90700	0.91268	0.91599	0.91820	0.92039	0.92058	0.92058
700.000	0.89233	0.89370	0.90012	0.90378	0.90602	0.90818	0.90843	0.90843
800.000	0.88666	0.88160	0.88865	0.89254	0.89462	0.89654	0.89686	0.89686
900.000	0.85622	0.87070	0.87829	0.88229	0.88402	0.88549	0.88589	0.88589
1000.000	0.84500	0.86100	0.86900	0.87300	0.87420	0.87500	0.87550	0.87550

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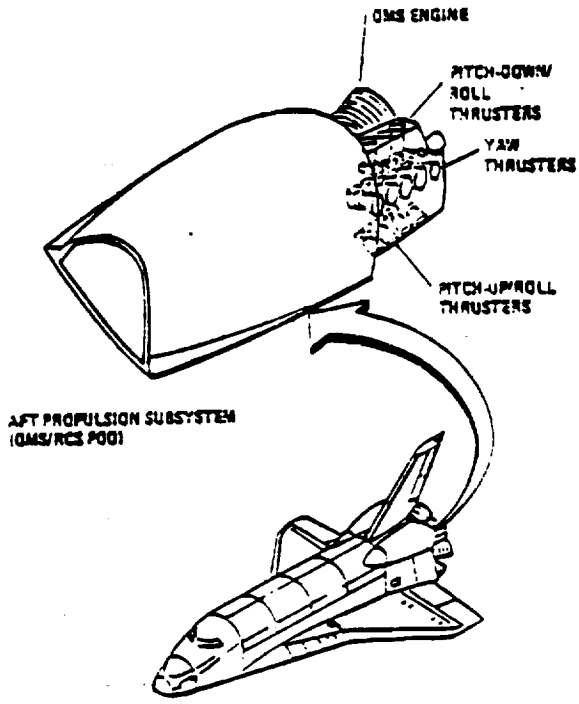
FIGURE A.1-31
FLEXIBLE/RIGID OUTBOARD ELEVON HINGE MOMENT

APPENDIX

B. RCS FLOW FIELD INTERACTIONS. Reaction Control System (RCS) effectiveness is critical to the Space Shuttle Orbiter Vehicle flight performance and safety. That portion of the RCS pertinent to this report is located in the aft section of the Orbiter Vehicle as shown in the sketch. The aft RCS provides control during entry until the aerodynamic surfaces attain sufficient effectiveness to assume full control of the vehicle.



Studies performed by Convair (Reference B-1) and wind tunnel test data on the baseline Orbiter have shown that the RCS effectiveness is appreciably altered by the presence of the air flow over and around the vehicle. These RCS-flow field interactions have acted in directions such that the net effect is much lower than the thrust moments alone, thus making it critical to flight safety and performance to be aware of the induced RCS flow field interactions and to develop methods of predicting the interactions. Data analyses and the analytical model for the aft RCS presented in the data sections of this report were obtained from Reference B-2. This reference concluded that RCS nozzle momentum ratio was the primary correlating parameter for the up- and down-firing jet interactions whereas mass flow ratio was the primary parameter for the side firing jet interactions. The analytical model developed indicates the total reaction control moments to be the sum of thrust, impingement, interaction and cross coupling terms; i.e., the equation is of the form:

$$M_{RCS} = M_{THRUST} + M_{IMPINGEMENT} + M_{INTERACTION \& CROSS-COUPLING}$$

The force and moment terms due to RCS jet thrust are presented in Figure B-1. These values have been included for reference only and are not intended for design purposes. The values are based on a nominal vacuum thrust of 870 pounds/jet and average moment arms for each jet group. All moments are referenced to 65 percent of body length. Figure B-2 presents the Thruster Identification for the Orbiter Vehicle aft RCS.

JET GROUP	LONGITUDINAL ONE SIDE FIRING			LATERAL-DIRECTIONAL LH SIDE FIRING ONLY (RH SIDE – USE OPPOSITE SIGN)		
	N_{JET}	A_{JET}	M_{JET}	Y_{JET}	$\mathcal{N}_{JET}$	$\mathcal{L}_{JET}$
	LB/JET	LB/JET	FT-LB/JET	LB/JET	FT-LB/JET	FT-LB/JET
DOWN FIRING	+ 802	– 170	– 31,140	+ 292	– 9,422	+ 8,996
UP FIRING	– 870	0	+ 32,791	0	0	– 9,570
SIDE FIRING	+ 22	0	– 856	+ 871	– 33,282	+ 6,373

- Based on average moment arm for each jet group.
- Based on nominal vacuum thrust of 870 lb/jet
- Effect of jet engine cant included.
- Moments referenced to 0.65L_B & WL 375
- Values per Reference B-3

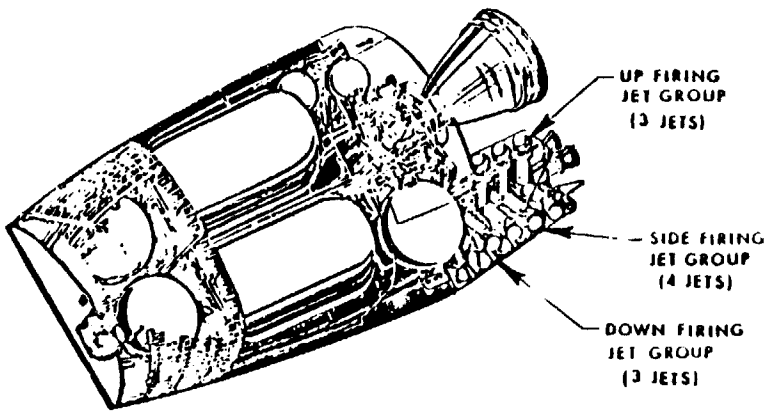


Figure B-1
REFERENCE JET THRUST

Rockwell International
Space Division

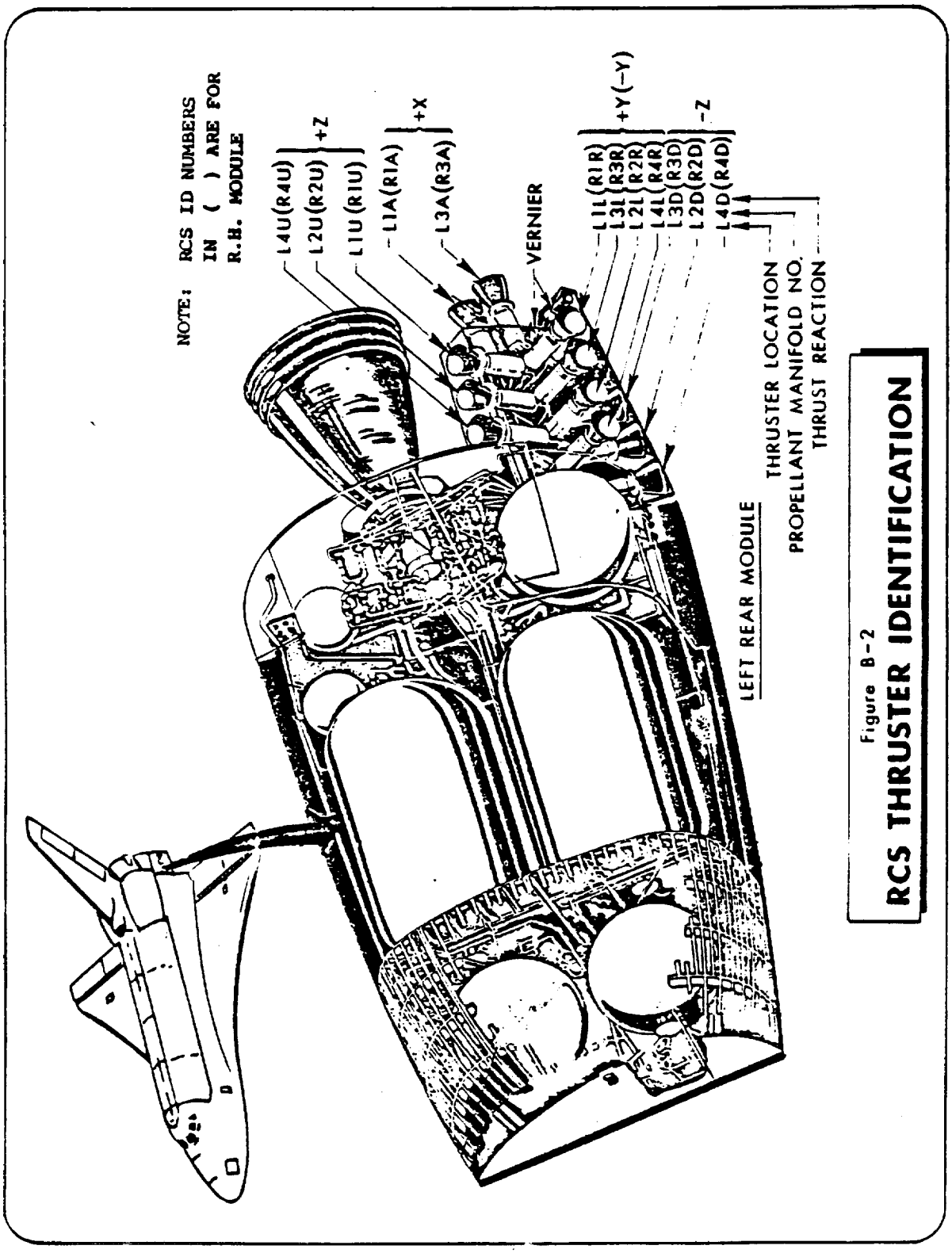


Figure B-2
RCS THRUSTER IDENTIFICATION

Impingement forces were determined by use of a computer program based on modified Newtonian impact theory and a modified vacuum plume flow field. These impingement forces (or moments) account for the RCS plume impinging on the Orbiter Vehicle surface(s) and are provided as a function of free-stream static pressure, p_∞.

The interaction terms were determined by wind tunnel test data. The RCS jets were simulated by high pressure air discharged through non-metric ports in the wind tunnel model of the Orbiter Vehicle. The aerodynamic increment due to jet firing was computed and forces (or moments) due to the interaction of the jet plume were computed from:

$$M_{INTERACTION} = (C_{m_{RCS\ ON}} - C_{m_{RCS\ OFF}})\bar{q}\, S\bar{c} - M_{IMPINGEMENT}$$

The procedure for determining RCS jet effectiveness during the thrust build-up and shut-down transient firing periods (as shown in Figure B-3) is as follows:

STEP 1 - Evaluate RCS interaction and impingement effects for the full power condition (i.e., $P_{CHAMBER} = 152$PSIA ≈ 870 lb_f thrust level)

STEP 2 - Reduce the results of STEP 1 to the actual momentary pressure level using the ratio $P_{C_{ACTUAL}} / P_{C_{FULL\ POWER}}$.

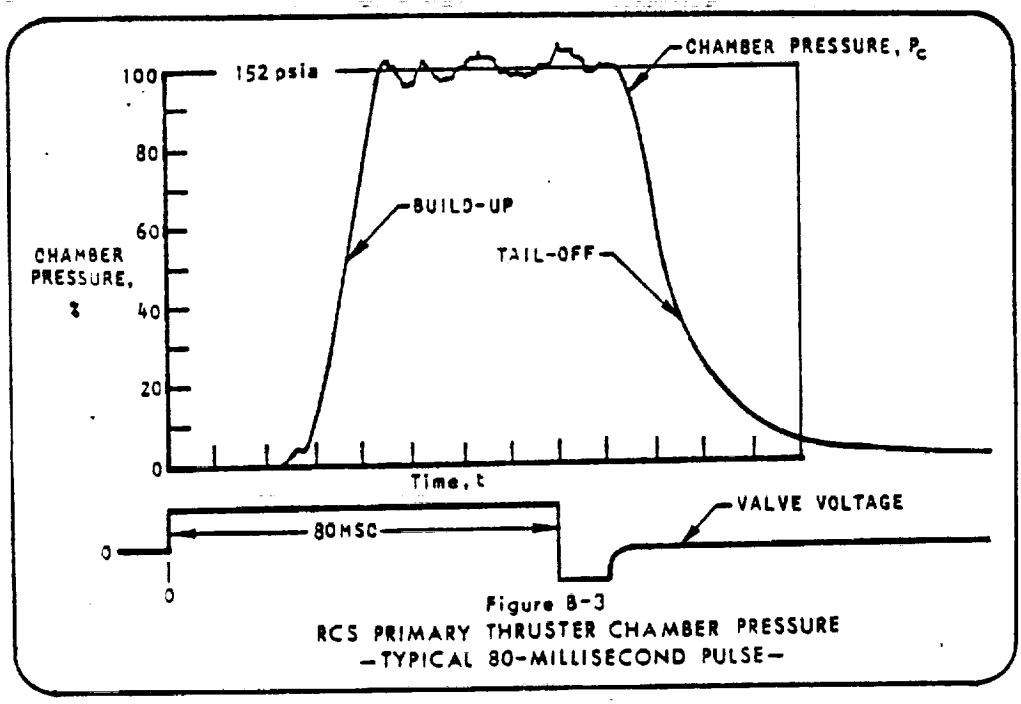


Figure B-3
RCS PRIMARY THRUSTER CHAMBER PRESSURE
—TYPICAL 80-MILLISECOND PULSE—

REFERENCES

B. RCS FLOW FIELD INTERACTIONS

B-1 CASD-NSC-75-002, "Space Shuttle Orbiter Reaction Control System Jet Interaction Study Final Report," Rausch, J. R., General Dynamics Convair Division, San Diego, California (June 1975)

B-2 CASD-NSC-77-003, "Space Shuttle Orbiter Rear Mounted Reaction Control System Jet Interaction Study Final Report," Rausch, J. R., General Dynamics Convair Division, San Diego, California (May 1977)

B-3 JSC-08934 (Vol. 1), Shuttle Operational Data Book, Vol. 1, Shuttle Systems Performance and Constraint Data, October 1976 (includes Amendment 83)

APPENDIX C

C. HIGH ALTITUDE AERODYNAMICS

A high altitude-high Mach number analysis was conducted for the purpose of obtaining aerodynamic characteristics of the Orbiter Vehicle in the entry flight regime. The resulting hypersonic aerodynamic data, including the effects of viscous interaction and low density, are included in the appropriate data sections of this report. The "lower altitude" hypersonic data have been presented as a function of Mach number ($4 \leq M_\infty \leq 20$), viscous interaction data are presented as a function of the viscous parameter ($0.005 \leq \overline{V}_\infty' \leq 0.08$), and low density data are given as a function of altitude ($300{,}000$ ft $\leq h \leq 600{,}000$ ft). The data do not currently include the effects of real gas which may be significant between 200,000 and 300,000 feet (Reference C-1).

The experimentally derived viscous interaction data are applicable over a range of viscous parameters from 0.005 (approximate onset of viscous interaction) to 0.08 which corresponds to an altitude range from 185,000 feet to 300 000 feet. The viscous parameter is interpreted as a subscale-full scale simulation parameter and is based on freestream properties of Mach number, Reynolds number, and temperature. The Orbiter Vehicle TPS Design Trajectory 14414.1 was assumed to be typical of the high altitude-high Mach number flight regimes (Figures C-1 through C-3). Theoretical calculations, using the Hypersonic Arbitrary Body Aerodynamic Computer Program (Reference C-2), were used to establish the general trends through the experimental data scatter and to obtain magnitudes in the free-molecular flight regimes (see Reference 3-5). The Lockheed Empirical Bridging Formula was utilized to bridge the transitional flow regime between continuum and free-molecular regimes (Reference C-3).

The hypersonic viscous parameter is defined as:

$$\overline{V}_\infty' = M_\infty \sqrt{\frac{C_\infty'}{Re_{\infty_{L_B}}}}$$

where, M_∞ = Freestream Mach number

$Re_{\infty_{L_B}}$ = Freestream Reynolds number (based on body length, L_B)

C_∞' = Proportionality factor for the linear viscosity-temperature relationship (Reference C-4)

$$= \left[\frac{T'}{T_\infty}\right]^K \left[\frac{T_\infty + 122.1 \times 10^{-(5/T_\infty)}}{T' + 122.1 \times 10^{-(5/T')}}\right]^J$$

with Monahan's empirical relationship given by

$$\frac{T'}{T_\infty} = 0.468 + 0.532 \frac{T_w}{T_\infty} + 0.195 \frac{\gamma - 1}{2} M_\infty^2$$

where,

T' = Reference temperature, degrees Kelvin

T_∞ = Freestream static temperature, degrees Kelvin

T_w = Wall temperature, degrees Kelvin

γ = Specific heat ratio

K = Empirical constant = 0.5 for air

J = Empirical constant = 1.0 for air

NOTE: A constant wall temperature of 2000°F and specific heat ratio of 1.15 have been assumed for the flight conditions analyzed.

The formula used to bridge the transitional flow regime from continuum to free-molecular flow (Reference C-3) is given as:

$$C_{TRANSITION} = C_{CONTINUUM} + (C_{FM} - C_{CONTINUUM}) \sin^n [\pi (A + B \log_{10} K_{n_\infty})]$$

where,

$C_{CONTINUUM}$ = Viscous data value at $\bar{V}'_\infty = 0.08$ (300,000 feet)

C_{FM} = Data value at free-molecular flow condition

n = 2

A = 3/8

B = 1/8

$0.001 \leq K_{n_{\infty TRANSITION}} \leq 10$

$K_{n_\infty} = \frac{\lambda_\infty}{L_{ref}}$ = Knudsen number

λ_∞ = Mean free path

L_{ref} = 474.8 inches

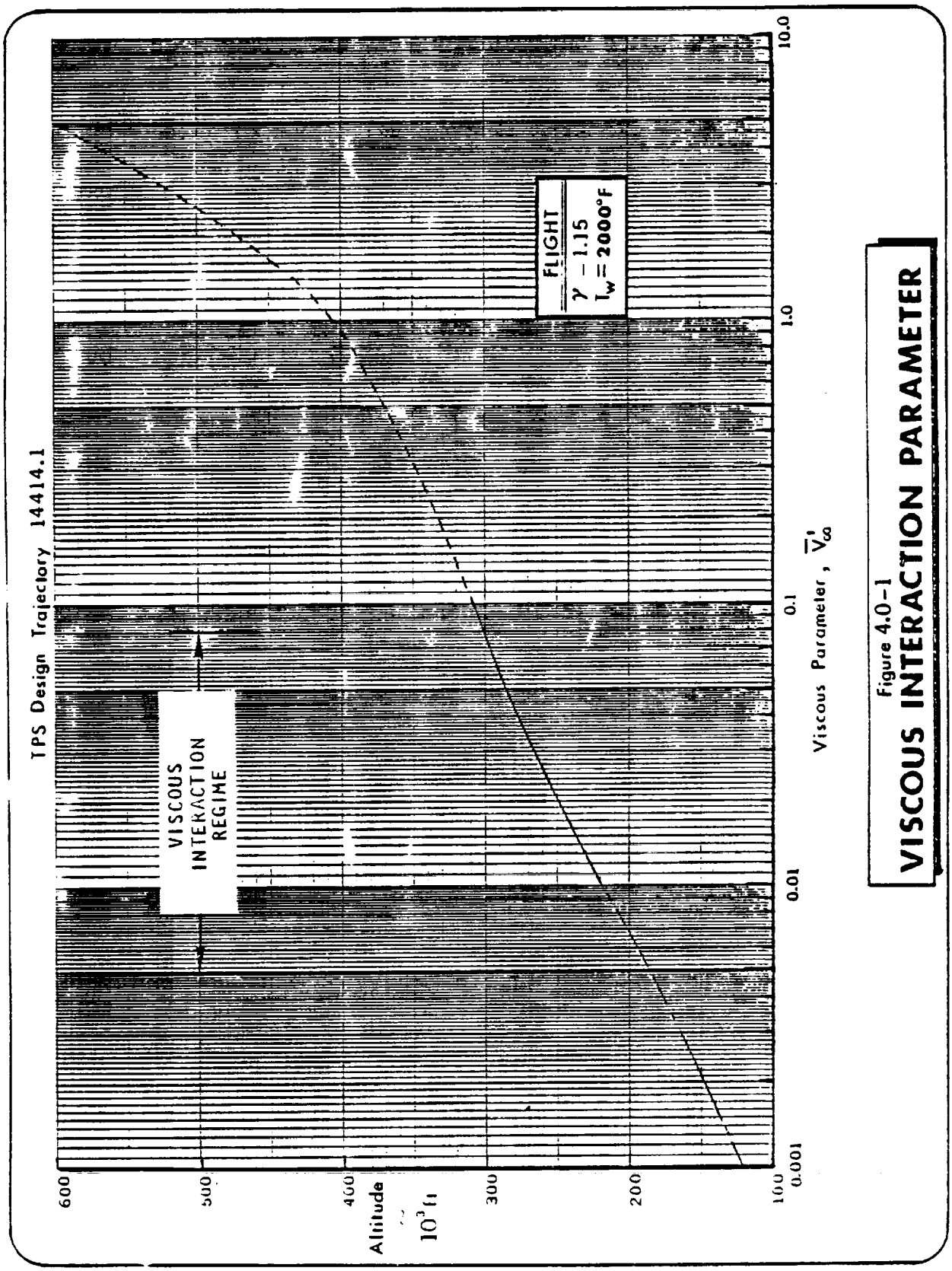
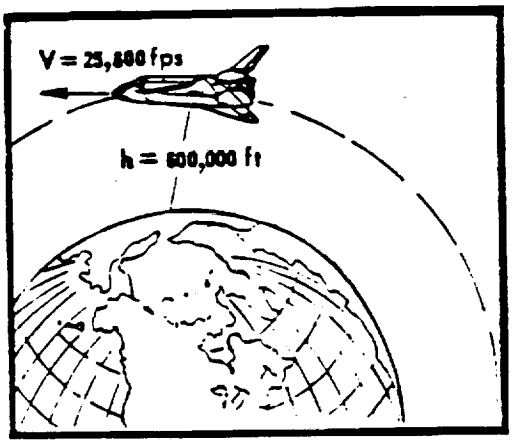


Figure 4.0-1
VISCOUS INTERACTION PARAMETER

Figure C-2
HIGH MACH No.-HIGH ALTITUDE REGIMES

Figure C-3
VARIATIONS WITH VISCOUS PARAMETER

ORBITAL AERODYNAMICS. On-orbit aerodynamic data are provided for use in all trajectory simulations. These data are intended to provide a common base for all on-orbit trajectory simulations and studies such as orbital drift and decay.



The data are presented for an orbital altitude of 600,000 feet and a velocity of 25,600 feet per second. This altitude is in the free-molecular flow regime where the mean free path, λ, is many times greater than the characteristic length (mean aerodynamic chord, $\bar{c}$) of the Orbiter vehicle. At 600,000 feet the Orbiter will have a Knudsen number ($\lambda/\bar{c}$) of 11.5. Since the free-molecular flow regime nominally begins at a Knudsen number of 10, the data presented are considered valid for altitudes of approximately 590,000 feet and up (see Figure C-4) provided that the following flight conditions are met:

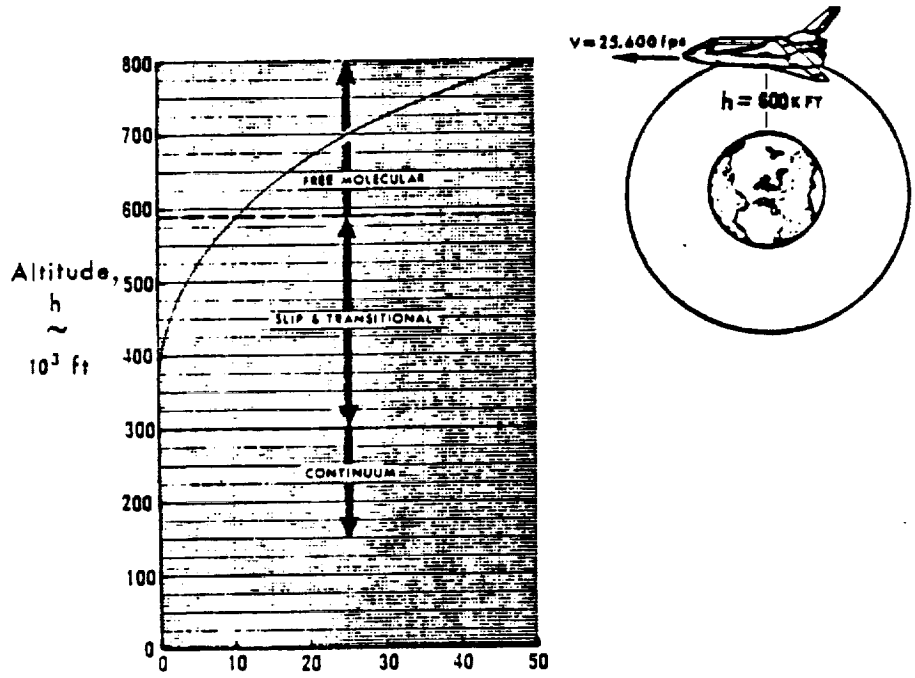
$$\text{Molecular Speed Ratio, } \frac{V_\infty}{\sqrt{2RT_w}} = 9.03$$

$$\text{Temperature Ratio, } T_w/T_\infty = 0.25$$

All flight control surfaces neutral.

The orbital aerodynamics are based on completely diffused reflection in which the vehicle receives both normal and tangential momentum transfer. Analytical results are presented for all combinations of angle of attack from zero degree to 350 degrees in 10-degree increments and sideslip angles from zero degree to 180 degrees in 15-degree increments. The Orbiter vehicle is symmetric with respect to the X-Z plane; therefore, the longitudinal coefficients obtained between zero degree and negative 180 degrees of sideslip are of the same magnitude and sign as those for corresponding positive sideslip. Lateral-directional coefficients are of the same magnitude but of opposite sign. A detailed description of the analytical method and an analysis of results is contained in Reference C-5.

The geometric model used for generating the orbital aerodynamic characteristics is shown on Figure C-5. The longitudinal data are given in Figures C-6 (Normal Force), C-7 (Axial Force), C-8 (Pitching Moment), C-9 (Lift), C-10 (Drag), and C-11 (Lift-to-Drag Ratio). The lateral-directional data are given in Figures C-12 (Side Force), C-13 (Yawing Moment), and C-14 (Rolling Moment). Tabular data are included in correspondingly numbered tables immediately following the respective figures.



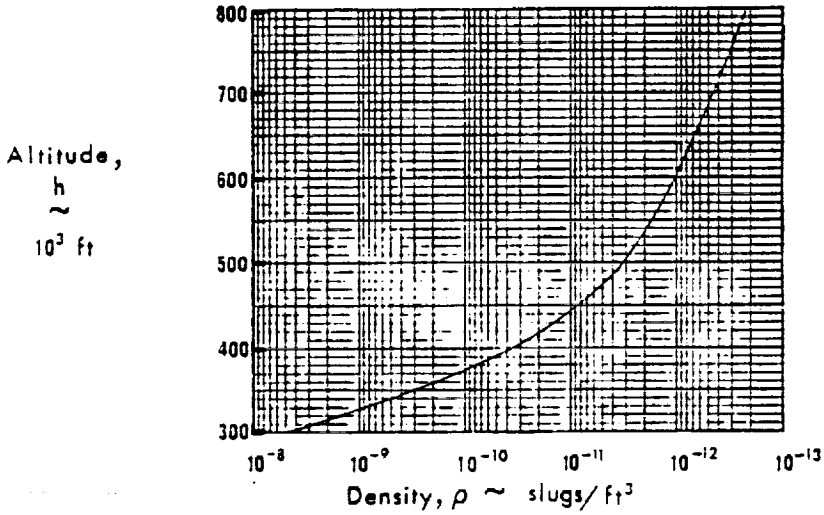
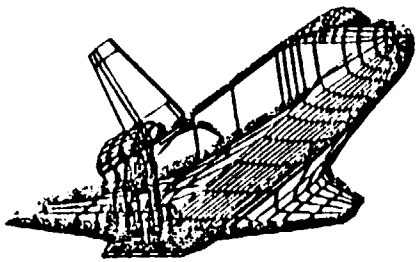
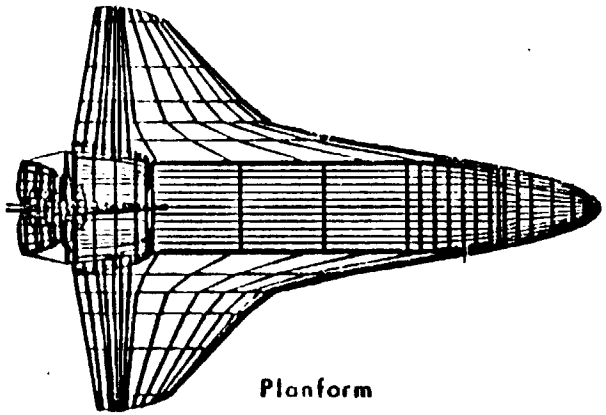


Figure
GAS DYNAMICS REGIMES



$\alpha = 20°$ $\beta = 30°$

Oblique



Planform

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE	X_{cg} = FS	1076.70
	Y_{cg} = BL	0.00
	Z_{cg} = WL	375.00

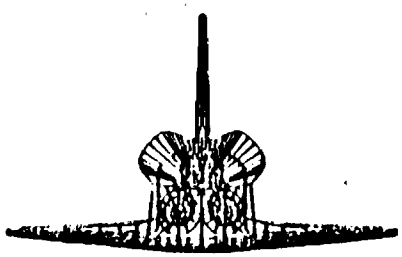
REFERENCE DIMENSIONS

AREA	S_w =	2690.000 ft²
SPAN	b_w =	78.056 ft
MAC	c_w =	39.560 ft
BODY LENGTH	l_B =	1290.380 in

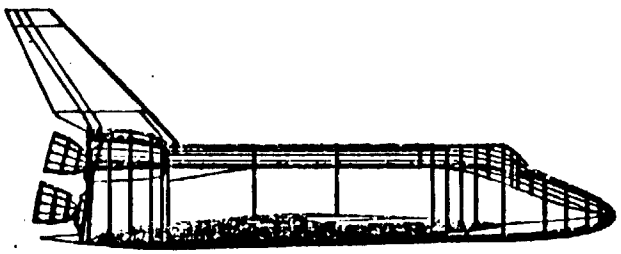
$\delta_e = 0°$

$\delta_{BF} = 0°$

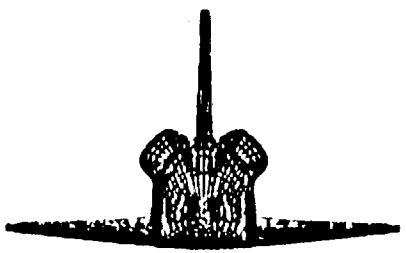
$\delta_{Sb} = 0°$



Aft



Side



Front

Figure

OV 102 GEOMETRIC MODEL

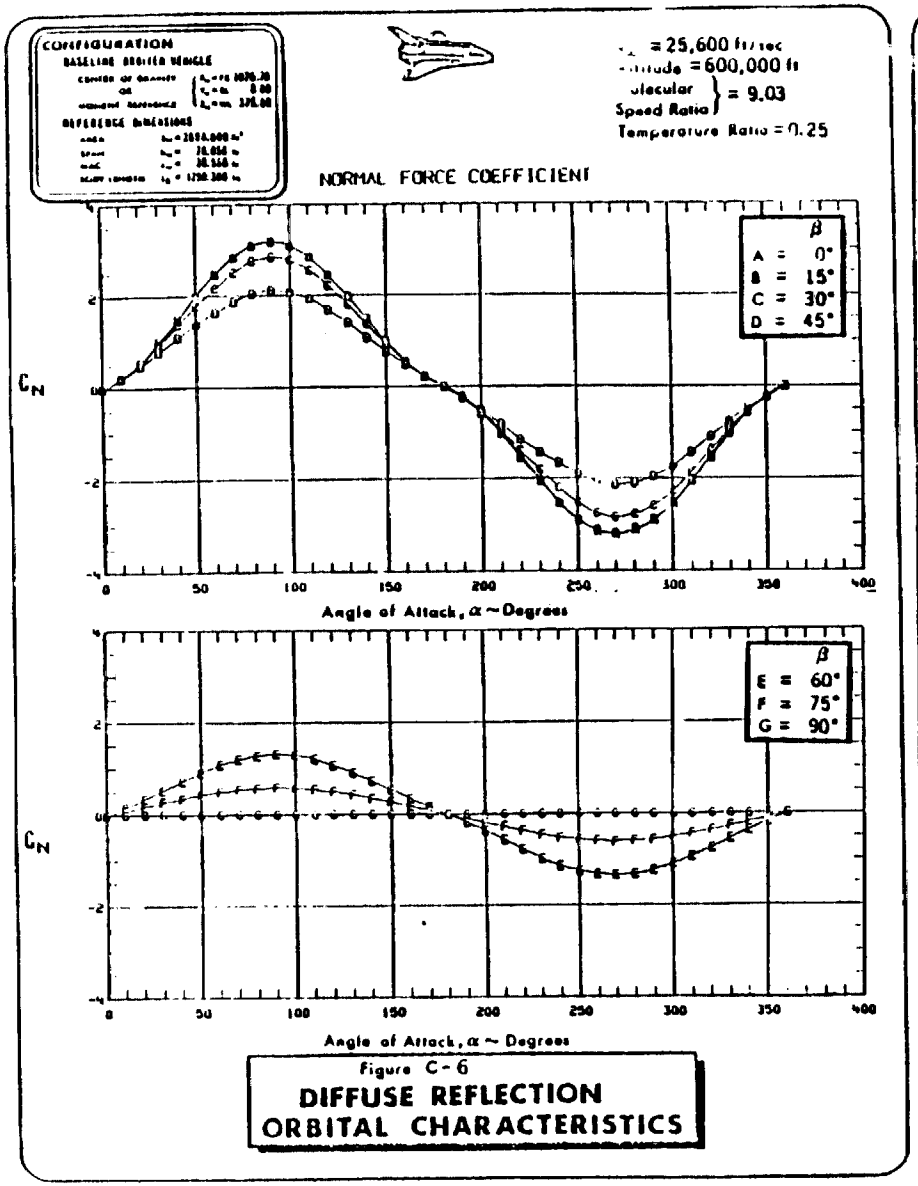


Figure C-6
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

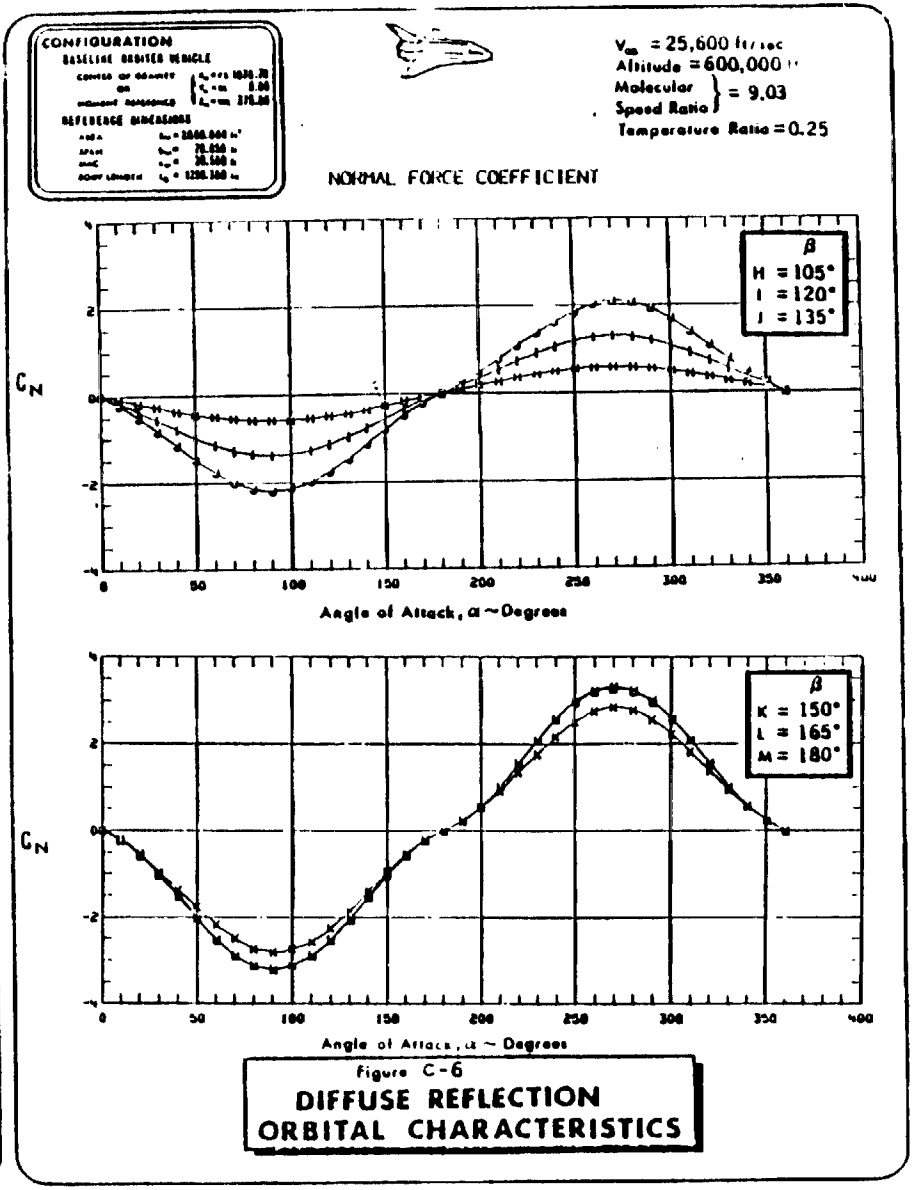


Figure C-6
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

Temperature Ratio = 0.25

V_∞ = 25,600 ft/sec
Altitude = 600,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees												
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	NORMAL FORCE COEFFICIENT, C_N												
0.0	-0.00456	-0.00412	-0.00619	-0.00760	-0.00866	-0.00891	-0.00962	-0.00806	-0.00839	-0.00739	-0.00527	-0.00386	-0.00253
10.000	0.19797	0.21910	0.23165	0.21212	0.16120	0.08335	-0.00959	-0.10144	-0.18504	-0.23931	-0.25357	-0.23819	-0.21447
20.000	0.51031	0.55115	0.54376	0.46855	0.34000	0.17404	-0.00960	-0.19376	-0.37414	-0.51120	-0.57883	-0.58019	-0.54606
30.000	0.99179	0.99305	0.92532	0.76657	0.53352	0.26320	-0.00960	-0.28368	-0.57718	-0.82573	-0.97742	-1.02569	-0.99019
40.000	1.45667	1.49583	1.35097	1.08681	0.72611	0.34955	-0.00965	-0.36852	-0.78373	-1.15968	-1.37820	-1.53489	-1.50672
50.000	1.99212	2.00997	1.76569	1.38133	0.91310	0.42743	-0.00953	-0.44424	-0.98404	-1.48723	-1.78632	-2.05074	-2.03360
60.000	2.47800	2.47438	2.16101	1.63501	1.08028	0.49282	-0.00953	-0.50697	-1.15565	-1.78397	-2.18323	-2.52209	-2.51778
70.000	2.86359	2.84265	2.50520	1.86224	1.20479	0.54204	-0.00953	-0.55321	-1.28888	-2.01428	-2.50775	-2.89249	-2.90436
80.000	3.11757	3.09002	2.75282	2.04055	1.28328	0.57212	-0.00952	-0.58280	-1.36956	-2.15776	-2.73366	-3.11598	-3.13643
90.000	3.19846	3.17101	2.83957	2.11915	1.31697	0.58235	-0.00952	-0.59328	-1.39485	-2.20413	-2.81321	-3.18633	-3.21499
100.000	3.09740	3.08137	2.76783	2.07552	1.28775	0.57204	-0.00952	-0.58329	-1.36430	-2.14878	-2.74759	-3.09263	-3.12311
110.000	2.82967	2.83110	2.55211	1.92744	1.20645	0.54051	-0.00926	-0.55338	-1.28330	-2.00567	-2.56981	-2.88220	-2.90790
120.000	2.44197	2.45032	2.21515	1.69109	1.07696	0.49271	-0.00926	-0.50523	-1.15007	-1.77529	-2.26388	-2.52640	-2.53940
130.000	1.98262	1.99525	1.80246	1.39835	0.91163	0.42837	-0.00934	-0.43899	-0.97665	-1.47746	-1.85552	-2.05662	-2.05170
140.000	1.47555	1.49505	1.35867	1.07531	0.72562	0.35133	-0.00921	-0.36317	-0.77854	-1.14787	-1.39476	-1.54051	-1.52319
150.000	0.97421	0.99803	0.92079	0.75513	0.53263	0.26643	-0.00921	-0.27888	-0.57066	-0.81108	-0.99138	-1.02590	-0.99924
160.000	0.54113	0.55662	0.53188	0.46822	0.34433	0.17659	-0.00921	-0.19030	-0.36092	-0.49777	-0.53997	-0.57519	-0.55192
170.000	0.21018	0.22520	0.23436	0.21946	0.16501	0.08434	-0.00921	-0.09976	-0.18219	-0.23129	-0.23947	-0.22930	-0.21386
180.000	-0.00259	-0.00393	-0.00571	-0.00744	-0.00814	-0.00805	-0.00689	-0.00886	-0.00860	-0.00756	-0.00616	-0.00416	-0.00449
190.000	-0.21471	-0.23819	-0.25566	-0.23929	-0.18394	-0.10146	-0.00689	0.08255	0.15909	0.21042	0.23039	0.22276	0.20814
200.000	-0.54628	-0.58019	-0.58090	-0.51120	-0.37047	-0.19378	-0.00696	0.17215	0.33619	0.46374	0.53921	0.56622	0.54223
210.000	-0.96964	-1.02569	-0.98031	-0.82573	-0.57465	-0.28367	-0.00700	0.26028	0.52621	0.75699	0.91784	1.02365	0.99346
220.000	-1.50479	-1.53462	-1.39814	-1.15244	-0.78320	-0.36853	-0.00706	0.34513	0.71543	1.07202	1.35292	1.55142	1.52625
230.000	-2.03300	-2.05075	-1.80780	-1.43237	-0.98017	-0.44661	-0.00705	0.42189	0.89807	1.36130	1.75956	2.09267	2.07608
240.000	-2.51938	-2.52209	-2.20558	-1.67038	-1.13733	-0.51336	-0.00705	0.48609	1.06190	1.61201	2.15941	2.58209	2.57934
250.000	-2.90838	-2.89249	-2.53208	-1.88902	-1.24607	-0.56332	-0.00705	0.53473	1.18346	1.83636	2.50520	2.96725	2.98080
260.000	-3.13653	-3.11598	-2.76107	-2.06159	-1.31270	-0.59370	-0.00702	0.56395	1.26159	2.01550	2.75282	3.20988	3.23623
270.000	-3.21119	-3.18633	-2.84028	-2.13626	-1.33413	-0.60326	-0.00702	0.57412	1.29460	2.09775	2.83957	3.28585	3.32198
280.000	-3.12478	-3.09264	-2.76859	-2.09279	-1.30774	-0.59078	-0.00702	0.56349	1.26592	2.05708	2.76783	3.19281	3.22857
290.000	-2.90591	-2.88221	-2.58503	-1.95822	-1.22962	-0.55749	-0.00723	0.53256	1.18756	1.91067	2.55211	2.94982	2.98224
300.000	-2.53842	-2.52650	-2.27340	-1.72620	-1.09454	-0.50664	-0.00723	0.48568	1.06163	1.67862	2.21515	2.56267	2.58404
310.000	-2.05361	-2.05665	-1.85791	-1.42180	-0.92218	-0.43897	-0.00715	0.42250	0.89942	1.38947	1.80222	2.08707	2.09190
320.000	-1.52237	-1.54054	-1.39477	-1.09559	-0.74121	-0.36317	-0.00730	0.34675	0.71672	1.06862	1.35867	1.55921	1.54990
330.000	-0.99838	-1.02392	-0.94138	-0.76847	-0.54433	-0.27888	-0.00730	0.26317	0.52680	0.75100	0.92077	1.03560	1.01496
340.000	-0.53795	-0.56280	-0.53997	-0.47429	-0.35574	-0.19027	0.00730	0.17459	0.34098	0.46541	0.53179	0.58207	0.55771
350.000	-0.20227	-0.22409	-0.23947	-0.22418	-0.17741	-0.09976	-0.00730	0.08347	0.16356	0.21827	0.23436	0.23372	0.21410
360.000	-0.00456	-0.00412	-0.00619	-0.00760	-0.00866	-0.00891	-0.00962	-0.00806	-0.00839	-0.00739	-0.00527	-0.00386	-0.00253

Table C-6

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

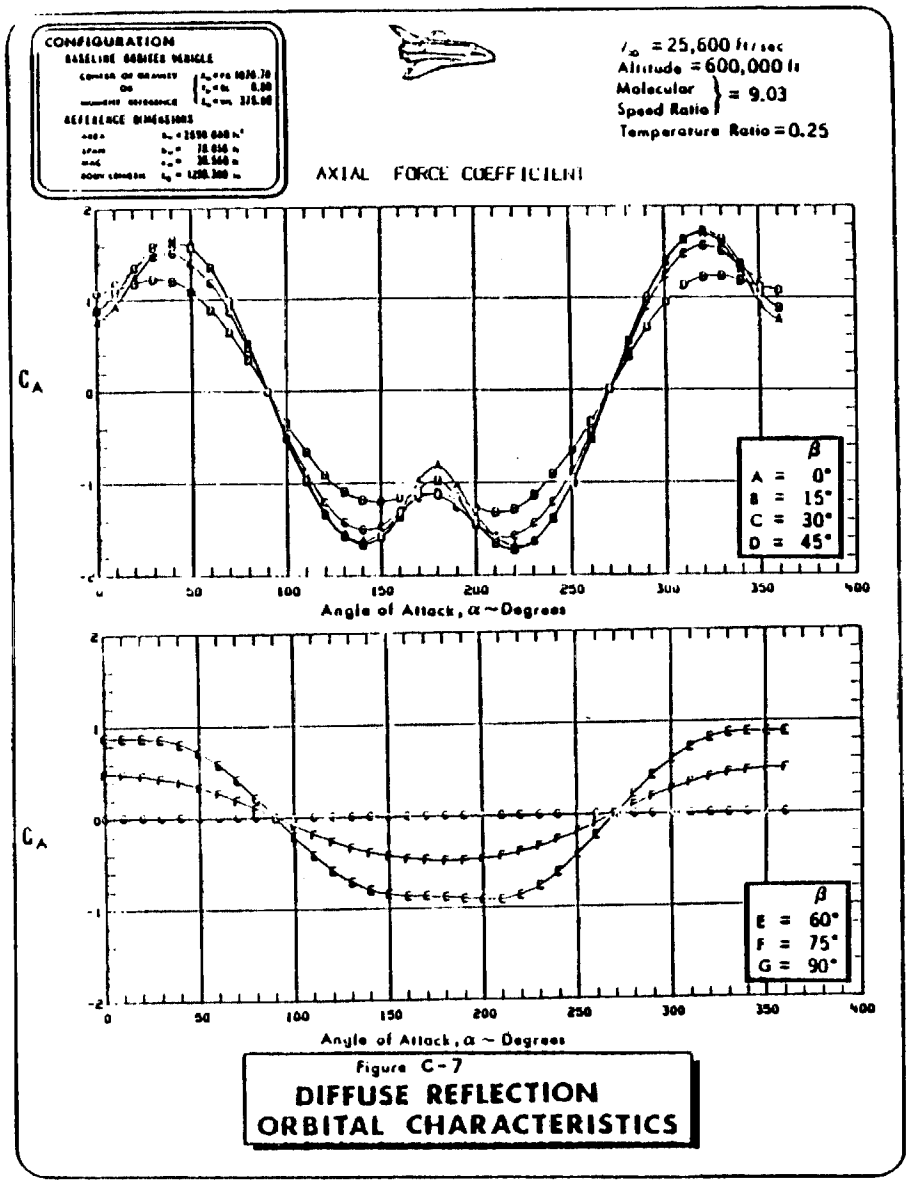


Figure C-7
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

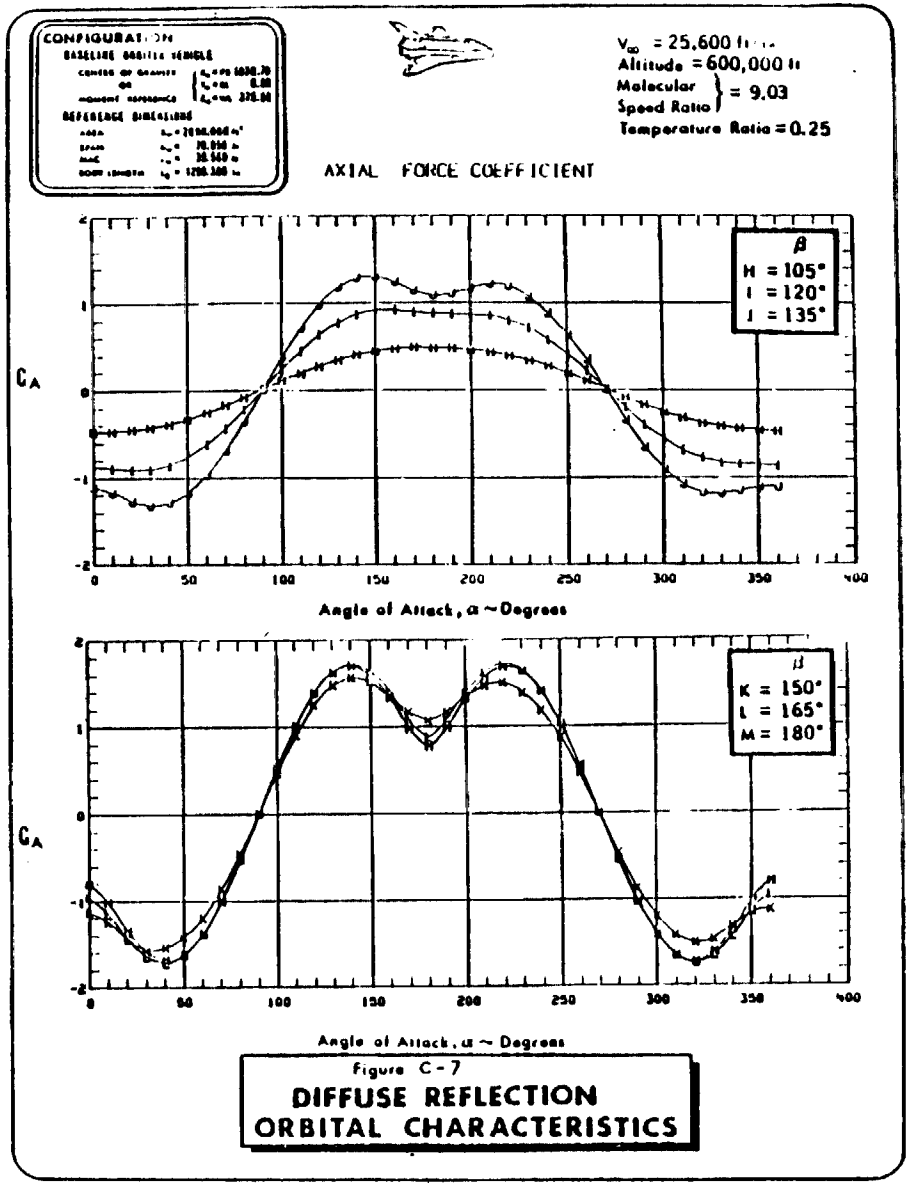


Figure C-7
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

Temperature Ratio = 0.25

V_∞ = 25,600 ft/sec
Altitude = 300,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees											
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	AXIAL FORCE COEFFICIENT, C_A												
0.0	0.76320	0.80148	1.07501	1.00511	0.88222	0.48574	0.00773	-0.47816	-0.87701	-1.11282	-1.13152	-0.96413	-0.79828
10.000	0.93347	1.07067	1.17702	1.11526	0.87582	0.48023	0.00777	-0.47361	-0.89529	-1.17656	-1.24976	-1.15610	-1.02212
20.000	1.23349	1.35358	1.35651	1.18081	0.86997	0.46265	0.00782	-0.45838	-0.91324	-1.27092	-1.44708	-1.44508	-1.35156
30.000	1.40275	1.57865	1.47829	1.23035	0.85940	0.43471	0.00782	-0.43136	-0.90821	-1.32253	-1.57428	-1.65045	-1.58757
40.000	1.60951	1.66146	1.51252	1.21002	0.80908	0.39575	0.00708	-0.39014	-0.85970	-1.29275	-1.54633	-1.72089	-1.68562
50.000	1.56877	1.58762	1.39371	1.08953	0.71999	0.34119	0.00789	-0.33337	-0.76621	-1.17456	-1.42073	-1.63015	-1.61385
60.000	1.35290	1.35377	1.18135	0.89077	0.58906	0.27186	0.00789	-0.26186	-0.62143	-0.97304	-1.19791	-1.38549	-1.38148
70.000	0.99072	0.98532	0.86836	0.64292	0.41672	0.19056	0.00789	-0.17842	-0.43659	-0.69292	-0.86744	-1.00265	-1.00604
80.000	0.52542	0.52183	0.46547	0.34436	0.21786	0.10055	0.00788	-0.08747	-0.22195	-0.35704	-0.45115	-0.52005	-0.52387
90.000	0.00322	0.00361	0.00394	0.00407	0.00488	0.00647	0.00788	0.00752	0.00666	0.00657	0.00683	0.00640	0.00625
100.000	-0.51588	-0.51417	-0.46109	-0.34279	-0.20904	-0.08792	0.00796	0.10242	0.23381	0.36807	0.47116	0.52966	0.53451
110.000	-0.97112	-0.97442	-0.87778	-0.65080	-0.40734	-0.17699	0.00790	0.19331	0.44687	0.70123	0.90057	1.00976	1.01773
120.000	-1.32427	-1.33288	-1.20460	-0.91438	-0.57675	-0.25847	0.00790	0.27558	0.63918	0.97768	1.25005	1.39502	1.40025
130.000	-1.55569	-1.57022	-1.41757	-1.09399	-0.70756	-0.32793	0.00792	0.34432	0.77054	1.17412	1.47854	1.63776	1.63105
140.000	-1.62953	-1.65709	-1.50548	-1.18619	-0.79601	-0.38303	0.00786	0.39989	0.86365	1.28309	1.56377	1.72352	1.69990
150.000	-1.53734	-1.58324	-1.46274	-1.19027	-0.84457	-0.42430	0.00786	0.44007	0.90689	1.30057	1.51257	1.63925	1.58935
160.000	-1.31303	-1.36068	-1.30895	-1.16420	-0.86297	-0.45220	0.00786	0.46722	0.91065	1.23554	1.34459	1.41086	1.34070
170.000	-0.98163	-1.07836	-1.16111	-1.12332	-0.86739	-0.46910	0.00786	0.48365	0.89408	1.13755	1.17000	1.07691	0.97587
180.000	-0.80060	-0.97298	-1.13068	-1.11039	-0.88061	-0.47814	0.00826	0.48169	0.87450	1.07806	1.07102	0.87238	0.76314
190.000	-1.02353	-1.15610	-1.25778	-1.17659	-0.89208	-0.47365	0.00826	0.47533	0.86807	1.10542	1.16984	1.08776	0.99036
200.000	-1.35216	-1.44508	-1.45186	-1.27092	-0.90643	-0.45811	0.00829	0.45727	0.85936	1.16749	1.34403	1.39270	1.31904
210.000	-1.58656	-1.65045	-1.57065	-1.32253	-0.90479	-0.43138	0.00832	0.42948	0.84663	1.21369	1.46535	1.62816	1.56985
220.000	-1.68316	-1.72060	-1.56774	-1.28535	-0.85921	-0.39014	0.00840	0.39036	0.79624	1.19231	1.50526	1.72443	1.68933
230.000	-1.61335	-1.63015	-1.43749	-1.13317	-0.76355	-0.33487	0.00838	0.33642	0.70728	1.07267	1.38858	1.65441	1.63629
240.000	-1.38240	-1.38549	-1.21013	-0.91248	-0.61233	-0.26480	0.00838	0.26785	0.57832	0.87743	1.18041	1.41405	1.40922
250.000	-1.00767	-1.00265	-0.87596	-0.64980	-0.42281	-0.18151	0.00838	0.18777	0.40882	0.63349	0.86836	1.02933	1.03185
260.000	-0.52385	-0.52005	-0.46022	-0.34062	-0.21276	-0.08925	0.00835	0.09900	0.21388	0.33988	0.46547	0.54218	0.54542
270.000	0.00670	0.00640	0.00663	0.00703	0.00703	0.00726	0.00831	0.00638	0.00472	0.00399	0.00394	0.00285	0.00233
280.000	0.53475	0.52966	0.47448	0.35930	0.22528	0.10325	0.00831	-0.08648	-0.20531	-0.33975	-0.46109	-0.53493	-0.54009
290.000	1.01707	1.00977	0.90564	0.68562	0.42995	0.19435	0.00824	-0.17413	-0.40056	-0.65276	-0.87778	-1.02104	-1.03170
300.000	1.39967	1.39503	1.25508	0.95213	0.60197	0.27615	0.00823	-0.25443	-0.56795	-0.90722	-1.20460	-1.40277	-1.41315
310.000	1.63252	1.63779	1.48036	1.13251	0.73207	0.34430	0.00822	-0.32299	-0.69732	-1.08655	-1.41736	-1.65262	-1.65403
320.000	1.69095	1.72355	1.56377	1.22802	0.82752	0.39990	0.00813	-0.37750	-0.78535	-1.17818	-1.50548	-1.73868	-1.72418
330.000	1.58768	1.63577	1.51257	1.23797	0.87244	0.44007	0.00813	-0.41853	-0.83451	-1.19106	-1.46269	-1.65247	-1.61252
340.000	1.30398	1.37944	1.34459	1.18735	0.88717	0.46719	0.00813	-0.44647	-0.85353	-1.15634	-1.30871	-1.43353	-1.36177
350.000	0.91656	1.05147	1.17001	1.11636	0.88341	0.48364	0.00813	-0.46361	-0.85861	-1.11627	-1.16111	-1.12948	-1.00626
360.000	0.76320	0.80148	1.07501	1.00511	0.88222	0.48574	0.00773	-0.47816	-0.87701	-1.11282	-1.13152	-0.96413	-0.79828

Table C-7

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

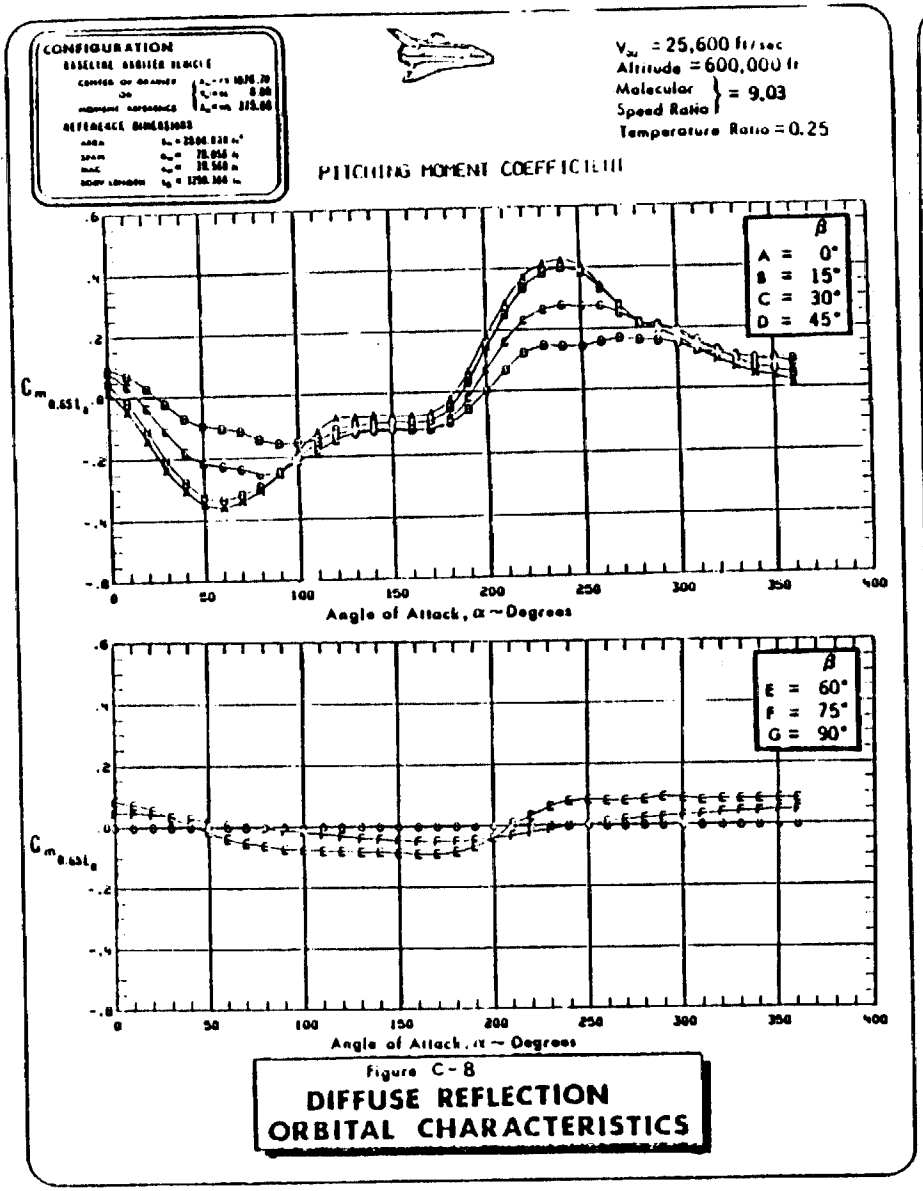


Figure C-8
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

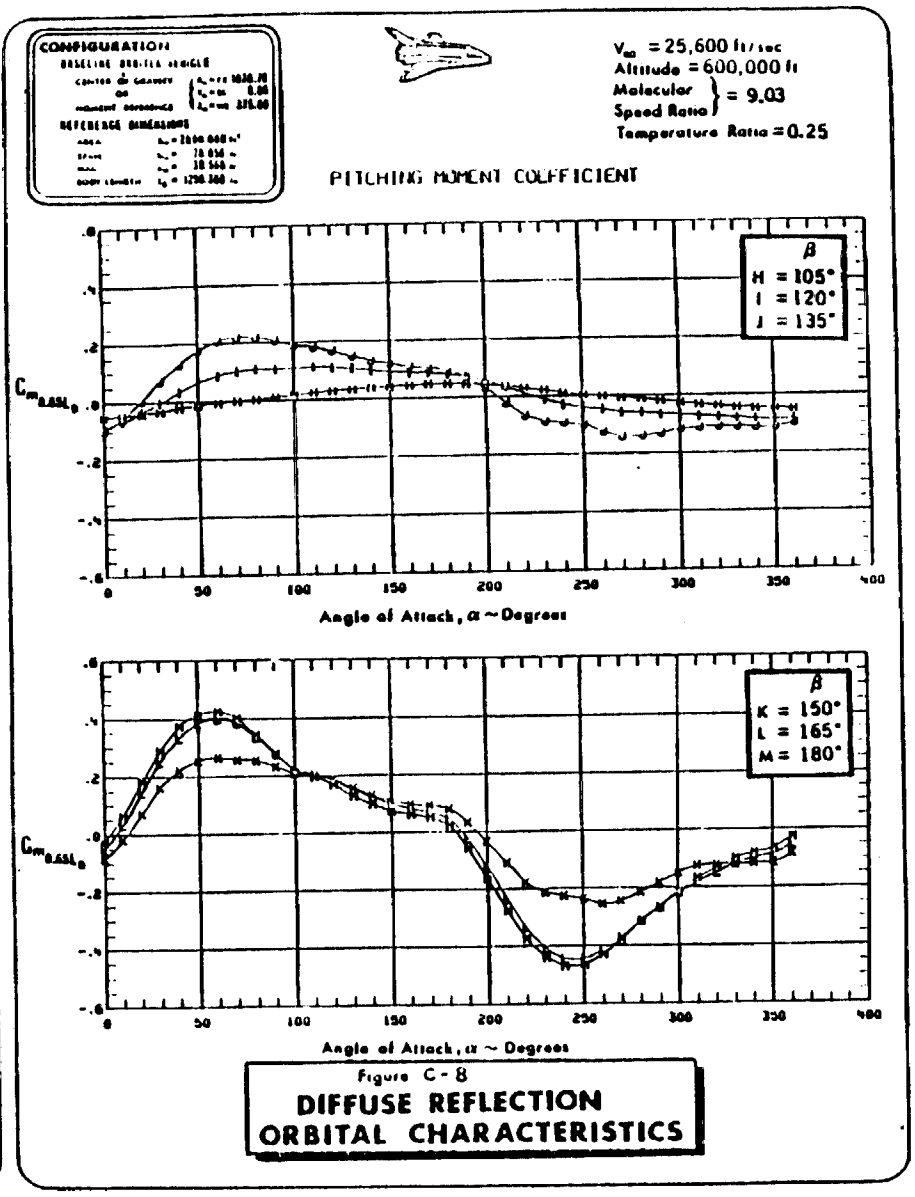


Figure C-8
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

Temperature Ratio = 0.25

V_{∞} = 25,600 ft/sec
Altitude = 600,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees												
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	PITCHING MOMENT COEFFICIENT, $C_{m_{0.65 l_B}}$												
0.0	0.01853	0.04327	0.07874	0.09220	0.08078	0.04561	-0.00203	-0.05114	-0.00512	-0.10071	-0.08652	-0.05401	-0.02576
10.000	-0.04873	-0.01957	0.03330	0.06979	0.07223	0.04385	-0.00205	-0.04750	-0.06799	-0.09866	-0.02007	0.03194	0.06472
20.000	-0.14175	-0.10971	-0.03903	0.02803	0.05584	0.04055	-0.00204	-0.04154	-0.03895	0.00338	0.07121	0.14292	0.17998
30.000	-0.23737	-0.20319	-0.11189	-0.02444	0.02967	0.03471	-0.00204	-0.03343	-0.00442	0.06910	0.16109	0.24839	0.28822
40.000	-0.30674	-0.27093	-0.18114	-0.07233	0.00600	0.02568	-0.00198	-0.02434	0.02958	0.12649	0.21991	0.33300	0.37059
50.000	-0.35152	-0.32651	-0.21718	-0.09691	-0.01835	0.01615	-0.00209	-0.01562	0.06259	0.17068	0.25375	0.38162	0.41291
60.000	-0.36279	-0.33871	-0.22703	-0.10672	-0.04147	0.00698	-0.00209	-0.00831	0.08512	0.20386	0.26264	0.39832	0.42252
70.000	-0.34215	-0.32116	-0.23743	-0.11690	-0.05430	-0.00091	-0.00209	-0.00286	0.10057	0.21745	0.25723	0.38177	0.40138
80.000	-0.30779	-0.29624	-0.25590	-0.14250	-0.06367	-0.00785	-0.00210	0.00290	0.10606	0.21536	0.25273	0.33208	0.34141
90.000	-0.25201	-0.25239	-0.24954	-0.15756	-0.07104	-0.01421	-0.00210	0.00965	0.10691	0.20374	0.23064	0.27445	0.27669
100.000	-0.18419	-0.20260	-0.21572	-0.15453	-0.07701	-0.02090	0.00208	0.01566	0.10673	0.18759	0.20579	0.21765	0.21385
110.000	-0.11808	-0.15440	-0.18235	-0.14448	-0.08043	-0.02668	-0.00236	0.02200	0.10973	0.17814	0.19907	0.20384	0.19458
120.000	-0.07789	-0.11505	-0.14920	-0.12933	-0.08269	-0.03354	-0.00238	0.02790	0.10767	0.16435	0.18359	0.18277	0.18644
130.000	-0.07491	-0.10351	-0.12914	-0.12145	-0.08397	-0.03950	-0.00227	0.03180	0.10225	0.14537	0.15486	0.14792	0.12367
140.000	-0.07299	-0.09781	-0.12269	-0.11655	-0.08578	-0.04407	-0.00242	0.03617	0.09604	0.13040	0.12689	0.12112	0.09622
150.000	-0.07325	-0.09216	-0.12069	-0.11521	-0.08853	-0.04817	-0.00242	0.03953	0.08986	0.11716	0.10761	0.09567	0.07113
160.000	-0.07574	-0.09187	-0.11961	-0.11947	-0.09215	-0.05103	-0.00242	0.04240	0.08664	0.10577	0.09512	0.07903	0.06083
170.000	-0.06940	-0.09242	-0.11739	-0.11849	-0.09297	-0.05213	-0.00242	0.04433	0.08460	0.10105	0.09200	0.06632	0.04973
180.000	-0.02390	-0.05217	-0.08752	-0.09957	-0.08587	-0.05117	-0.00382	0.04432	0.07836	0.09003	0.07750	0.04091	0.01835
190.000	0.06501	0.03194	-0.02111	-0.05862	-0.06845	-0.04750	-0.00302	0.04290	0.07076	0.06793	0.03196	-0.02642	-0.06038
200.000	0.18027	0.14292	0.07107	0.00338	-0.04093	-0.04154	-0.00374	0.04023	0.05527	0.02731	-0.03968	-0.12680	-0.16804
210.000	0.28788	0.24839	0.16164	0.06910	0.00563	-0.03343	-0.00369	0.03516	0.03097	-0.02468	-0.11046	-0.23657	-0.27831
220.000	0.36907	0.33295	0.22696	0.12340	0.02945	-0.02434	-0.00362	0.02717	0.00977	-0.06701	-0.17905	-0.33587	-0.37389
230.000	0.41269	0.38162	0.26373	0.14569	0.06163	-0.01409	-0.00364	0.01861	-0.01133	-0.08729	-0.21393	-0.40847	-0.43069
240.000	0.42394	0.39832	0.27516	0.14332	0.07759	-0.00421	-0.00364	0.01053	-0.03148	-0.09374	-0.22609	-0.44350	-0.46801
250.000	0.40496	0.38177	0.27267	0.14242	0.08105	0.00374	-0.00364	0.00337	-0.04140	-0.10060	-0.23742	-0.44350	-0.46421
260.000	0.34171	0.33208	0.27174	0.15788	0.07990	0.01010	-0.00366	-0.00257	-0.04971	-0.12545	-0.25590	-0.41504	-0.43056
270.000	0.27339	0.27445	0.25024	0.16635	0.07940	0.01601	-0.00368	-0.00650	-0.05056	-0.14211	-0.24454	-0.36798	-0.37791
280.000	0.21552	0.21765	0.21874	0.16019	0.08310	0.02060	-0.00368	-0.01445	-0.06076	-0.14085	-0.21572	-0.31288	-0.31370
290.000	0.19242	0.20385	0.20991	0.15850	0.08888	0.02471	-0.00348	-0.02026	-0.06539	-0.13106	-0.18235	-0.26859	-0.26504
300.000	0.16524	0.18278	0.19027	0.14597	0.08582	0.02885	-0.00348	-0.02743	-0.06950	-0.11867	-0.14920	-0.21900	-0.21059
310.000	0.12557	0.14793	0.15654	0.12415	0.07996	0.03180	-0.00357	-0.03393	-0.07254	-0.11326	-0.12591	-0.18364	-0.16980
320.000	0.09526	0.12113	0.12689	0.11226	0.08197	0.03617	-0.00343	-0.03922	-0.07650	-0.10993	-0.12269	-0.14944	-0.13348
330.000	0.07018	0.09386	0.10761	0.10393	0.08059	0.03953	-0.00343	-0.04416	-0.08153	-0.11048	-0.12066	-0.11820	-0.10014
340.000	0.04600	0.06099	0.09512	0.10031	0.08273	0.04239	-0.00343	-0.04790	-0.08700	-0.11531	-0.11951	-0.10181	-0.08328
350.000	0.03709	0.06022	0.09200	0.10032	0.08337	0.04432	-0.00343	-0.04984	-0.08931	-0.11559	-0.11739	-0.08889	-0.06759
360.000	0.01853	0.04327	0.07874	0.09220	0.08078	0.04561	-0.00203	-0.05114	-0.00512	-0.10071	-0.08652	-0.05401	-0.02576

Table C-8

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

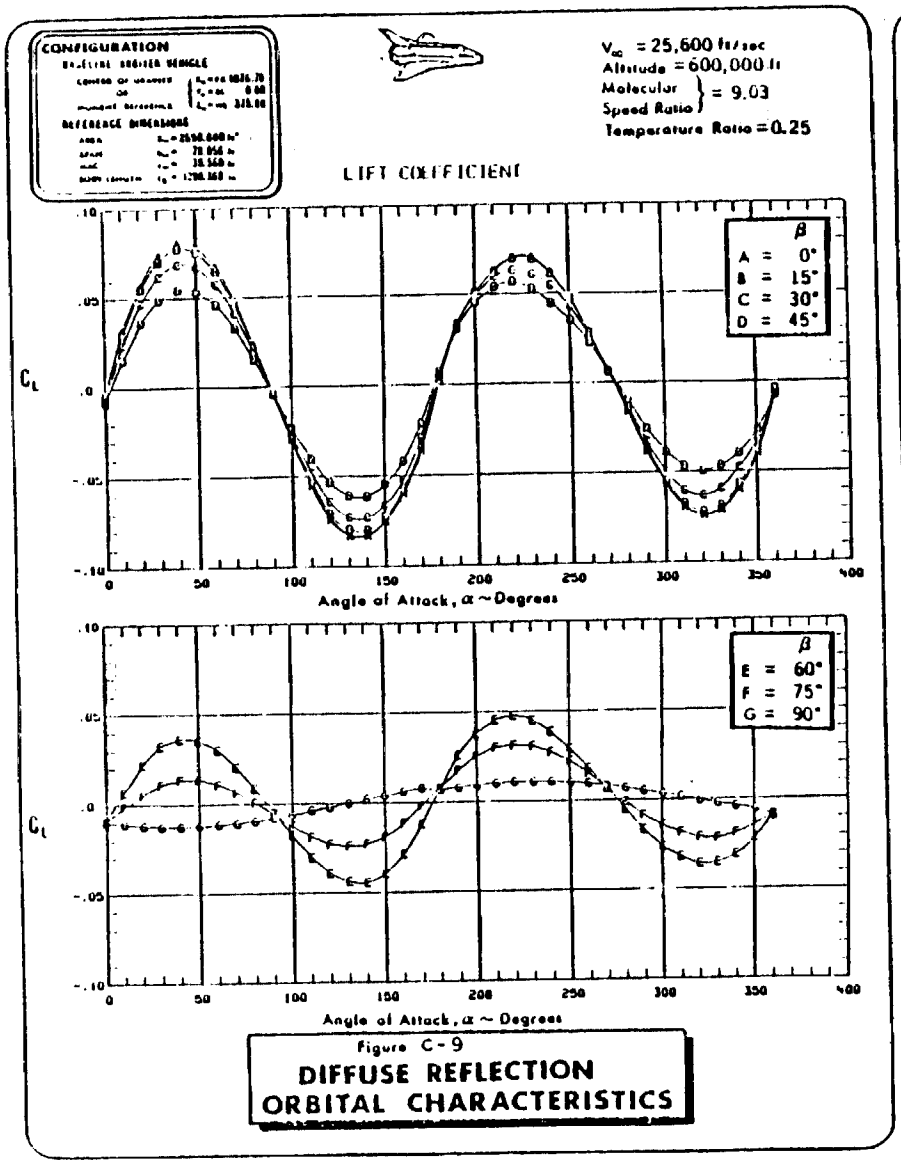


Figure C-9

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

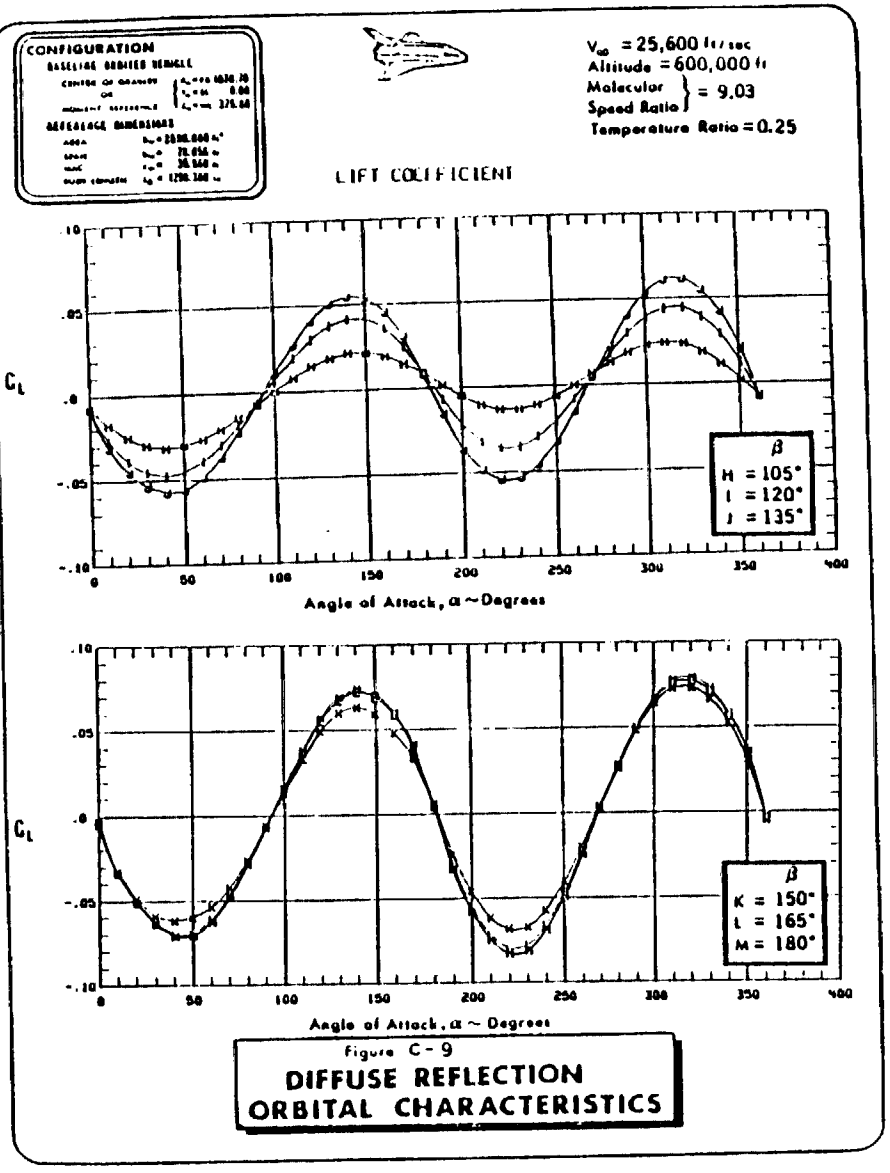


Figure C-9

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Temperature Ratio = 0.25

V_∞ = 25,600 ft/sec
Altitude = 600,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees												
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	LIFT COEFFICIENT, C_L												
0.0	-0.00456	-0.00412	-0.00695	-0.00760	-0.00866	-0.00891	-0.00962	-0.00806	-0.00839	0.00739	-0.00527	-0.00386	-0.00253
10.000	0.03287	0.02985	0.02374	0.01524	0.00667	-0.00131	-0.01079	-0.01766	-0.02676	-0.03137	-0.03270	-0.03381	-0.03372
20.000	0.05766	0.05496	0.04702	0.03643	0.02195	0.00530	-0.01169	-0.02530	-0.03923	-0.04569	-0.04899	-0.05096	-0.05087
30.000	0.07424	0.07068	0.06221	0.04869	0.03234	0.01058	-0.01222	-0.02998	-0.04575	-0.05304	-0.05933	-0.06305	-0.06374
40.000	0.08130	0.07790	0.06881	0.05476	0.03616	0.01339	-0.01245	-0.03153	-0.04777	-0.05741	-0.06180	-0.06963	-0.07072
50.000	0.07876	0.07579	0.06732	0.05327	0.03539	0.01338	-0.01217	-0.03017	-0.04557	-0.05621	-0.05988	-0.06942	-0.07090
60.000	0.06736	0.06479	0.05743	0.04607	0.03000	0.01097	-0.01160	-0.02671	-0.03965	-0.04931	-0.05419	-0.06117	-0.06249
70.000	0.04813	0.04634	0.04084	0.03278	0.02047	0.00632	-0.01067	-0.02155	-0.03056	-0.03779	-0.04257	-0.04711	-0.04798
80.000	0.02393	0.02268	0.01963	0.01521	0.00828	0.00033	-0.00941	-0.01506	-0.01925	-0.02308	-0.02617	-0.02815	-0.02872
90.000	-0.00322	-0.00361	-0.00394	-0.00407	-0.00488	-0.00647	-0.00788	-0.00752	-0.00666	-0.00657	-0.00683	-0.00640	-0.00625
100.000	-0.02981	-0.02871	-0.02654	-0.02283	-0.01775	0.01275	-0.00619	0.00043	0.00665	0.01066	0.01311	0.01542	0.01594
110.000	-0.05525	-0.05264	-0.04803	-0.04016	-0.02986	-0.01855	-0.00426	0.00762	0.01899	0.02704	0.03267	0.03690	0.03820
120.000	-0.07405	-0.07085	-0.06436	-0.05367	-0.03900	-0.02251	-0.00221	0.01395	0.02968	0.04095	0.04936	0.05512	0.05705
130.000	-0.08268	-0.07966	-0.07268	-0.06079	-0.04396	-0.02414	-0.00006	0.01812	0.03751	0.05026	0.06008	0.06737	0.06935
140.000	-0.08209	-0.08012	-0.07301	-0.06127	-0.04419	-0.02293	0.00201	0.02116	0.04125	0.05456	0.06328	0.07224	0.07416
150.000	-0.07503	-0.07270	-0.06606	-0.05482	-0.03898	-0.01859	0.00405	0.02149	0.04076	0.05282	0.05897	0.06883	0.07069
160.000	-0.05941	-0.05767	-0.05212	-0.04181	-0.02841	-0.01128	0.00597	0.01903	0.03531	0.04517	0.04753	0.05803	0.06009
170.000	-0.03653	-0.03452	-0.02917	-0.02106	-0.01189	-0.00160	0.00771	0.01426	0.02417	0.03024	0.03266	0.03889	0.04115
180.000	0.00259	0.00393	0.00571	0.00744	0.00814	0.00805	0.00609	0.00886	0.00860	0.00756	0.00616	0.00416	0.00449
190.000	0.03371	0.03381	0.03337	0.03134	0.02610	0.01767	0.00822	0.00125	-0.00672	-0.01527	-0.02375	-0.03019	-0.03301
200.000	0.05087	0.05096	0.04930	0.04569	0.03811	0.02531	0.00937	-0.00537	-0.02200	-0.03646	-0.04701	-0.05574	-0.05839
210.000	0.06370	0.06305	0.05965	0.05384	0.04526	0.02998	0.01023	-0.01067	-0.03240	-0.04873	-0.06219	-0.07243	-0.07544
220.000	0.07083	0.06961	0.06331	0.05661	0.04760	0.03153	0.01081	-0.01347	-0.03624	-0.05481	-0.06883	-0.08001	-0.08329
230.000	0.07094	0.06942	0.06085	0.05265	0.04513	0.03055	0.01095	-0.01348	-0.03516	-0.05331	-0.06731	-0.07779	-0.08101
240.000	0.06242	0.06117	0.05479	0.04696	0.03837	0.02735	0.01078	-0.01108	-0.03011	-0.04613	-0.05744	-0.06644	-0.06925
250.000	0.04702	0.04711	0.04289	0.03539	0.02887	0.02210	0.01028	-0.00644	-0.02060	-0.03283	-0.04084	-0.04761	-0.04907
260.000	0.02876	0.02815	0.02623	0.02254	0.01842	0.01520	0.00945	-0.00043	-0.00845	-0.01528	-0.01963	-0.02344	-0.02483
270.000	0.00670	0.00640	0.00663	0.00703	0.00703	0.00726	0.00831	0.00638	0.00472	0.00399	0.00394	0.00285	0.00233
280.000	-0.01598	-0.01542	-0.01349	-0.00957	-0.00523	-0.00091	0.00696	0.01269	0.01763	0.02276	0.02654	0.02762	0.02796
290.000	-0.03814	-0.03690	-0.03311	-0.02548	-0.01653	-0.00865	0.00527	0.01851	0.02977	0.04009	0.04803	0.04943	0.05051
300.000	-0.05706	-0.05512	-0.04977	-0.03853	-0.02594	-0.01416	0.00352	0.02250	0.03896	0.05364	0.06436	0.06650	0.06820
310.000	-0.06945	-0.06737	-0.06022	-0.04636	-0.03197	-0.01841	0.00178	0.02415	0.04396	0.06079	0.07268	0.07556	0.07759
320.000	-0.07414	-0.07224	-0.06328	-0.04940	-0.03508	-0.02116	-0.00037	0.02297	0.04423	0.06129	0.07310	0.07682	0.07901
330.000	-0.07078	-0.06886	-0.05897	-0.04653	-0.03519	-0.02149	-0.00226	0.01865	0.03904	0.05486	0.06606	0.07062	0.07272
340.000	-0.05953	-0.05706	-0.04753	-0.03969	-0.03085	-0.01901	-0.00408	0.01136	0.02819	0.04185	0.05212	0.05667	0.05833
350.000	-0.04004	-0.03810	-0.03266	-0.02692	-0.02131	-0.01426	-0.00578	0.00169	0.01197	0.02111	0.02917	0.03404	0.03611
360.000	-0.00456	-0.00412	-0.00695	-0.00760	-0.00866	-0.00891	-0.00962	-0.00806	-0.00839	-0.00739	-0.00527	-0.00386	-0.00253

Table C-9

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

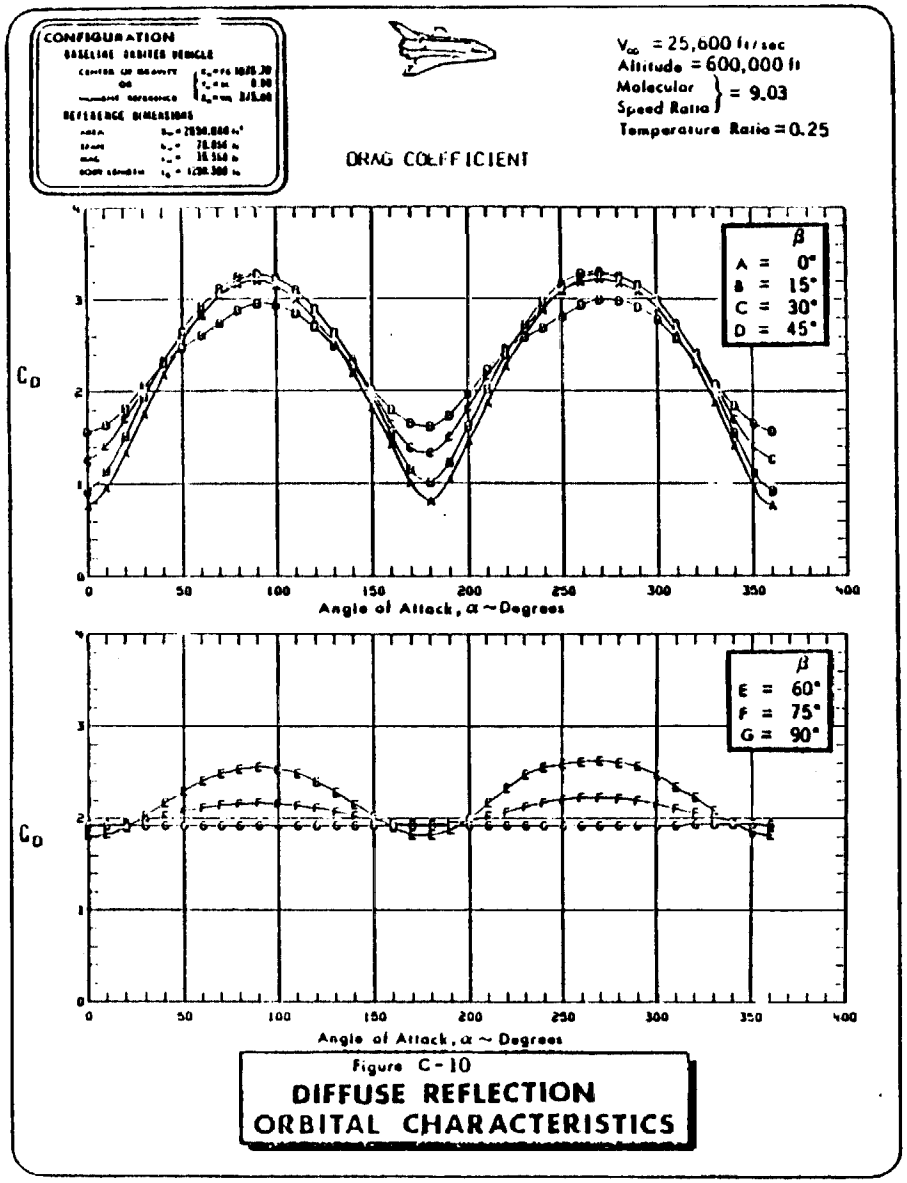


Figure C-10
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

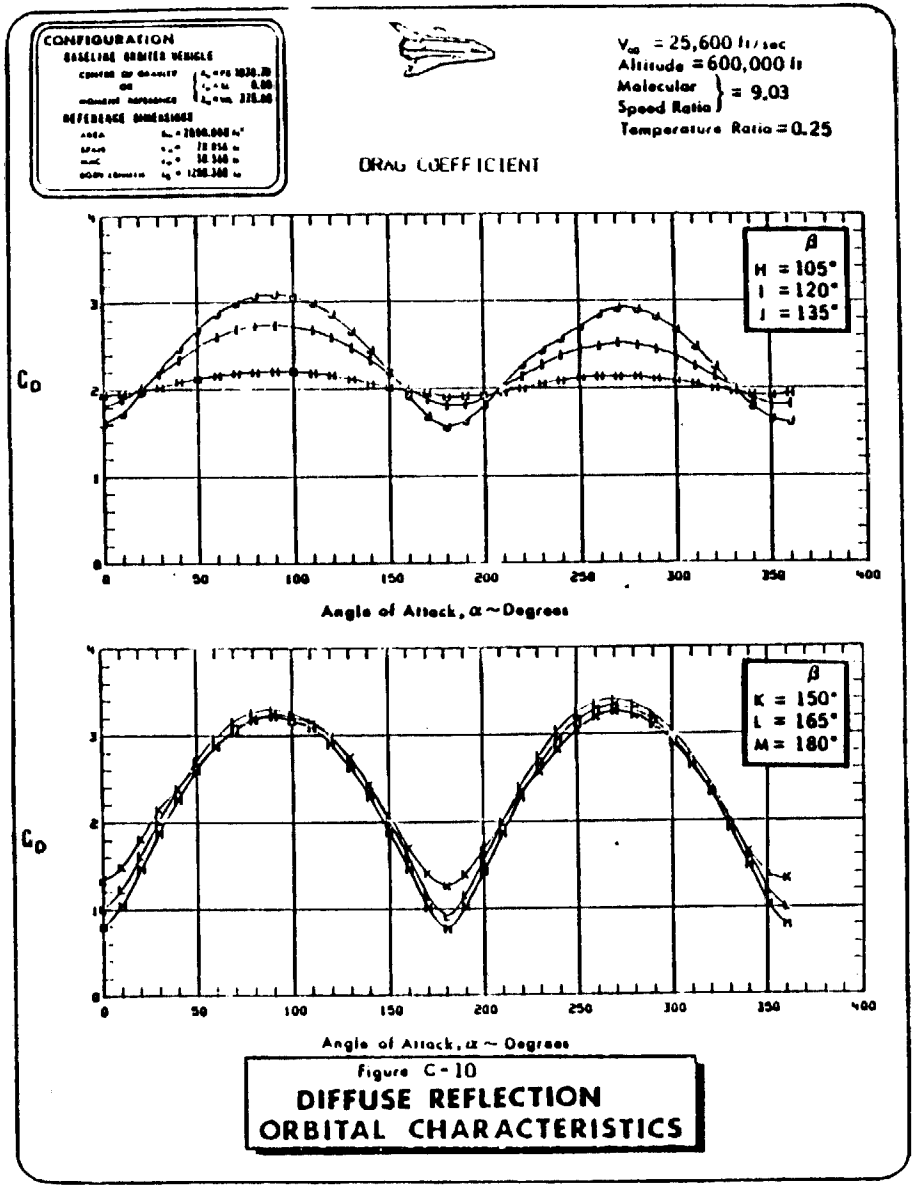


Figure C-10
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

Temperature Ratio = 0.25

V_∞ = 25,600 ft/sec
Altitude = 600,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees												
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	DRAG COEFFICIENT, C_D												
0.0	0.76320	0.91988	1.26359	1.57321	1.81467	1.91823	1.92837	1.93658	1.81530	1.61137	1.32474	1.00332	0.79828
10.000	0.95367	1.13744	1.40439	1.64007	1.82740	1.92408	1.92652	1.93967	1.80285	1.73205	1.48933	1.22659	1.04384
20.000	1.33364	1.51678	1.70103	1.82067	1.90140	1.94015	1.92467	1.97868	2.01443	1.96418	1.81340	1.61572	1.45682
30.000	1.75499	1.93269	2.02003	2.06113	2.03752	1.97487	1.92469	2.02324	2.17563	2.22246	2.14932	2.01422	1.86997
40.000	2.16929	2.31430	2.34652	2.29673	2.16775	2.02807	1.92287	2.07279	2.33150	2.46306	2.39744	2.38849	2.25976
50.000	2.53944	2.64968	2.58712	2.46861	2.29755	2.07661	1.91859	2.11806	2.48054	2.67624	2.63660	2.71215	2.59519
60.000	2.82246	2.91635	2.82747	2.59777	2.41345	2.11642	1.91859	2.15325	2.59387	2.85967	2.87178	2.97809	2.87120
70.000	3.02974	3.10998	3.04157	2.74064	2.48609	2.14520	1.91859	2.17577	2.67791	2.99003	3.05629	3.16759	3.07329
80.000	3.16145	3.23913	3.20230	2.87647	2.52967	2.16011	1.91877	2.19283	2.72218	3.06495	3.18934	3.26851	3.17975
90.000	3.19846	3.27752	3.25715	2.94629	2.55850	2.16490	1.91812	2.20028	2.73315	3.08669	3.23649	3.29648	3.21499
100.000	3.13992	3.22899	3.21959	2.92739	2.53798	2.15825	1.91755	2.19509	2.71274	3.05370	3.20740	3.24624	3.16848
110.000	2.99116	3.09506	3.09846	2.83966	2.48581	2.13485	1.91642	2.17733	2.66765	2.97975	3.13429	3.16001	3.08062
120.000	2.77679	2.88400	2.89708	2.68813	2.39876	2.10975	1.91642	2.14852	2.58353	2.84805	2.97964	2.98680	2.89931
130.000	2.51076	2.62605	2.63933	2.49217	2.28373	2.07187	1.91765	2.10012	2.46498	2.66173	2.73813	2.72185	2.62011
140.000	2.19676	2.30954	2.33878	2.25896	2.15276	2.02603	1.91899	2.05417	2.32032	2.43894	2.42425	2.39448	2.28129
150.000	1.81848	1.93820	1.99848	2.01111	2.01836	1.98321	1.91897	2.00392	2.15609	2.18420	2.06807	2.00482	1.87604
160.000	1.41892	1.52370	1.63958	1.70678	1.90033	1.94723	1.91897	1.96305	1.99540	1.91037	1.68963	1.58165	1.44861
170.000	1.00322	1.14389	1.30227	1.65161	1.82297	1.92778	1.91897	1.93956	1.86893	1.67675	1.39945	1.14601	0.99810
180.000	0.80860	1.01244	1.33080	1.61915	1.82267	1.93655	1.92289	1.90187	1.79055	1.56286	1.25085	0.91047	0.76314
190.000	1.09566	1.22659	1.49891	1.73211	1.87813	1.94961	1.92289	1.90393	1.81094	1.62537	1.39571	1.15559	1.01146
200.000	1.45745	1.61572	1.81944	1.96418	1.99983	1.97081	1.92109	1.91695	1.87774	1.79983	1.68521	1.56035	1.42495
210.000	1.86882	2.01422	2.15534	2.22246	2.16765	2.02322	1.91974	1.95047	2.00664	2.03282	2.00223	1.99293	1.85626
220.000	2.25663	2.38808	2.43077	2.44892	2.33026	2.07279	1.91756	1.99960	2.13267	2.26275	2.33527	2.40133	2.27515
230.000	2.59447	2.71215	2.66763	2.58242	2.47195	2.12682	1.91842	2.04671	2.25621	2.43005	2.57761	2.75994	2.64215
240.000	2.87309	2.97809	2.90079	2.68112	2.55635	2.17512	1.91843	2.08431	2.36868	2.55860	2.82526	3.04451	2.93839
250.000	3.07763	3.16759	3.08564	2.80949	2.59546	2.20850	1.91843	2.11304	2.43022	2.70001	3.04157	3.24713	3.15395
260.000	3.17905	3.26851	3.22102	2.93205	2.61662	2.22704	1.91891	2.12506	2.48317	2.83094	3.20230	3.36511	3.28177
270.000	3.21119	3.29648	3.26732	2.99426	2.62177	2.23121	1.91922	2.13088	2.51126	2.91469	3.25715	3.39641	3.32198
280.000	3.17017	3.24625	3.23160	2.97650	2.60770	2.21851	1.91919	2.12238	2.49116	2.90092	3.21959	3.34629	3.27344
290.000	3.07852	3.16003	3.15258	2.91163	2.56401	2.19063	1.92384	2.09903	2.44333	2.81328	3.09846	3.22696	3.15525
300.000	2.89017	2.98691	2.99193	2.77324	2.46887	2.15335	1.92306	2.07611	2.36125	2.66682	2.89788	3.02075	2.94442
310.000	2.62252	2.72108	2.74157	2.56649	2.34088	2.10004	1.92264	2.03999	2.24992	2.47501	2.63896	2.75345	2.66568
320.000	2.28003	2.39452	2.42425	2.33535	2.22303	2.05417	1.93168	1.99620	2.12332	2.24350	2.33878	2.41669	2.31706
330.000	1.87416	2.00067	2.06807	2.07915	2.07422	2.00392	1.93168	1.95567	1.99381	1.99882	1.99842	2.01947	1.90397
340.000	1.40933	1.59685	1.68964	1.83624	1.99413	1.96092	1.93168	1.92207	1.87910	1.78343	1.63927	1.60395	1.47039
350.000	0.93776	1.11911	1.39945	1.64584	1.84676	1.93954	1.93168	1.90479	1.80415	1.64104	1.30227	1.19796	1.02815
360.000	0.76320	0.91988	1.26359	1.57321	1.81467	1.91823	1.92837	1.93658	1.81530	1.61137	1.32474	1.00332	0.79828

Table C-10

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

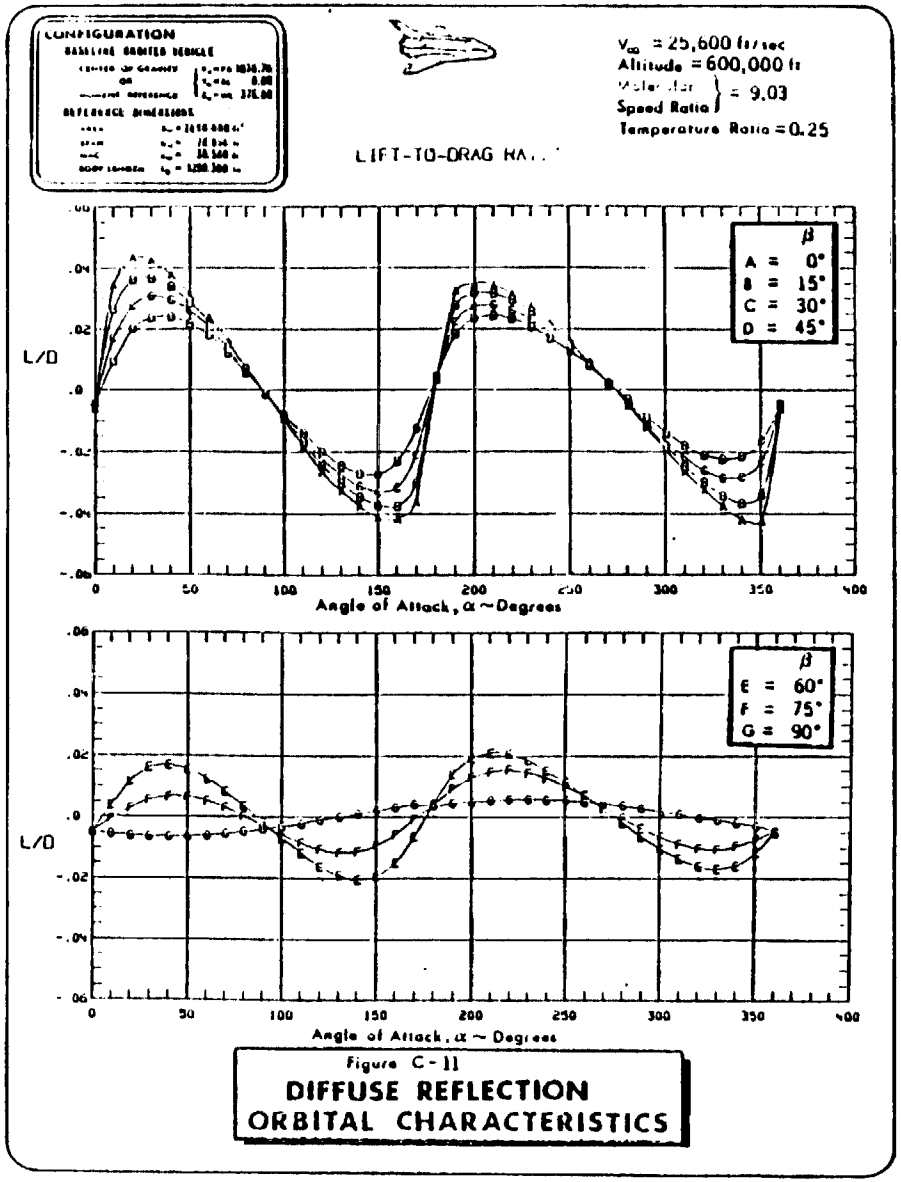


Figure C-11

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

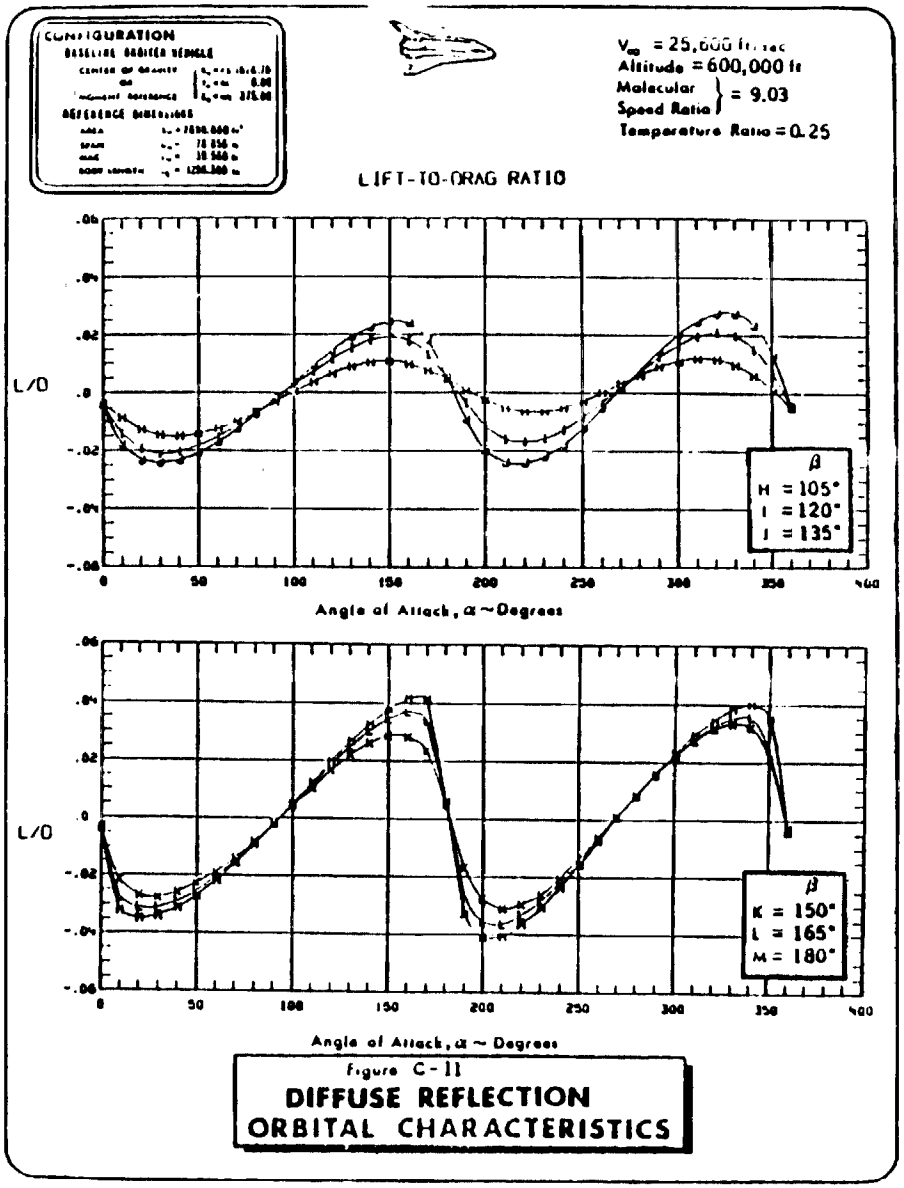


Figure C-11

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

Temperature Ratio = 0.25

V_∞ = 25,600 ft/sec
Altitude = 300,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees												
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	LIFT-TO-DRAG RATIO, L/D												
0.0	-0.00590	-0.00447	-0.00400	-0.00403	-0.00477	-0.00465	-0.00499	-0.00499	-0.00462	-0.00450	-0.00398	-0.00385	-0.00317
10.000	0.03446	0.02625	0.01690	0.00929	0.00365	-0.00068	-0.00560	-0.00906	-0.01421	-0.01811	-0.02196	-0.02757	-0.03231
20.000	0.04323	0.03624	0.02764	0.02001	0.01154	0.00273	-0.00607	-0.01279	-0.01947	-0.02326	-0.02702	-0.03154	-0.03492
30.000	0.04230	0.03657	0.03080	0.02362	0.01587	0.00736	-0.00635	-0.01482	-0.02103	-0.02423	-0.02761	-0.03130	-0.03409
40.000	0.03740	0.03366	0.02932	0.02384	0.01668	0.00660	-0.00648	-0.01521	-0.02049	-0.02331	-0.02578	-0.02915	-0.03130
50.000	0.03108	0.02861	0.02602	0.02158	0.01540	0.00644	-0.00634	-0.01425	-0.01837	-0.02100	-0.02271	-0.02560	-0.02732
60.000	0.02386	0.02222	0.02031	0.01774	0.01243	0.00519	-0.00605	-0.01240	-0.01529	-0.01724	-0.01887	-0.02054	-0.02176
70.000	0.01590	0.01490	0.01343	0.01196	0.00823	0.00295	-0.00566	-0.00991	-0.01141	-0.01264	-0.01393	-0.01487	-0.01561
80.000	0.00757	0.00700	0.00613	0.00529	0.00327	0.00015	-0.00491	-0.00687	-0.00707	-0.00753	-0.00820	-0.00861	-0.00930
90.000	-0.00101	-0.00110	-0.00121	-0.00138	-0.00191	-0.00299	-0.00411	-0.00324	-0.00244	-0.00213	-0.00211	-0.00194	-0.00194
100.000	-0.00919	-0.00889	-0.00824	-0.00760	-0.00700	-0.00591	-0.00323	0.00019	0.00295	0.00349	0.00409	0.00475	0.00503
110.000	-0.01849	-0.01701	-0.01550	-0.01414	-0.01201	-0.00869	-0.00222	0.00350	0.00712	0.00907	0.01042	0.01168	0.01240
120.000	-0.02667	-0.02457	-0.02221	-0.01996	-0.01626	-0.01067	-0.00115	0.00649	0.01157	0.01437	0.01657	0.01845	0.01968
130.000	-0.03282	-0.03039	-0.02754	-0.02439	-0.01925	-0.01165	-0.00003	0.00877	0.01522	0.01880	0.02194	0.02475	0.02647
140.000	-0.03773	-0.03469	-0.03126	-0.02712	-0.02053	-0.01132	0.00105	0.01030	0.01778	0.02237	0.02610	0.03017	0.03251
150.000	-0.04126	-0.03751	-0.03306	-0.02726	-0.01931	-0.00937	0.00211	0.01072	0.01891	0.02418	0.02852	0.03433	0.03768
160.000	-0.04187	-0.03785	-0.03179	-0.02328	-0.01495	-0.00579	0.00311	0.00969	0.01769	0.02364	0.02813	0.03669	0.04148
170.000	-0.03641	-0.03018	-0.02111	-0.01275	-0.00652	-0.00083	0.00402	0.00735	0.01293	0.01804	0.02334	0.03393	0.04122
180.000	0.00321	0.00388	0.00429	0.00459	0.00447	0.00415	0.00358	0.00466	0.00478	0.00484	0.00490	0.00475	0.00589
190.000	0.03225	0.02757	0.02226	0.01810	0.01389	0.00906	0.00428	0.00066	-0.00371	-0.00910	-0.01702	-0.02639	-0.03263
200.000	0.03490	0.03154	0.02710	0.02326	0.01906	0.01279	0.00488	-0.00280	-0.01172	-0.02026	-0.02709	-0.03572	-0.04098
210.000	0.03413	0.03130	0.02767	0.02423	0.02088	0.01482	0.00533	-0.00547	-0.01615	-0.02397	-0.03106	-0.03634	-0.04064
220.000	0.03139	0.02915	0.02605	0.02312	0.02046	0.01521	0.00564	-0.00674	-0.01699	-0.02422	-0.02948	-0.03332	-0.03661
230.000	0.02734	0.02560	0.02281	0.02039	0.01826	0.01436	0.00571	-0.00658	-0.01572	-0.02194	-0.02611	-0.02819	-0.03066
240.000	0.02173	0.02054	0.01889	0.01675	0.01501	0.01258	0.00562	-0.00531	-0.01271	-0.01803	-0.02033	-0.02182	-0.02357
250.000	0.01559	0.01487	0.01390	0.01260	0.01112	0.01001	0.00536	-0.00305	-0.00845	-0.01216	-0.01343	-0.01466	-0.01581
260.000	0.00904	0.00861	0.00814	0.00769	0.00704	0.00683	0.00492	-0.00020	-0.00340	-0.00538	-0.00613	-0.00697	-0.00757
270.000	0.00209	0.00194	0.00203	0.00235	0.00268	0.00325	0.00433	0.00299	0.00188	0.00137	0.00121	0.00084	0.00070
280.000	-0.00504	-0.00475	-0.00417	-0.00322	-0.00200	-0.00041	0.00363	0.00598	0.00700	0.00784	0.00824	0.00826	0.00854
290.000	-0.01239	-0.01168	-0.01050	-0.00875	-0.00645	-0.00367	0.00274	0.00882	0.01218	0.01425	0.01550	0.01532	0.01601
300.000	-0.01969	-0.01845	-0.01663	-0.01389	-0.01051	-0.00658	0.00183	0.01084	0.01650	0.02011	0.02221	0.02202	0.02316
310.000	-0.02648	-0.02475	-0.02196	-0.01806	-0.01366	-0.00877	0.00089	0.01181	0.01954	0.02456	0.02754	0.02744	0.02911
320.000	-0.03252	-0.03017	-0.02610	-0.02115	-0.01614	-0.01030	-0.00019	0.01151	0.02083	0.02732	0.03126	0.03179	0.03410
330.000	-0.03777	-0.03442	-0.02852	-0.02238	-0.01696	-0.01072	-0.00117	0.00954	0.01958	0.02744	0.03306	0.03497	0.03819
340.000	-0.04224	-0.03689	-0.02813	-0.02156	-0.01587	-0.00968	-0.00211	0.00591	0.01516	0.02347	0.03179	0.03533	0.03967
350.000	-0.04270	-0.03705	-0.02334	-0.01636	-0.01154	-0.00735	-0.00299	0.00089	0.00664	0.01287	0.02111	0.02341	0.03512
360.000	-0.00590	-0.00447	-0.00489	-0.00483	-0.00477	-0.00465	-0.00499	-0.00499	-0.00462	-0.00450	-0.00398	-0.00385	-0.00317

Table C-11

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

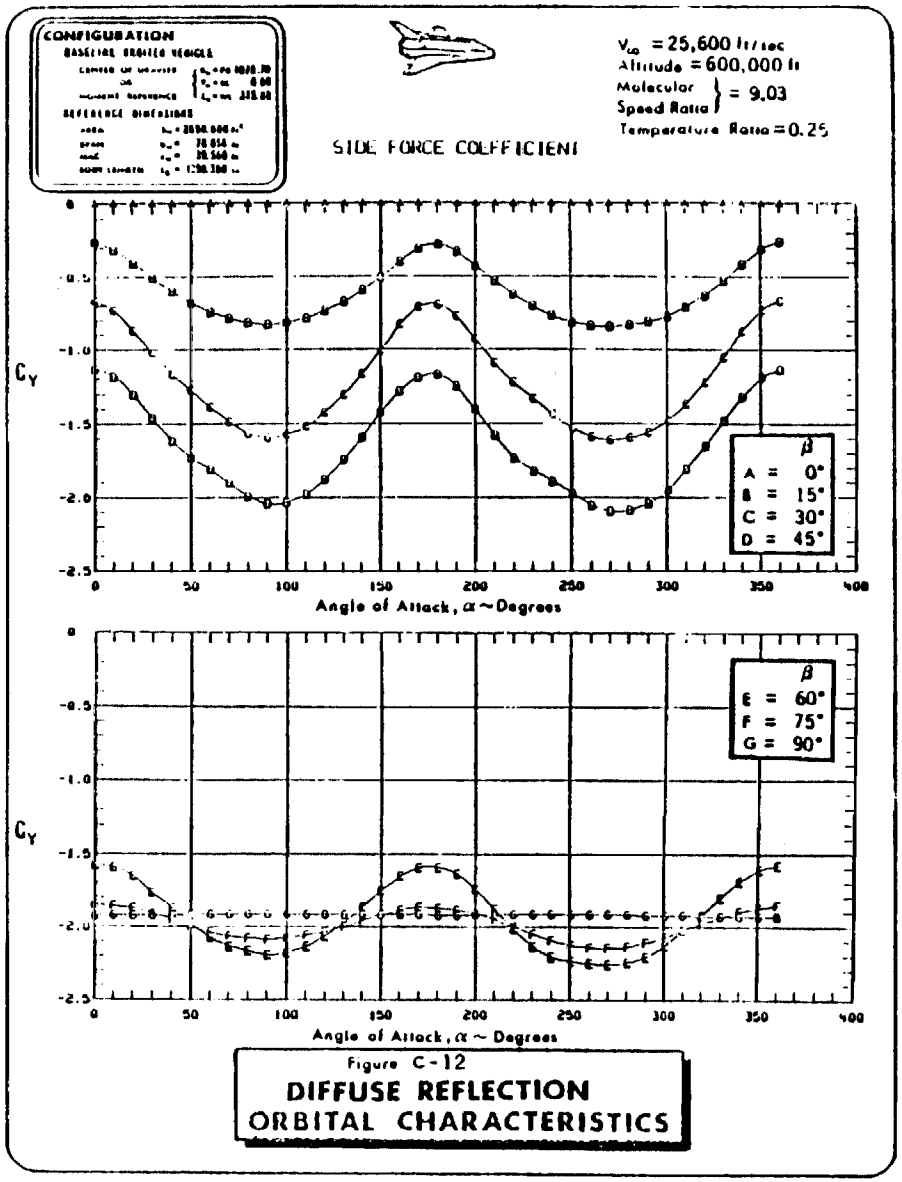


Figure C-12
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

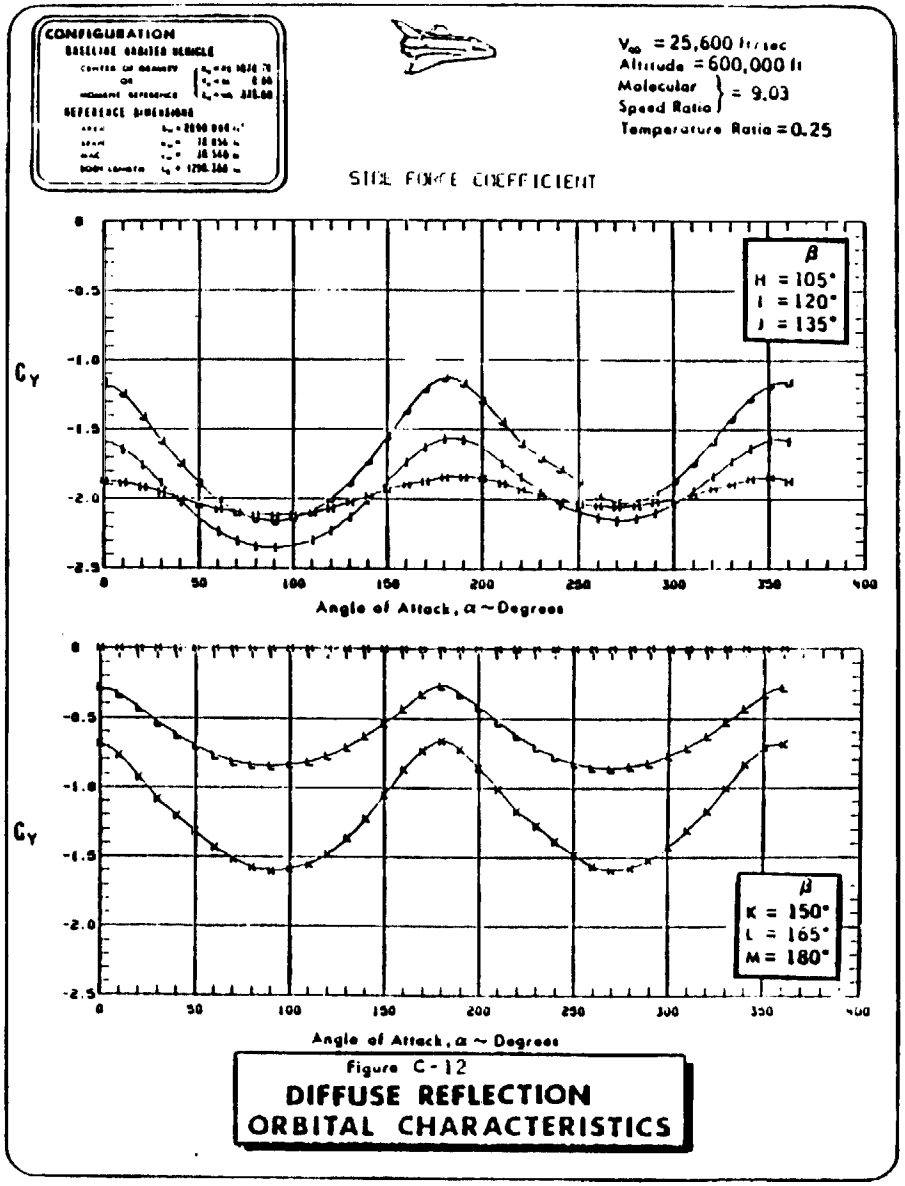


Figure C-12
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Temperature Ratio = 0.25

V_∞ = 25,600 ft/sec
Altitude = 600,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees												
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	SIDE FORCE COEFFICIENT, C_Y												
0.0	0.0	-0.26439	-0.66522	-1.13975	-1.58605	-1.85575	-1.92037	-1.87678	-1.58979	-1.16601	-0.68963	-0.27834	-0.00001
10.000	0.0	-0.31763	-0.73141	-1.18426	-1.59506	-1.86135	-1.92652	-1.88855	-1.64654	-1.21925	-0.77063	-0.33574	0.0
20.000	0.0	-0.40991	-0.87209	-1.30497	-1.65612	-1.87615	-1.92467	-1.91531	-1.75672	-1.40865	-0.92864	-0.43420	0.0
30.000	0.0	-0.51202	-1.02120	-1.46608	-1.76901	-1.90840	-1.92469	-1.95651	-1.89148	-1.58403	-1.09076	-0.53402	0.0
40.000	0.0	-0.60342	-1.17318	-1.62255	-1.87580	-1.95818	-1.92287	-2.00235	-2.02100	-1.74756	-1.20876	-0.62647	0.00004
50.000	0.0	-0.68269	-1.27980	-1.73265	-1.90191	-2.00337	-1.91859	-2.04417	-2.14471	-1.89050	-1.32131	-0.70542	0.00005
60.000	0.0	-0.74445	-1.39035	-1.81246	-2.07662	-2.04030	-1.91859	-2.07649	-2.23792	-2.01270	-1.43130	-0.76959	0.0
70.000	0.0	-0.78924	-1.49128	-1.90603	-2.13477	-2.06693	-1.91859	-2.09608	-2.30671	-2.09873	-1.51711	-0.81492	-0.00006
80.000	0.0	-0.81992	-1.56900	-1.98060	-2.16952	-2.08066	-1.91877	-2.11233	-2.34235	-2.14751	-1.57879	-0.83866	-0.00009
90.000	0.0	-0.82697	-1.59602	-2.04754	-2.19395	-2.08523	-1.91812	-2.11893	-2.35065	-2.16110	-1.60036	-0.84507	-0.00012
100.000	0.0	-0.81754	-1.57932	-2.08043	-2.17746	-2.07935	-1.91755	-2.11384	-2.33325	-2.13854	-1.58641	-0.83276	0.00026
110.000	0.0	-0.78599	-1.52314	-1.97936	-2.13543	-2.05785	-1.91642	-2.09709	-2.29587	-2.08946	-1.55248	-0.81265	0.00043
120.000	0.0	-0.73620	-1.42982	-1.87986	-2.06487	-2.03522	-1.91642	-2.07016	-2.22646	-2.00261	-1.48089	-0.77160	0.00031
130.000	0.0	-0.67516	-1.30808	-1.75006	-1.97124	-2.00055	-1.91765	-2.02479	-2.12841	-1.87774	-1.36820	-0.70783	0.00020
140.000	0.0	-0.59939	-1.16740	-1.59678	-1.86447	-1.95837	-1.91899	-1.98200	-2.00838	-1.72844	-1.22081	-0.62860	0.00025
150.000	0.0	-0.50916	-1.00542	-1.42085	-1.75456	-1.91902	-1.91897	-1.93513	-1.87145	-1.55667	-1.05202	-0.53353	0.00011
160.000	0.0	-0.40476	-0.83363	-1.20549	-1.65813	-1.88508	-1.91897	-1.89721	-1.73716	-1.37040	-0.87094	-0.42960	0.00004
170.000	0.0	-0.31033	-0.71350	-1.19137	-1.59526	-1.86807	-1.91897	-1.87572	-1.63143	-1.21085	-0.73115	-0.32116	0.00007
180.000	0.0	-0.28058	-0.69280	-1.17143	-1.59622	-1.87674	-1.92289	-1.83989	-1.57189	-1.13216	-0.66265	-0.26199	0.0
190.000	0.0	-0.33574	-0.77549	-1.24931	-1.64256	-1.88868	-1.92709	-1.84182	-1.58150	-1.17346	-0.72667	-0.32261	0.0
200.000	0.0	-0.43420	-0.93171	-1.40865	-1.74928	-1.91543	-1.92109	-1.85366	-1.63561	-1.28965	-0.86345	-0.42102	0.00002
210.000	0.0	-0.53402	-1.09374	-1.58483	-1.88471	-1.95649	-1.91974	-1.88475	-1.74184	-1.44527	-1.01157	-0.52761	-0.00001
220.000	0.0	-0.62638	-1.22481	-1.73789	-2.02009	-2.00236	-1.91756	-1.93057	-1.84494	-1.59757	-1.16705	-0.62629	-0.00004
230.000	0.0	-0.70542	-1.33622	-1.82645	-2.13749	-2.05260	-1.91842	-1.97437	-1.94557	-1.70429	-1.27461	-0.71204	0.00001
240.000	0.0	-0.76959	-1.44521	-1.89309	-2.20639	-2.09725	-1.91843	-2.00915	-2.03722	-1.78365	-1.38915	-0.77895	-0.00015
250.000	0.0	-0.81492	-1.53117	-1.97586	-2.23746	-2.12794	-1.91843	-2.03573	-2.09262	-1.87614	-1.49128	-0.82599	-0.00019
260.000	0.0	-0.83866	-1.59395	-2.05713	-2.25371	-2.14478	-1.91091	-2.04743	-2.12856	-1.97097	-1.56900	-0.85297	-0.00031
270.000	0.0	-0.84507	-1.61512	-2.09826	-2.25710	-2.14828	-1.91922	-2.05221	-2.15232	-2.02424	-1.59602	-0.85974	-0.00041
280.000	0.0	-0.83276	-1.59799	-2.08601	-2.24497	-2.13608	-1.91919	-2.04453	-2.13618	-2.01690	-1.57932	-0.84773	-0.00015
290.000	0.0	-0.81265	-1.56127	-2.04305	-2.20865	-2.10973	-1.92304	-2.02385	-2.09793	-1.95987	-1.52314	-0.81974	0.00003
300.000	0.0	-0.77161	-1.48682	-1.95096	-2.12976	-2.07475	-1.92306	-2.00255	-2.03177	-1.86412	-1.42982	-0.77100	0.0
310.000	0.0	-0.70784	-1.36986	-1.81244	-2.02348	-2.02472	-1.92264	-1.96960	-1.94141	-1.73737	-1.30868	-0.70729	0.00003
320.000	0.0	-0.62861	-1.22081	-1.65711	-1.92587	-1.98200	-1.93168	-1.92910	-1.83847	-1.58335	-1.16740	-0.62619	0.00003
330.000	0.0	-0.53244	-1.05202	-1.48101	-1.80175	-1.93513	-1.93168	-1.89228	-1.73290	-1.41977	-1.00538	-0.52929	0.00001
340.000	0.0	-0.42052	-0.87094	-1.31888	-1.69332	-1.89710	-1.93168	-1.86146	-1.63910	-1.27637	-0.83347	-0.42682	0.0
350.000	0.0	-0.31416	-0.73115	-1.18924	-1.61238	-1.87569	-1.93168	-1.84576	-1.57867	-1.18357	-0.71350	-0.32506	0.00002
360.000	0.0	-0.26439	-0.66522	-1.13975	-1.58605	-1.85575	-1.92037	-1.87678	-1.58979	-1.16601	-0.68963	-0.27834	-0.00001

Table C-12

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

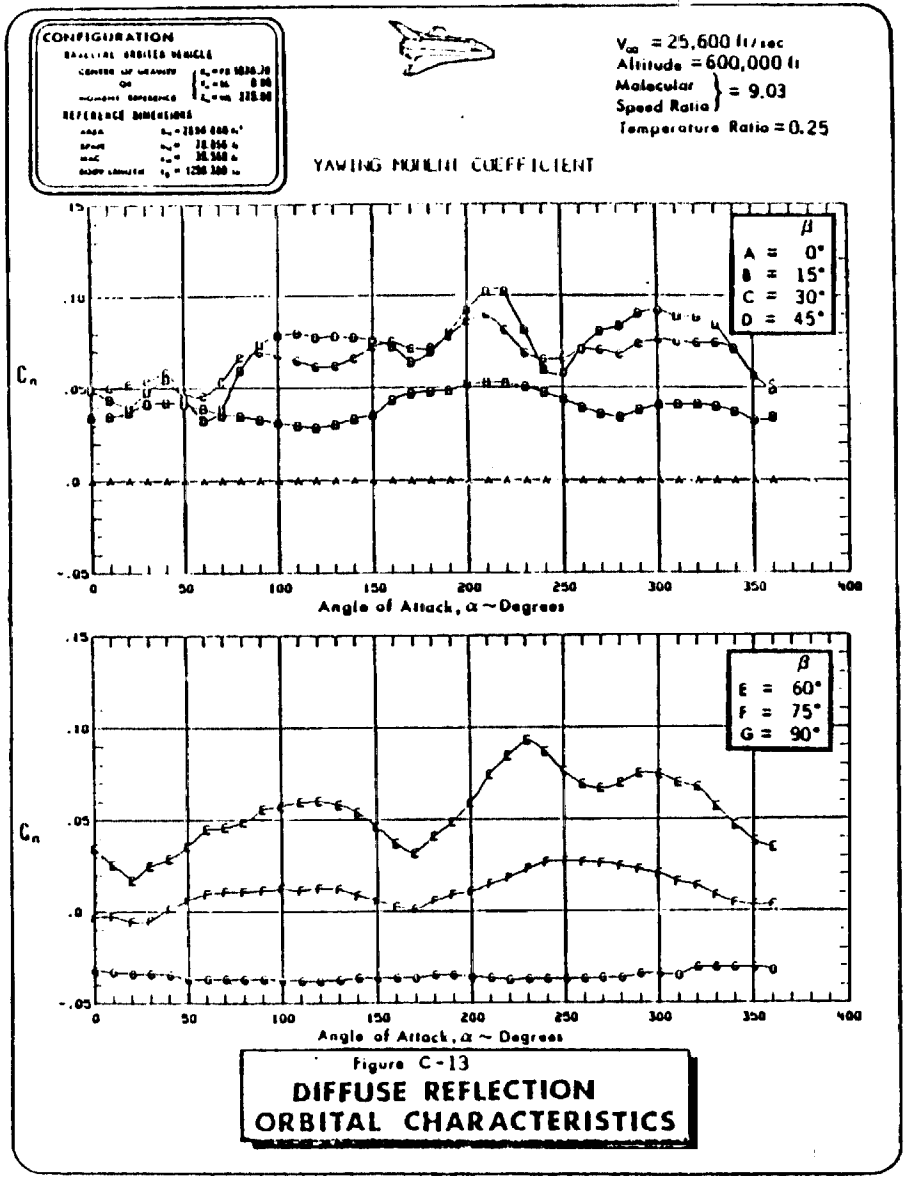


Figure C-13
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

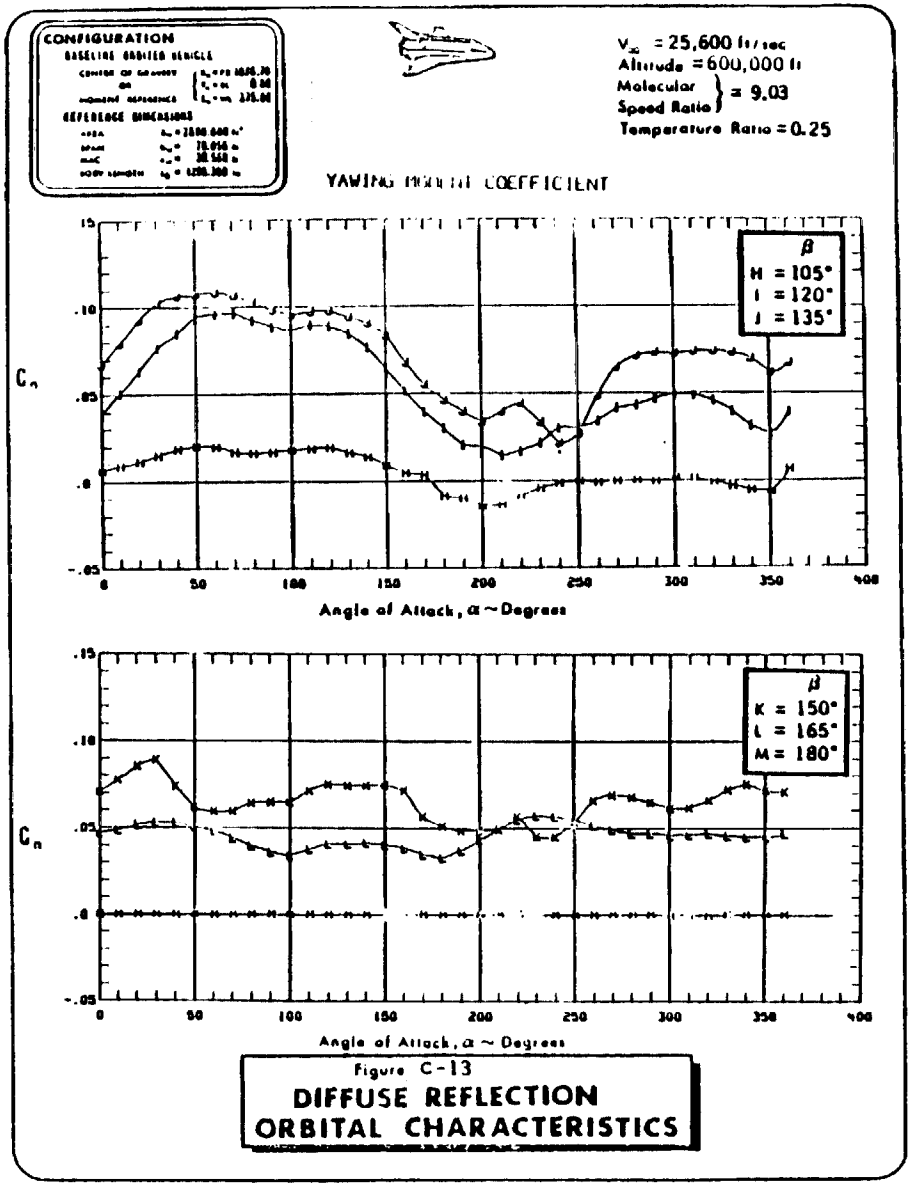


Figure C-13
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

Temperature Ratio = 0.25

V_∞ = 25,600 ft/sec
Altitude = 600,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees												
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	YAWING MOMENT COEFFICIENT, C_n												
0.0	0.0	0.03382	0.05167	0.04914	0.03494	-0.00337	-0.03217	0.00591	0.03887	0.06698	0.07097	0.04676	-0.00008
10.000	0.0	0.03400	0.05023	0.04374	0.02559	-0.00307	-0.03304	0.00878	0.05048	0.07968	0.07735	0.04654	0.00006
20.000	0.0	0.03695	0.05225	0.03936	0.01705	-0.00585	-0.03390	0.01074	0.06326	0.09230	0.08428	0.05153	0.00003
30.000	0.0	0.04151	0.05338	0.04790	0.02498	-0.00505	-0.03389	0.01469	0.07645	0.10474	0.08886	0.05478	-0.00002
40.000	0.0	0.04212	0.05879	0.05639	0.02879	0.00124	-0.03473	0.01834	0.08484	0.10620	0.07411	0.05250	-0.00011
50.000	0.0	0.04157	0.04743	0.04467	0.03573	0.00600	-0.03696	0.02014	0.09415	0.10891	0.06170	0.04836	-0.00002
60.000	0.0	0.03844	0.04561	0.03266	0.04491	0.00945	-0.03696	0.01952	0.09507	0.10050	0.05921	0.04783	0.00010
70.000	0.0	0.03539	0.05343	0.03856	0.04614	0.01069	-0.03696	0.01660	0.09598	0.10637	0.05962	0.04382	0.00015
80.000	0.0	0.03475	0.06628	0.05922	0.04860	0.01099	-0.03687	0.01560	0.09215	0.10221	0.06432	0.04916	0.00005
90.000	0.0	0.03317	0.06926	0.07335	0.05588	0.01115	-0.03706	0.01655	0.08845	0.09824	0.06473	0.03591	0.00004
100.000	0.0	0.03152	0.06766	0.07023	0.05763	0.01228	-0.03732	0.01742	0.08648	0.09512	0.06477	0.03388	-0.00012
110.000	0.0	0.02975	0.06455	0.07963	0.05955	0.01143	-0.03793	0.01853	0.08889	0.09705	0.07147	0.03781	-0.00015
120.000	0.0	0.02835	0.06144	0.07752	0.06017	0.01269	-0.03793	0.01914	0.08818	0.09741	0.07516	0.04062	-0.00008
130.000	0.0	0.03023	0.06167	0.07763	0.05822	0.01207	-0.03726	0.01610	0.08385	0.09393	0.07473	0.04070	-0.00006
140.000	0.0	0.03322	0.06619	0.07726	0.05406	0.00866	-0.03663	0.01367	0.07636	0.09031	0.07444	0.04095	-0.00008
150.000	0.0	0.03521	0.07199	0.07569	0.04621	0.00561	-0.03663	0.00848	0.06400	0.08278	0.07422	0.04004	-0.00015
160.000	0.0	0.04313	0.07490	0.07223	0.03695	0.00233	-0.03663	0.00445	0.05062	0.06803	0.07122	0.03838	-0.00007
170.000	0.0	0.04668	0.07129	0.06391	0.03167	0.00105	-0.03663	0.00323	0.03953	0.05486	0.05608	0.03463	-0.00012
180.000	0.0	0.04796	0.07132	0.06917	0.04081	0.00591	-0.03474	-0.00920	0.02967	0.04633	0.05070	0.03277	-0.00003
190.000	0.0	0.04854	0.07808	0.07947	0.04898	0.00881	-0.03474	-0.01036	0.02006	0.03994	0.04864	0.03122	0.0
200.000	0.0	0.05153	0.08573	0.09230	0.05935	0.01077	-0.03570	-0.01426	0.01891	0.03305	0.04895	0.04278	0.00001
210.000	0.0	0.05278	0.08962	0.10214	0.07454	0.01469	-0.03637	-0.01379	0.01435	0.03926	0.04909	0.04944	0.0
220.000	0.0	0.05244	0.08130	0.10217	0.08464	0.01834	-0.03739	-0.00905	0.01671	0.04410	0.05618	0.05431	-0.00002
230.000	0.0	0.05032	0.06857	0.08127	0.09290	0.02321	-0.03699	-0.00462	0.02154	0.03313	0.05410	0.05689	-0.00003
240.000	0.0	0.04738	0.06558	0.05983	0.08701	0.02689	-0.03698	-0.00196	0.02985	0.02117	0.04509	0.05621	0.00005
250.000	0.0	0.04382	0.06581	0.05787	0.07628	0.02753	-0.03698	-0.00053	0.03035	0.02689	0.05343	0.05404	0.00005
260.000	0.0	0.03916	0.07057	0.07113	0.06904	0.02682	-0.03676	-0.00093	0.03387	0.04072	0.06628	0.05147	0.00014
270.000	0.0	0.03591	0.07019	0.08056	0.06680	0.02638	-0.03662	-0.00052	0.04123	0.06481	0.06926	0.04881	0.00022
280.000	0.0	0.03380	0.06834	0.08365	0.06963	0.02469	-0.03663	-0.00002	0.04334	0.07120	0.06716	0.04669	0.00004
290.000	0.0	0.03702	0.07370	0.09010	0.07519	0.02252	-0.03432	-0.00043	0.04685	0.07305	0.06955	0.04684	0.00019
300.000	0.0	0.04063	0.07635	0.09219	0.07447	0.02058	-0.03431	0.00143	0.04913	0.07236	0.06144	0.04575	-0.00032
310.000	0.0	0.04070	0.07499	0.08891	0.07004	0.01610	-0.03498	0.00152	0.04849	0.07363	0.06161	0.04615	-0.00050
320.000	0.0	0.04096	0.07444	0.08802	0.06746	0.01367	-0.03044	-0.00113	0.04572	0.07390	0.06619	0.04652	-0.00036
330.000	0.0	0.03970	0.07422	0.08014	0.05670	0.00848	-0.03044	-0.00337	0.03929	0.07310	0.07190	0.04535	-0.00010
340.000	0.0	0.03701	0.07122	0.07078	0.04653	0.00444	-0.03044	-0.00584	0.03103	0.06960	0.07487	0.04499	-0.00006
350.000	0.0	0.03237	0.05608	0.05651	0.03809	0.00322	-0.03044	-0.00640	0.02647	0.06172	0.07129	0.04457	-0.00001
360.000	0.0	0.03382	0.05167	0.04914	0.03494	0.00337	-0.03217	0.00591	0.03887	0.06698	0.07097	0.04676	-0.00008

Table C-13

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

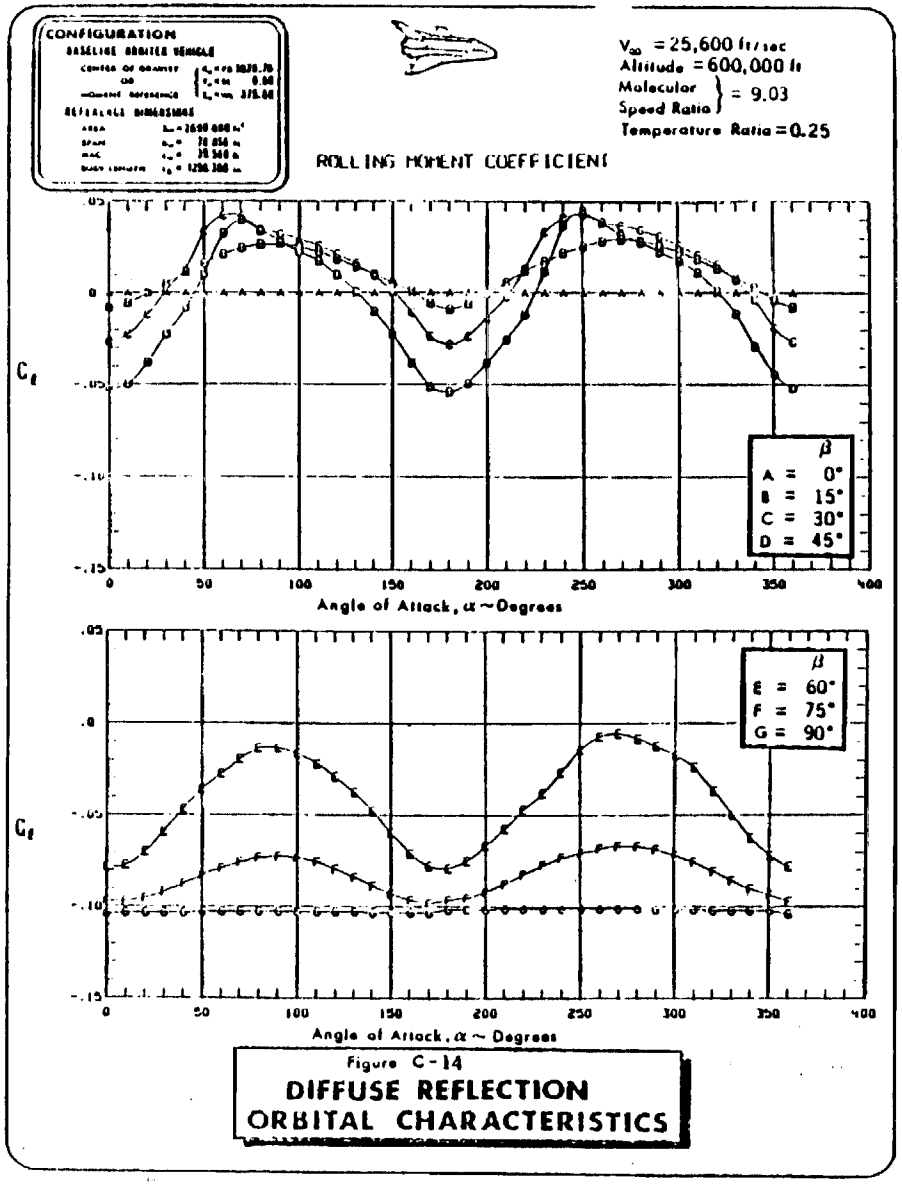


Figure C-14
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

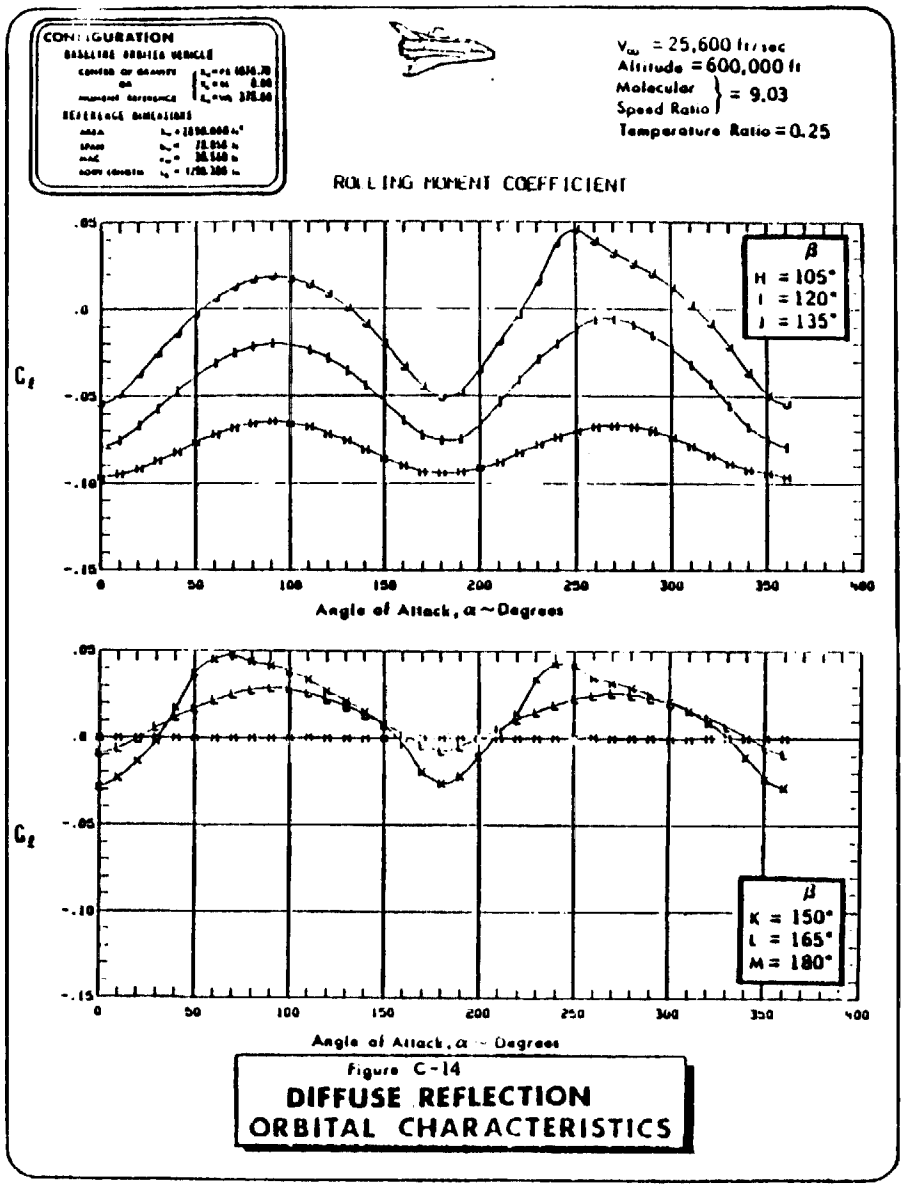


Figure C-14
DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Temperature Ratio = 0.25

V_∞ = 25,600 ft/sec
Altitude = 600,000 ft

Molecular Speed Ratio = 9.03

α ~ Degrees	SIDESLIP ANGLE, β ~ Degrees												
	A 0.0	B 15.000	C 30.000	D 45.000	E 60.000	F 75.000	G 90.000	H 105.000	I 120.000	J 135.000	K 150.000	L 165.000	M 180.000
	ROLLING MOMENT COEFFICIENT, C_ℓ												
0.0	0.0	-0.00706	-0.02655	-0.05184	-0.07707	-0.09706	-0.10383	0.09678	-0.07959	-0.05481	-0.02830	-0.00919	0.0
10.000	0.0	-0.00504	-0.02298	-0.04973	-0.07727	-0.09706	-0.10367	-0.09522	-0.07551	-0.04932	-0.02324	-0.00624	-0.00001
20.000	0.0	-0.00024	-0.01207	-0.03798	-0.06996	-0.09525	-0.10348	-0.09195	-0.06702	-0.03703	-0.01320	-0.00051	-0.00001
30.000	0.0	0.00514	0.00050	-0.02281	-0.05801	-0.09206	-0.10348	-0.08731	-0.05740	-0.02456	-0.00190	0.00570	0.00001
40.000	0.0	0.01114	0.01305	-0.00863	-0.04659	-0.08756	-0.10327	-0.08225	-0.04745	-0.01375	0.01720	0.01169	0.00006
50.000	0.0	0.01609	0.03338	0.01010	-0.03570	-0.08291	-0.10291	-0.07691	-0.03886	-0.00504	0.03745	0.01680	-0.00001
60.000	0.0	0.02104	0.04222	0.03257	-0.02752	-0.07886	-0.10291	-0.07220	-0.03141	0.00569	0.04506	0.02153	-0.00010
70.000	0.0	0.02436	0.04135	0.04166	-0.01940	-0.07554	-0.10291	-0.06832	-0.02559	0.01228	0.04750	0.02522	-0.00020
80.000	0.0	0.02587	0.03900	0.03375	-0.01373	-0.07352	-0.10294	-0.06601	-0.02183	0.01669	0.04368	0.02783	-0.00004
90.000	0.0	0.02644	0.03200	0.02723	-0.01347	-0.07266	-0.10300	-0.06497	-0.02020	0.01833	0.04171	0.02915	0.00012
100.000	0.0	0.02480	0.02914	0.02236	-0.01646	-0.07349	-0.10294	-0.06572	-0.02102	0.01706	0.03814	0.02802	0.00009
110.000	0.0	0.02192	0.02532	0.01682	-0.02197	-0.07581	-0.10296	-0.06811	-0.02393	0.01361	0.03360	0.02558	0.00024
120.000	0.0	0.01828	0.02124	0.00942	-0.02893	-0.07950	-0.10296	-0.07178	-0.02875	0.00812	0.02727	0.02218	0.00015
130.000	0.0	0.01407	0.01574	0.00059	-0.03751	-0.08392	-0.10305	-0.07579	-0.03550	0.00062	0.02114	0.01813	0.00007
140.000	0.0	0.01002	0.00889	-0.01016	-0.04768	-0.08865	-0.10328	-0.08005	-0.04401	-0.00867	0.01517	0.01331	0.00006
150.000	0.0	0.00510	0.00042	-0.02270	-0.05963	-0.09306	-0.10328	-0.08595	-0.05386	-0.02033	0.00680	0.00799	-0.00005
160.000	0.0	0.00097	-0.01087	-0.03813	-0.07086	-0.09642	-0.10328	-0.09042	-0.06414	-0.03315	-0.00396	0.00185	-0.00002
170.000	0.0	-0.00593	-0.02398	-0.05121	-0.07792	-0.09803	-0.10328	-0.09353	-0.07260	-0.04512	-0.01925	-0.00430	-0.00002
180.000	0.0	-0.00896	-0.02864	-0.05426	-0.07879	-0.09663	-0.10175	-0.09044	-0.07566	-0.05066	-0.02615	-0.00752	0.0
190.000	0.0	-0.00624	-0.02375	-0.04928	-0.07523	-0.09524	-0.10175	-0.09394	-0.07493	-0.04795	-0.02219	-0.00513	0.0
200.000	0.0	-0.00051	-0.01344	-0.03783	-0.06676	-0.09196	-0.10149	-0.09160	-0.06646	-0.03528	-0.01045	0.00010	0.0
210.000	0.0	0.00570	-0.00222	-0.02556	-0.05722	-0.08731	-0.10132	-0.08818	-0.05411	-0.01894	0.00284	0.00558	0.0
220.000	0.0	0.01174	0.01319	-0.01182	-0.04738	-0.08225	-0.10107	-0.08298	-0.04111	-0.00382	0.01433	0.01078	0.00003
230.000	0.0	0.01680	0.03316	0.01128	-0.03829	-0.07743	-0.10117	-0.07807	-0.02908	0.01560	0.03450	0.01516	0.00003
240.000	0.0	0.02153	0.04063	0.03642	-0.02689	-0.07353	-0.10117	-0.07362	-0.02028	0.03817	0.04250	0.01921	0.00004
250.000	0.0	0.02522	0.04273	0.04468	-0.01437	-0.07003	-0.10117	-0.07030	-0.01160	0.04552	0.04135	0.02256	0.00017
260.000	0.0	0.02783	0.03836	0.03805	-0.00724	-0.06821	-0.10122	-0.06789	-0.00621	0.03917	0.03488	0.02492	0.00016
270.000	0.0	0.02915	0.03652	0.03142	-0.00545	-0.06700	-0.10126	-0.06705	-0.00597	0.03178	0.03200	0.02586	-0.00020
280.000	0.0	0.02802	0.03417	0.02721	-0.00836	-0.06726	-0.10126	-0.06759	-0.00893	0.02613	0.02914	0.02491	-0.00015
290.000	0.0	0.02558	0.03075	0.02216	-0.01275	-0.06900	-0.10163	-0.07008	-0.01520	0.02050	0.02532	0.02292	-0.00040
300.000	0.0	0.02218	0.02553	0.01699	-0.01738	-0.07210	-0.10163	-0.07403	-0.02302	0.01231	0.02124	0.02001	-0.00049
310.000	0.0	0.01813	0.02071	0.01085	-0.02414	-0.07578	-0.10154	-0.07878	-0.03223	0.00208	0.01578	0.01597	-0.00053
320.000	0.0	0.01332	0.01517	0.00124	-0.03686	-0.08085	-0.10236	-0.08389	-0.04318	-0.00818	0.00889	0.01186	-0.00027
330.000	0.0	0.00808	0.00680	-0.01158	-0.04900	-0.08595	-0.10236	-0.08873	-0.05594	-0.02116	0.00042	0.00676	-0.00005
340.000	0.0	0.00288	-0.00396	-0.02486	-0.06272	-0.09042	-0.10236	-0.09251	-0.06778	-0.03659	-0.01085	0.00062	-0.00002
350.000	0.0	-0.00392	-0.01925	-0.04420	-0.07225	-0.09353	-0.10236	-0.09450	-0.07528	-0.04995	-0.02398	-0.00576	0.0
360.000	0.0	-0.00706	-0.02655	-0.05184	-0.07707	-0.09693	-0.10383	-0.09678	-0.07959	-0.05481	-0.02830	-0.00919	0.0

Table C-14

DIFFUSE REFLECTION ORBITAL CHARACTERISTICS

Rockwell International
Space Division

ON-ORBIT RCS JET IMPINGEMENT. On-orbit RCS jet plume impingement effects provided by the NASA/JSC.(References C-6 and C-7) are presented herein. Data are given for the three RCS jet groups (down-firing, up-firing, and side-firing) with all controls neutral (Table C-15).

Table C-15

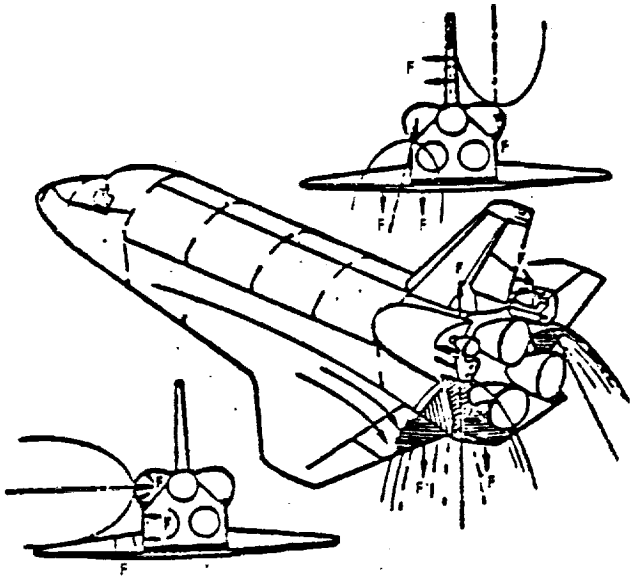
BASIC ON-ORBIT PLUME IMPINGEMENT FORCES AND MOMENTS

(ONE JET ONLY)

JET GROUP	$N_{SURF\ IMP}$ (lb)	$A_{SURF\ IMP}$ (lb)	$M_{SURF\ IMP}$ (ft-lb)	$Y_{SURF\ IMP}$ (lb)	$\mathcal{N}_{SURF\ IMP}$ (ft-lb)	$\mathcal{L}_{SURF\ IMP}$ (ft-lb)
DOWN-FIRING	-225.7	-40.2	+6469.0	+26.6	-645.5	-2475.5
UP-FIRING	-2.2	-0.1	+94.2	+76.3	-2932.3	+1359.9
SIDE-FIRING	-27.2	-3.3	+762.4	-1.7	+144.5	-795.3

NOTE: 1. All forces and moments for one left-hand jet only

2. To obtain one right-hand jet data for $Y_{SURF\ IMP}$, $\mathcal{N}_{SURF\ IMP}$, and $\mathcal{L}_{SURF\ IMP}$ the sign should be changed.



The effects of inboard and outboard elevon deflections are presented in Table C-16 and the effect of body flap deflection is given in Table C-17 for the down-firing jet group (one jet firing only). These data are intended for use in all trajectory on-orbit simulations and are considered applicable for altitudes in excess of 475,000 feet. (For altitudes less than 475,000 feet see appropriate force or moment sections of this report.)

These data are intended to be algebraically added in the following manner:

$$F_{PI_{TOTAL}} + F_{PI_{BASIC}}^{TABLE\ C-15} + \Delta F_{PI\delta e_{INBOARD}}^{TABLE\ C-16} + \Delta F_{PI\delta e_{OUTBOARD}}^{TABLE\ C-16} + \Delta F_{PI\delta_{BF}}^{TABLE\ C-17}$$

Table C-16
ELEVON PLUME IMPINGEMENT INCREMENTS
(ONE LEFT-HAND DOWNFIRING JET ONLY)

ELEVON DEFLECTION δ_e Degrees	ΔN_{p_1} lb		ΔA_{p_1} lb		ΔM_{p_1} ft-lb		ΔY_{p_1} lb		$\Delta \mathscr{L}_{p_1}$ ft-lb		$\Delta \mathscr{Z}_{p_1}$ ft-lb	
	Inboard	Outboard	Inboard	Outboard	Inboard	Outboard	Inboard	Outboard	Inboard	Outboard	Inboard	Outboard
-35	+74.5	+2.2	-11.4	+0.3	-2480.2	-65.4	+4.5	+0.1	-316.6	-13.7	+1091.8	-63.3
-30	+67.3	+2.0	-14.0	+0.4	-2255.8	-61.1	+4.1	+0.1	-338.8	-15.0	+ 990.4	-58.8
-25	+56.9	+1.8	-16.3	+0.4	-1928.9	-55.0	+3.4	+0.1	-350.8	-15.8	+ 844.7	-52.5
-20	+44.4	+1.5	-17.3	+0.4	-1527.6	-47.2	+2.7	+0.1	-340.5	-15.9	+ 665.5	-44.6
-15	+31.6	+1.2	-16.0	+0.4	-1108.7	-37.5	+1.9	+0.1	-299.5	-14.7	+ 479.6	-35.0
-10	+19.4	+0.8	-12.6	+0.3	- 697.0	-26.3	+1.2	+0.1	-227.0	-11.8	+ 297.6	-24.2
- 5	+ 8.1	+0.4	- 7.1	+0.2	- 302.2	-13.5	+0.5	0.0	-124.1	- 7.0	+ 127.4	-12.2
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ 5	- 3.4	-0.4	- 7.8	-0.3	+ 150.8	+13.1	-0.3	0.0	+128.4	+ 9.2	- 64.4	-11.5
+10	- 5.9	-0.7	-16.2	-0.6	+ 289.4	+25.1	-0.5	-0.1	+267.4	+20.2	- 108.8	-21.3
+15	- 7.6	-1.0	-23.7	-1.0	+ 261.6	+36.0	-0.6	-0.1	+386.8	+33.0	- 86.4	-29.6
+20	+ 1.9	-1.2	-29.7	-1.5	+ 128.5	+43.4	-0.4	-0.1	+479.8	+46.4	- 13.5	-34.7

NOTE: 1. All forces and moments for one left-hand jet only.
2. To obtain one right-hand jet data for ΔY_{p_1}, $\Delta \mathscr{L}_{p_1}$, $\Delta \mathscr{Z}_{p_1}$ the sign should be changed.

Table C-17
BODY-FLAP PLUME IMPINGEMENT INCREMENTS
(ONE LEFT-HAND DOWNFIRING JET ONLY)

BODY FLAP DEFLECTION δ Degrees	ΔN_{p_1} lb	ΔA_{p_1} lb	ΔM_{p_1} ft-lb	ΔY_{p_1} lb	$\Delta \mathscr{L}_{p_1}$ ft-lb	$\Delta \mathscr{Z}_{p_1}$ ft-lb
-11.7	- 8.3	-21.5	- 128.6	0.0	-183.3	- 78.4
- 5.0	- 6.2	+11.9	+ 171.2	0.0	-101.2	- 57.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ 5.0	+ 6.7	- 7.7	- 214.7	0.0	+ 64.7	+ 60.8
+10.0	+15.2	-14.3	- 510.8	0.0	-117.3	+134.4
+15.0	+24.0	-19.0	- 823.3	0.0	-157.8	+211.7
+22.55	+38.6	-26.4	-1373.9	0.0	-192.8	+337.4

NOTE: 1. All forces and moments for one left-hand jet only.
2. To obtain one right-hand jet data for ΔY_{p_1}, $\Delta \mathscr{L}_{p_1}$, $\Delta \mathscr{Z}_{p_1}$, the sign should be changed.

REFERENCES

C. HIGH ALTITUDE AERODYNAMICS

C-1 SAS/AERO/74-734, "Real Gas Flow Field Abort Entry Orbiter," Chen, T. Y. Internal Letter - Rockwell International, Downey, California (October 16, 1975)

C-2 DAC 61552, "Hypersonic Arbitrary Body Aerodynamic Computer Program," Gentry, A. E., Douglas Aircraft Company, Incorporated (April 1968)

C-3 PDR RID No. 07.01.25, "Extrapolation of Viscous Data from h = 300,000 to 600,000 ft," NASA/JSC Memorandum, Young, J. C. (April 14, 1975)

C-4 NASA TN D-3523, "Hypersonic Laminar Viscous Interaction Effects on the Aerodynamics of Two-Dimensional Wedge and Triangular Planform Wings," Bertram, Mitchel H., NASA/LRC (August 1966)

C-5 NASA TN D-(TBD), (Currently Unpublished).

C-6 NASA Memorandum EX32/7901-4, "Update of On-Orbit Plume Impingement Values", Kanipe, D., (January 17, 1979)

C-7 NASA Memorandum EX32/7903-38, "On-Orbit RCS Plume Impingement Increments Due to Elevon and Body Flap Deflections", (March 9, 1979)

APPENDIX

D. DATA TAPE USAGE. The aerodynamic data for Orbiter Vehicle 102 presented in this report have been digitized and stored in direct (random) access format. These data are available for use on both IBM and CDC computer systems. Specific information for accessing these data with the load and interpolation package to be used is given at the top of page D-2.

The data are in four argument format and the description presented in this Appendix includes the table number and argument list for each coefficient. Circled numbers above the elements of each equation indicate the particular table number for that element. The parameters immediately following each element indicate the arguments to be used when entering the table to obtain the required term. Equations for hinge moments, RCS flow field interaction, aeroelastic effects, and total aerodynamic uncertainties are also included.

This appendix[D]is presented in two parts:

(1) Aerodynamic Coefficients
(2) RCS Interaction/Impingement

IBM SYSTEM DATA DESCRIPTION

DISK PACK INFORMATION (UNIT = 3330, VOLUME SERIAL NUMBER = 300031)
ALL DATA ARE IN FOUR ARGUMENT FORMAT AND STORED IN COMPRESSED DIRECT ACCESS FORM

ITEM	DATA LOAD AND INTERPOLATION PACKAGE	AERODYNAMIC DATA AND UNCERTAINTIES	AEROELASTIC DATA	RCS AERODYNAMIC * INTERACTION DATA
OV101	OV101.DATASUBS.OBJ	OV101.TCOFF.REV123.JULY77.DATA OV101.TCON.REV123.JULY77.DATA	OV101.FLEX.OCT&76.DATA	NONE
OV102	OV102.DATASUBS.NOV77.OBJ	OV102.AERO.MAY80.DATA	OV102.FLEX.APR79.DATA	OV102.RCS.INCR.APR79.DATA
STS1	OV102.DATASUBS.NOV77.OBJ	OV102.AERO.MAY80.DATA	OV102.FLEX.APR79.DATA	OV102.RCS.INCR.APR79.DATA
STS2	OV102.DATASUBS.NOV77.OBJ	OV102.AERO.AUG80.DATA	OV102.FLEX.APR79.DATA	OV102.RCS.INCR.APR79.DATA
STS3				
STS4				
MISC			CONT.ABORT.FLEX.APR79.DATA	

* NOTE: RCS DATA IS IN INCREMENTAL FORM, FOR DATA IN POLYNOMIAL COEFFICIENT FORMAT REPLACE "INCR" WITH "POLYCOEF" IN DATA SET NAME.

CDC SYSTEM DATA DESCRIPTION

DISK PACK INFORMATION (ID = XX073, SETNAME = IN0034M, VOLUME SERIAL NUMBER = IN0034)
ALL DATA ARE IN FOUR ARGUMENT FORMAT AND STORED IN COMPRESSED DIRECT ACCESS FORM

ITEM	DATA LOAD AND INTERPOLATION PACKAGE	AERODYNAMIC DATA AND UNCERTAINTIES	AEROELASTIC DATA	RCS AERODYNAMIC * INTERACTION DATA
OV102	OV102DATASUBSNOV77LIB	OV102MAY80AERO	OV102APR79FLEX	OV102APR79RCSINCR
STS1	OV102DATASUBSNOV77LIB	OV102MAY80AERO	OV102APR79FLEX	OV102APR79RCSINCR
STS2	OV102DATASUBSNOV77LIB	OV102AUG80AERO	OV102APR79FLEX	OV102APR79RCSINCR
STS3				
STS4				
MISC				

* NOTE: RCS DATA IS IN INCREMENTAL FORM, FOR DATA IN POLYNOMIAL COEFFICIENT FORMAT REPLACE "INCR" WITH "POLYCOEF" IN DATA SET NAME.

D.1 AERODYNAMIC COEFFICIENTS

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                    ROCKWELL   INTERNATIONAL

                      SPACE   DIVISION

                      DOWNEY   CALIFORNIA

                    TABULATED  OUTPUT  FOR

        OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB ; REVISION - AUG 1980)
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```
 OOOOOOOO      AAAAAA     TTTTTTTTTT     AAAAAA          88888888      000000      000000     KKK    KKK
 OOOOOOOOO    AAAAAAAA    TTTTTTTTTT    AAAAAAAA        888888888    00000000    00000000    KKK    KKK
OO      OOO  AAA    AAA       TT       AAA    AAA      88      888  000    000  000    000   KKK   KKK
OO      OO   AA      AA       TT       AA      AA      88      888  00      00  00      00   KKK KKK
OO      OO   AA      AA       TT       AA      AA      888888888   00      00  00      00   KKKKKK
OO      OO   AAAAAAAAAA       TT       AAAAAAAAAA      888888888   00      00  00      00   KKKKKK
OO      OO   AAAAAAAAAA       TT       AAAAAAAAAA      88      888 00      00  00      00   KKK KKK
OO      OOO  AA      AA       TT       AA      AA      88      888 000    000  000    000   KKK   KKK
OOOOOOOOO    AA      AA       TT       AA      AA      888888888   00000000    00000000    KKK    KKK
 OOOOOOO     AA      AA       TT       AA      AA      88888888     000000      000000     KKK    KKK
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OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB ; REVISION - AUG 1980)

SUMMARY

DATASET CREATED WITH 1100 RECORDS	EACH RECORD CONTAINS 100 WORDS
TOTAL NUMBER OF TABLES = 153	DATA WRITTEN TO TAPE 12
TOTAL NUMBER OF POINTS = 64649	LAST RECORD USED IS 1079

JOB CARD USED TO CREATE OR CHANGE FILE			TIME OF DAY	DATE
STT443	*0410871	000	XXXXXX	.10:24:44 07/14/80

FILE DESCRIPTION

OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB ; REVISION - AUG 1980)

OV102 AERODYNAMIC DATA (OCTOBER 1979 ADB ; REVISION - AUG 1980)

TYPE	COEFF*	PROGRAM NAME	TLKUP4 ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
BASIC CONFIGURATION	C_L	CL	ALPHA (DEG)	MACH NUMBER			1	4.1.2.1- 1 > 4
$\delta_e = \delta_a = \delta_r = 0°$ $\delta_{SB} = 25°$ $\delta_{BF} = 0°$ $X_{CG} = 1076.6$ IN. $= 0.65\ L_B$ $Y_{CG} = 0.3$ IN. $Z_{CG} = 375.0$ IN.	C_D	CD	ALPHA (DEG)	MACH NUMBER			2	4.1.2.2- 1 > 4
	C_m	CM	ALPHA (DEG)	MACH NUMBER			3	4.1.1.3- 1 > 4
	C_Y	CY	BETA (DEG)	ALPHA (DEG)	MACH NUMBER		4	4.2.1.1- 1> 27
	C_n	CLN	BETA (DEG)	ALPHA (DEG)	MACH NUMBER		5	4.2.1.2- 1> 27
	C_ℓ	CLL	BETA (DEG)	ALPHA (DEG)	MACH NUMBER		6	4.2.1.3- 1> 27
LANDING GEAR	$\Delta C_{L_{LG}}$	DCLLG	ALPHA (DEG)	THETA (DEG)			7	4.1.2.1- 98
	$\Delta C_{D_{LG}}$	DCDLG	ALPHA (DEG)	THETA (DEG)			8	4.1.2.2- 118
	$\Delta C_{m_{LG}}$	DCMLG	ALPHA (DEG)	THETA (DEG)			9	4.1.1.3- 109
	$\Delta C_{Y_{\beta_{LG}}}$	DCYBLG	ALPHA (DEG)	THETA (DEG)			10	4.2.1.1- 134
	$\Delta C_{n_{\beta_{LG}}}$	DCLNBLG	ALPHA (DEG)	THETA (DEG)			11	4.2.1.2- 151
	$\Delta C_{\ell_{\beta_{LG}}}$	DCLBLG	ALPHA (DEG)	THETA (DEG)			12	4.2.1.3- 161
GROUND EFFECT	$\Delta C_{L_{GE}}$	DCLGE	HEIGHT/SPAN	ALPHA (DEG)	DELE (DEG)		13	4.1.2.1- 99>108
	$\Delta C_{D_{GE}}$	DCDGE	HEIGHT/SPAN	ALPHA (DEG)	DELE (DEG)		14	4.1.2.2- 120>129
	$\Delta C_{m_{GE}}$	DCMGE	HEIGHT/SPAN	ALPHA (DEG)	DELE (DEG)		15	4.1.1.3- 110>119
ELEVON	ΔC_{L_e}	DCLE	DELE (DEG)	ALPHA (DEG)	MACH NUMBER		16	4.1.2.1- ?> 33
	ΔC_{D_e}	DCDE	DELE (DEG)	ALPHA (DEG)	MACH NUMBER		17	4.1.2.2- ?> 33
	ΔC_{m_e}	DCME	DELE (DEG)	ALPHA (DEG)	MACH NUMBER		18	4.1.1.3- ?> 33
	$\Delta C_{Y_{\beta_e}}$	DCYBE	DELE (DEG)	ALPHA (DEG)	MACH NUMBER		19	4.2.1.1- 30> 42
	$\Delta C_{n_{\beta_e}}$	DCLNBE	DELE (DEG)	ALPHA (DEG)	MACH NUMBER		20	4.2.1.2- 30> 46

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB ; REVISION - AUG 1980)

TYPE	COEFF*	PROGRAM NAME	TLKUP4 ARGUMENTS X		Y		Z		W		FILE NUMBER	DATA BOOK REFERENCE**
AILERON	$\Delta C_{\ell_{\delta_a}}$	DCLLDE	DELE	(DEG)	ALPHA	(DEG)	MACH	NUMBER			21	4.2.1.3- 30> 56
	$C_{Y_{\delta_a}}$	CYDA	DELE	(DEG)	ALPHA	(DEG)	MACH	NUMBER			22	4.2.1.1- 43> 71
	$C_{n_{\delta_a}}$	CLNDA	DELE	(DEG)	ALPHA	(DEG)	MACH	NUMBER			23	4.2.1.2- 47> 71
	$C_{\ell_{\delta_a}}$	CLLDA	DELE	(DEG)	ALPHA	(DEG)	MACH	NUMBER			24	4.2.1.3- 57> 81
SPEEDBRAKE	$\Delta C_{L_{SB}}$	DCLSB	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			25	4.1.2.1- 67> 93
	$\Delta C_{D_{SB}}$	DCDSB	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			26	4.1.2.2- 66> 92
	$\Delta C_{m_{SB}}$	DCMSB	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			27	4.1.1.3- 73> 99
	$\Delta C_{Y_{\beta_{SB}}}$	DCYBSB	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			28	4.2.1.1- 101>127
	$\Delta C_{n_{\beta_{SB}}}$	DCLNBSB	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			29	4.2.1.2- 112>138
	$\Delta C_{\ell_{\beta_{SB}}}$	DCLLBSB	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			30	4.2.1.3- 122>148
RUDDER	$C_{Y_{\delta_r}}$	CYDR	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			31	4.2.1.1- 74>100
	$C_{n_{\delta_r}}$	CLNDR	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			32	4.2.1.2- 85>111
	$C_{\ell_{\delta_r}}$	CLLDR	DELSB	(DEG)	ALPHA	(DEG)	MACH	NUMBER			33	4.2.1.3- 95>121
BODY FLAP	$\Delta C_{L_{BF}}$	DCLBF	DELBF	(DEG)	ALPHA	(DEG)	MACH	NUMBER			34	4.1.2.1- 37> 63
	$\Delta C_{D_{BF}}$	DCDBF	DELBF	(DEG)	ALPHA	(DEG)	MACH	NUMBER			35	4.1.2.2- 36> 62
	$\Delta C_{m_{BF}}$	DCMBF	DELBF	(DEG)	ALPHA	(DEG)	MACH	NUMBER			36	4.1.1.3- 39> 65
	$\Delta C_{Y_{BF}}$	DCYBF	BETA	(DEG)	ALPHA	(DEG)	MACH	NUMBER	DELBF	(DEG)	37	ZERO FILE
	$\Delta C_{n_{BF}}$	DCLNBF	BETA	(DEG)	ALPHA	(DEG)	MACH	NUMBER	DELBF	(DEG)	38	ZERO FILE
	$\Delta C_{\ell_{BF}}$	DCLLBF	BETA	(DEG)	ALPHA	(DEG)	MACH	NUMBER	DELBF	(DEG)	39	ZERO FILE
ROTARY DERIVATIVE	C_{m_q} (PER RAD)	CMQ	ALPHA	(DEG)	MACH	NUMBER					40	4.1.1.3- 100>101

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB : REVISION - AUG 1980)

TYPE	COEFF*	PROGRAM NAME	TLKUP4 ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
	C_{n_β} (PER RAD)	CLNR	ALPHA (DEG)	MACH NUMBER			41	4.2.1.2- 141>142
	C_{ℓ_β} (PER RAD)	CLLR	ALPHA (DEG)	MACH NUMBER			42	4.2.1.3- 144>150
	$C_{n_{\bar{p}}}$ (PER RAD)	CLNP	ALPHA (DEG)	MACH NUMBER			43	4.2.1.2- 139>140
	$C_{\ell_{\bar{p}}}$ (PER RAD)	CLLP	ALPHA (DEG)	MACH NUMBER			44	4.2.1.3- 151>152
HINGE MOMENT	$C_{h_{e_I}}$	CHEI	DELE (DEG)	ALPHA (DEG)	MACH NUMBER		45	5.1 - 2> 26
	$C_{h_{e_0}}$	CHEO	DELE (DEG)	ALPHA (DEG)	MACH NUMBER		46	5.1 - 24> 55
	$C_{h_{SB_{RH}}}$	CHSBRH	ALPHA (DEG)	DELSB (DEG)	MACH NUMBER		47	5.3 - 2> 28
	$C_{h_{\delta_{r_{RH}}}}$	CHDRRH	DELSB (DEG)	ALPHA (DEG)	MACH NUMBER		48	5.3 - 56> 82
	$C_{h_{\beta_{RH}}}$	CHBRH	DELSB (DEG)	ALPHA (DEG)	MACH NUMBER		49	5.3 - 29> 55
	$C_{h_{BF}}$	CHBF	DELBF (DEG)	ALPHA (DEG)	MACH NUMBER		50	5.2 - 2> 28
TOLERANCE, VARIATION	$\Delta C_{L_{TV}}$	DCLTV	MACH NUMBER	TYPE			51	6.1 - 1
	$\Delta C_{D_{TV}}$	DCDTV	MACH NUMBER	TYPE			52	6.1 - 2
	$\Delta C_{m_{TV}}$	DCMTV	MACH NUMBER	TYPE			53	6.1 - 4
	$\Delta C_{L_{\alpha_{TV}}}$	DCLATV	MACH NUMBER	TYPE			54	6.1 - 9
	$\Delta C_{m_{\alpha_{TV}}}$	DCMATV	MACH NUMBER	TYPE			55	6.1 - 5
	$\Delta C_{m_{\delta_{e_{TV}}}}$	DCMDETV	MACH NUMBER	TYPE			56	6.1 - 5
	$\Delta C_{Y_{\beta_{TV}}}$	DCYBTV	MACH NUMBER	TYPE			57	6.2 - 2
	$\Delta C_{n_{\beta_{TV}}}$	DCNBTV	MACH NUMBER	TYPE			58	6.2 - 4
	$\Delta C_{\ell_{\beta_{TV}}}$	DCLBTV	MACH NUMBER	TYPE			59	6.2 - 6
	$\Delta C_{Y_{\delta_{a_{TV}}}}$	DCYDATVT	MACH NUMBER	TYPE			60	6.2 - 1

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB : REVISION = AUG 1980)

TYPE	COEFF*	PROGRAM NAME	TLKUP4 ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
	$\Delta C_{n_{\delta_{a_{TV}}}}$	DCLNDATV MACH NUMBER TYPE					61	6.2 - 3
	$\Delta C_{\ell_{\delta_{a_{TV}}}}$	DCLLDATV MACH NUMBER TYPE					62	6.2 - 5
	$\Delta C_{Y_{\delta_{r_{TV}}}}$	DCYDRTV MACH NUMBER TYPE					63	6.2 - 1
	$\Delta C_{n_{\delta_{r_{TV}}}}$	DCLNDRTV MACH NUMBER TYPE					64	6.2 - 3
	$\Delta C_{\ell_{\delta_{r_{TV}}}}$	DCLLDRTV MACH NUMBER TYPE					65	6.2 - 5
	$\Delta C_{h_{e_{TV}}}$	DCHETV MACH NUMBER TYPE					66	6.3 - 3
	$\Delta C_{h_{\beta_{TV}}}$	DCHBTV MACH NUMBER TYPE					67	6.3 - 2
	$\Delta C_{h_{\delta_{r_{TV}}}}$	DCHDRTV MACH NUMBER TYPE					68	6.3 - 1
	$\Delta C_{L_{GE_{TV}}}$	DCLGETV HEIGHT/SPAN TYPE					69	6.5 - 1
	$\Delta C_{D_{GE_{TV}}}$	DCDGETV HEIGHT/SPAN TYPE					70	6.5 - 2
	$\Delta C_{m_{GE_{TV}}}$	DCMGETV HEIGHT/SPAN TYPE					71	6.5 - 3
	$\Delta C_{Y_{\beta_{GE_{TV}}}}$	DCYBGETV HEIGHT/SPAN TYPE					72	6.5 - 4
	$\Delta C_{n_{\beta_{GE_{TV}}}}$	DCLNBGET HEIGHT/SPAN TYPE					73	6.5 - 5
	$\Delta C_{\ell_{\beta_{GE_{TV}}}}$	DCLLBGET HEIGHT/SPAN TYPE					74	6.5 - 6
	$\Delta C_{L_{\delta_{e_{GE_{TV}}}}}$	DCLDEGET HEIGHT/SPAN TYPE					75	6.5 - 7
	$\Delta C_{m_{\delta_{e_{GE_{TV}}}}}$	DCMDEGET HEIGHT/SPAN TYPE					76	6.5 - 8
	$\Delta C_{n_{\delta_{a_{GE_{TV}}}}}$	DCNDAGET HEIGHT/SPAN TYPE					77	6.5 - 9
	$\Delta C_{\ell_{\delta_{a_{GE_{TV}}}}}$	DCLDAGET HEIGHT/SPAN TYPE					78	6.5 - 10
	$\Delta C_{n_{\beta_{TV}}}$	DCLNBA ALPHA (DEG) MACH NUMBER					79	ZERO FILE
MISC.	$\Delta C_{\ell_{\beta_{GE}}}$	DCLLBGE HEIGHT/SPAN					80	4.2.1.3-162

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB : REVISION - AUG 1980)

TYPE	COEFF*	PROGRAM NAME	TLKUP4 ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
	$\Delta C_{\ell_{\delta_{aGE}}}$	DCLLDAGE	HEIGHT/SPAN	PHI	(DEG)		81	4.2.1.3- 163
$\Delta C_{m_{qSB,BF}}$	(PER RAD)	DCMQSBBF	ALPHA (DEG)	MACH	NUMBER		82	4.1.1.3- 102
PARTIAL SPAN	$K_{L_{\delta_e}}$	KLSE	DELE (DEG)	MACH	NUMBER		83	4.1.2.1- 36
	$K_{m_{\delta_e}}$	KMSE	DELE (DEG)	MACH	NUMBER		84	4.1.1.3- 38
	$K_{n_{\delta_a}}$	KLNSE	DELE (DEG)	MACH	NUMBER		85	4.2.1.2- 84
	$K_{\ell_{\delta_a}}$	KLLSE	DELE (DEG)	MACH	NUMBER		86	4.2.1.3- 94
VISCOUS INTERACTION	C_L	CL	ALPHA (DEG)	VBAR			87	4.1.2.1- 5
	C_D	CD	ALPHA (DEG)	VBAR			88	4.1.2.2- 5
	C_m	CM	ALPHA (DEG)	VBAR			89	4.1.1.3- 5
	C_{Y_β}	CYB	ALPHA (DEG)	VBAR			90	4.2.1.1- 28
	C_{n_β}	CLNB	ALPHA (DEG)	VBAR			91	4.2.1.2- 28
	C_{ℓ_β}	CLLB	ALPHA (DEG)	VBAR			92	4.2.1.3- 28
	$\Delta C_{L_{\delta_e}}$	DCLE	DELE (DEG)	ALPHA (DEG)	VBAR		93	4.1.2.1- 34
	$\Delta C_{D_{\delta_e}}$	DCDE	DELE (DEG)	ALPHA (DEG)	VBAR		94	4.1.2.2- 36
	$\Delta C_{m_{\delta_e}}$	DCME	DELE (DEG)	ALPHA (DEG)	VBAR		95	4.1.1.3- 34> 36
	$\Delta C_{L_{BF}}$	DCLBF	DELBF (DEG)	ALPHA (DEG)	VBAR		96	4.1.2.1- 64> 65
	$\Delta C_{D_{BF}}$	DCDBF	DELBF (DEG)	ALPHA (DEG)	VBAR		97	4.1.2.2- 63> 64
	$\Delta C_{m_{BF}}$	DCMBF	DELBF (DEG)	ALPHA (DEG)	VBAR		98	4.1.1.3- 64> 71
	$C_{Y_{\delta_a}}$	CYDA	DELE (DEG)	ALPHA (DEG)	VBAR		99	4.2.1.1- 72
	$C_{n_{\delta_a}}$	CLNDA	DELE (DEG)	ALPHA (DEG)	VBAR		100	4.2.1.2- 72> 77

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB ; REVISION - AUG 1980)

TYPE	COEFF*	PROGRAM NAME	TLKUP4 ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
	$C_{\ell_{\delta_a}}$	CLLDA	DELE (DEG)	ALPHA (DEG)	VBAR		101	4.2.1.3- 82> 87
Viscous Tolerance, Variation	$\Delta C_{L_{TV}}$	DCLTV	VBAR	TYPE			102	6.1 - 1
	$\Delta C_{D_{TV}}$	DCDTV	VBAR	TYPE			103	6.1 - 2
	$\Delta C_{m_{TV}}$	DCMTV	VBAR	TYPE			104	6.1 - 4
HIGH ALTITUDE	C_L	CL	ALPHA (DEG)	ALTITUDE (FT			105	4.1.2.1- 6
	C_D	CD	ALPHA (DEG)	ALTITUDE (FT			106	4.1.2.2- 6
	C_m	CM	ALPHA (DEG)	ALTITUDE (FT			107	4.1.1.3- 6
	C_{Y_β}	CYB	ALPHA (DEG)	ALTITUDE (FT			108	4.2.1.1- 29
	C_{n_β}	CLNB	ALPHA (DEG)	ALTITUDE (FT			109	4.2.1.2- 29
	C_{ℓ_β}	CLLB	ALPHA (DEG)	ALTITUDE (FT			110	4.2.1.3- 29
	$\Delta C_{L_{\delta_e}}$	DCLE	DELE (DEG)	ALPHA (DEG)	ALTITUDE (FT		111	4.1.2.1- 35
	$\Delta C_{D_{\delta_e}}$	DCDE	DELE (DEG)	ALPHA (DEG)	ALTITUDE (FT		112	4.1.2.2- 35
	$\Delta C_{m_{\delta_e}}$	DCME	DELE (DEG)	ALPHA (DEG)	ALTITUDE (FT		113	4.1.1.3- 37
	$\Delta C_{L_{BF}}$	DCLBF	DELBF (DEG)	ALPHA (DEG)	ALTITUDE (FT		114	4.1.2.1- 64
	$\Delta C_{D_{BF}}$	DCDBF	DELBF (DEG)	ALPHA (DEG)	ALTITUDE (FT		115	4.1.2.2- 65
	$\Delta C_{m_{BF}}$	DCMBF	DELBF (DEG)	ALPHA (DEG)	ALTITUDE (FT		116	4.1.1.3- 72
	$C_{Y_{\delta_a}}$	CYDA	DELE (DEG)	ALPHA (DEG)	ALTITUDE (FT		117	4.2.1.1- 73
	$C_{n_{\delta_a}}$	CLNDA	DELE (DEG)	ALPHA (DEG)	ALTITUDE (FT		118	4.2.1.2- 78> 83
	$C_{\ell_{\delta_a}}$	CLLDA	DELE (DEG)	ALPHA (DEG)	ALTITUDE (FT		119	4.2.1.3- 88> 93
TOLERANCE, VARIATION	$\Delta C_{L_{\delta_{e_{TV}}}}$	DCLDETV	MACH NUMBER	TYPE			120	6.1 - 7

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 AERODYNAMIC DATA (OCTOBER 1978 ADB : REVISION - AUG 1980)

TYPE	COEFF*	PROGRAM NAME	TLKUP4 ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
	$\Delta C_{h_{BF_{TV}}}$	DCHBFTV	MACH NUMBER	TYPE			121	6.3 - 4
	$\Delta C_{h_{SB_{TV}}}$	DCHSBTV	MACH NUMBER	TYPE			122	6.3 - 5
	ΔC_{n_o}	DCLNO	MACH NUMBER	TYPE			123	PAGE 6.7 - 1
	ΔC_{ℓ_o}	DCLLO	MACH NUMBER	TYPE			124	PAGE 6.7 - 1
CORRELATION COEFFICIENTS								
	$\rho_{C_{n_{\delta_a}} C_{\ell_{\delta_a}}}$	CDCCDA	MACH NUMBER				125	6.2 - 7
	$\rho_{C_{n_{\delta_r}} C_{\ell_r}}$	CDCCDR	MACH NUMBER				126	6.2 - 7
	$\rho_{C_{n_\beta} C_{\ell_\beta}}$	CDCCB	MACH NUMBER				127	6.2 - 7
	$\rho_{C_{n_{\delta_a}} C_{m_{\delta_a}}}$	CLNCMDA	MACH NUMBER				128	6.2 - 7
	$\rho_{C_{n_{\delta_r}} C_{h_{\delta_r}}}$	CLNCHMDR	MACH NUMBER				129	6.2 - 7
	$\rho_{C_{\ell_{\delta_r}} C_{h_{\delta_r}}}$	CLLCHMDR	MACH NUMBER				130	6.2 - 7
	$\rho_{C_L C_D}$	PCLCD	MACH NUMBER				131	6.1 - 8
	$\rho_{C_L C_m}$	PCLCM	MACH NUMBER				132	6.1 - 8
	$\rho_{C_D C_m}$	PCDCM	MACH NUMBER				133	6.1 - 8
	$\rho_{C_L C_D}$	VPCLCD	VBAR				134	6.1 - 8
	$\rho_{C_L C_m}$	VPCLCM	VBAR				135	6.1 - 8
TOLERANCE, VARIATION								
	$\Delta C_{Y_{\beta_{TV}}}$	VDCYBTV	VBAR	TYPE			136	6.2 - 3
	$\Delta C_{n_{\beta_{TV}}}$	VDCNBTV	VBAR	TYPE			137	6.2 - 4
	$\Delta C_{\ell_{\beta_{TV}}}$	VDCLBTV	VBAR	TYPE			138	6.2 - 6

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

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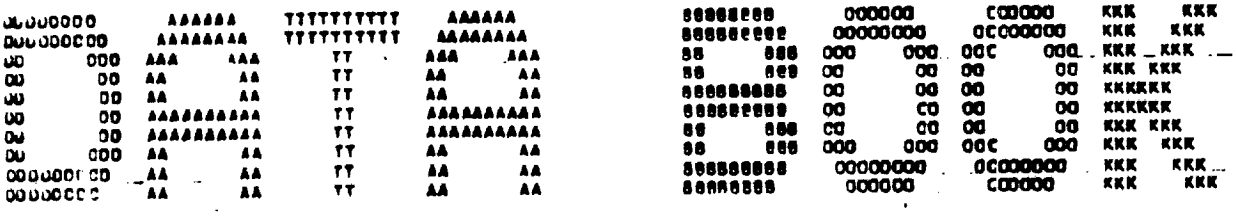
ROCKWELL INTERNATIONAL
SPACE DIVISION
DOWNEY CALIFORNIA

TABULATED OUTPUT FOR

OV102 AEROELASTIC DATA (OCTOBER 1978 ADB : REVISION - APRIL 1979)



OV102 AEROELASTIC DATA (OCTOBER 1978 ADB : REVISION - APRIL 1979)

SUMMARY

DATASET CREATED WITH 1100 RECORDS	EACH RECORD CONTAINS 100 WORDS
TOTAL NUMBER OF TABLES = 42	DATA WRITTEN TO TAPE 12
TOTAL NUMBER OF POINTS = 6508	LAST RECORD USED IS 136

JOB CARD USED TO CREATE OR CHANGE FILE			TIME OF DAY	DATE
$TT443	*0410871	000	XXXXXX	15:35:03 06/18/80

FILE DESCRIPTION
OV102 AEROELASTIC DATA (OCTOBER 1978 ADB : REVISION - APRIL 1979)

OV102 AEROELASTIC DATA (OCTOBER 1978 ADB : REVISION - APRIL 1979)

TYPE	COEFF*	PROGRAM NAME	TLKUP4 ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
	$\Delta C^{R}_{Y_{\beta_V}}$	ROCYBV	ALPHA (DEG)	MACH NUMBER			1	4.2.1.1- 132>133
	$\Delta C^{R}_{n_{\beta_V}}$	ROCLNBV	ALPHA (DEG)	MACH NUMBER			2	4.2.1.2- 149>150
	$\Delta C^{R}_{\ell_{\beta_V}}$	RCCLLBV	ALPHA (DEG)	MACH NUMBER			3	4.2.1.3- 159>160
	ΔC_{L_o}	OCLO	QBAR (PSF)	MACH NUMBER			4	4.1.2.1- 97
	ΔC_{m_o}	OCMO	QBAR (PSF)	MACH NUMBER			5	4.1.1.3- 107
	η_N	YN	QBAR (PSF)	MACH NUMBER			6	4.1.2.1- 94
	$\frac{\Delta X_{AC}}{\bar{c}} \cdot 100$	DXAC	QBAR (PSF)	MACH NUMBER			7	4.1.1.3- 108
	η_{L_e}	YLE	QBAR (PSF)	MACH NUMBER			8	4.1.2.1- 95
	η_{m_e}	YME	QBAR (PSF)	MACH NUMBER			9	4.1.1.3- 104
	$\eta_{L_{BF}}$	YLBF	QBAR (PSF)	MACH NUMBER			10	4.1.2.1- 96
	$\eta_{m_{BF}}$	YMBF	QBAR (PSF)	MACH NUMBER			11	4.1.1.3- 105
	$\eta_{Y_{\beta_V}}$	YYBV	QBAR (PSF)	MACH NUMBER			12	4.2.1.1- 128
	$\eta_{n_{\beta_V}}$	YLNBV	QBAR (PSF)	MACH NUMBER			13	4.2.1.2- 143
	$\eta_{\ell_{\beta_V}}$	YLLBV	QBAR (PSF)	MACH NUMBER			14	4.2.1.3- 153
	η_{Y_v}	YYV	QBAR (PSF)	MACH NUMBER			15	4.2.1.1- 129
	η_{n_v}	YLNV	QBAR (PSF)	MACH NUMBER			16	4.2.1.2- 144
	η_{ℓ_v}	YLLV	QBAR (PSF)	MACH NUMBER			17	4.2.1.3- 154
	η_{Y_a}	YYA	QBAR (PSF)	MACH NUMBER			18	4.2.1.1- 130
	η_{n_a}	YLNA	QBAR (PSF)	MACH NUMBER			19	4.2.1.2- 145
	η_{ℓ_a}	YLLA	QBAR (PSF)	MACH NUMBER			20	4.2.1.3- 155

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 AEROELASTIC DATA (OCTOBER 1978 ADD : REVISION - APRIL 1979)

TYPE	COEFF*	PROGRAM NAME	TLKUP ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
	η_{Y_R}	YYDR	QBAR (PSF)	MACH NUMBER			21	4.2.1.1- 131
	η_{n_R}	YLNDR	QBAR (PSF)	MACH NUMBER			22	4.2.1.2- 146
	η_{ℓ_R}	YLLDR	QBAR (PSF)	MACH NUMBER			23	4.2.1.3- 156
			QBAR (PSF)	MACH NUMBER			24	DUMMY FILE
			QBAR (PSF)	MACH NUMBER			25	DUMMY FILE
			QBAR (PSF)	MACH NUMBER			26	DUMMY FILE
			QBAR (PSF)	MACH NUMBER			27	DUMMY FILE
			QBAR (PSF)	MACH NUMBER			28	DUMMY FILE
			QBAR (PSF)	MACH NUMBER			29	DUMMY FILE
	$\Delta C_{h_{SF_{0,0}}}$	DCHSF00	QBAR (PSF)	MACH NUMBER			30	ZERO FILE
	$\eta_{HM_{SF_\alpha}}$	YHMSFA	QBAR (PSF)	MACH NUMBER			31	5.2-29
	$\eta_{HM_{SF_{\delta_{SF}}}}$	YHMSFSF	QBAR (PSF)	MACH NUMBER			32	5.2-30
	η_{HM_β}	YHMB	QBAR (PSF)	MACH NUMBER			33	5.3-83
	$\eta_{HM_{\delta_r}}$	YHMDR	QBAR (PSF)	MACH NUMBER			34	5.3-84
	$\eta_{\dot{\alpha}}$	YAD	QBAR (PSF)	MACH NUMBER			35	4.1.1.3- 106
	η_{n_β}	YLNB	QBAR (PSF)	MACH NUMBER			36	4.2.1.2- 147
	η_{ℓ_β}	YLLB	QBAR (PSF)	MACH NUMBER			37	4.2.1.3- 157
	$\eta_{n_{\delta_r}}$	YLNR	QBAR (PSF)	MACH NUMBER			38	4.2.1.2- 148
	$\eta_{\ell_{\delta_r}}$	YLLR	QBAR (PSF)	MACH NUMBER			39	4.2.1.3- 158
	$\Delta C_{D_{\alpha^2}} = 300$	DCDFLEX	DELE (DEG)	ALPHA (DEG)	MACH NUMBER	QBARREF(PSF)	40	4.1.2.2- 93>117
	$\eta_{C_{he_I}}$	YCHEI	QBAR (PSF)	MACH NUMBER			41	5.1- 56
	$\eta_{C_{he_O}}$	YCHEO	QBAR (PSF)	MACH NUMBER			42	5.1- 57

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

The prescribed use of the aerodynamic data is to start with the altitude tables. When 300,000 ft $\leq h \leq$ 600,000 ft and $\bar{V}'_\infty > 0.08$, it is recommended that the value of $\bar{V}'_\infty$ be converted to an equivalent altitude using the data given in Figure 4.0-1 or Figure C-1 (see Table D-1 for digitized data) and that this equivalent altitude (h_{eq}) be used when entering the altitude tables. When $0.005 \leq \bar{V}'_\infty \leq 0.08$, use the viscous parameter tables and, when $\bar{V}'_\infty \leq 0.005$ transition to the Mach tables.

Table D-1
VISCOUS INTERACTION PARAMETER

$\bar{V}'_\infty$	ALTITUDE (h_{eq}) (ft)
0.080	300,000
0.160	325,000
0.315	350,000
0.560	375,000
0.920	400,000
1.300	425,000
1.650	450,000
2.050	475,000
2.500	500,000
3.000	525,000
3.600	550,000
4.300	575,000
5.200	600,000

LONGITUDINAL AERODYNAMIC CHARACTERISTICS (STABILITY AXIS DATA)

(n) = Rockwell SSG data tape file (or table) number

where,

(An) =Aerodynamic data file numbers

(Fn) = Flexible data file numbers

LIFT COEFFICIENT

The total aerodynamic lift force coefficient is obtained by the following equation:

$$C_{L_{TOTAL}} = C_{L_{BASIC}} + \left[\Delta C_{L_{ELEVATOR}} + \Delta C_{L_{AILERON}}\right]_{ELEVON} + \Delta C_{L_{\substack{BODY\\FLAP}}} + \Delta C_{L_{RUDDER}} + \Delta C_{L_{\substack{SPEED\\BRAKE}}}$$

$$+ C_{L_{\dot{\alpha}}} \frac{\dot{\alpha}\bar{c}}{2V} + C_{L_{\hat{q}}} \frac{q\bar{c}}{2V} + \Delta C_{L_{FLEX}} + \Delta C_{L_{\substack{LANDING\\GEAR}}} + \Delta C_{L_{\substack{GROUND\\EFFECT}}} + \Delta C_{L_{\substack{SILTS\\POD}}}$$

where,

$$\Delta C_{L_{FLEX}} = \Delta C^{F}_{L_{o}} - (1 - \eta_N)(C^{R}_{L} - C^{R}_{L_o})_{BASIC} - (1 - \eta_{L_e})\Delta C^{R}_{L_e}$$

$$- (1 - \eta_{L_{BF}})\ \Delta C^{R}_{L_{BF}} - (1 - \eta_{L_{SB}})\ \Delta C^{R}_{L_{SB}}$$

Substituting the expression for $\Delta C_{L_{FLEX}}$ yields;

$$C_{L_{\substack{TOTAL\\FLEX}}} = C_{L_{O_{BASIC}}} + \Delta C_{L_{O_{FLEX}}} + \eta_N(C_L - C_{L_O})_{BASIC} + \eta_{L_e}(\Delta C_{L_{ELEVON}} + \Delta C_{L_{AILERON}}) + \eta_{L_{BF}}(\Delta C_{L_{\substack{BODY\\FLAP}}})$$

$$+ \Delta C_{L_{RUDDER}} + \eta_{L_{SB}}(\Delta C_{L_{SB}}) + \Delta C_{L_{\substack{LANDING\\GEAR}}} + \Delta C_{L_{\substack{GROUND\\EFFECT}}} + \Delta C_{L_{\substack{SILTS\\POD}}}$$

$$+ C_{L_{\dot{\alpha}}} \frac{\dot{\alpha}\bar{c}}{2V} + C_{L_{\hat{q}}} \frac{q\bar{c}}{2V}$$

where,

$$C_{L_{O_{BASIC}}} = C_{L_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\ (A1)\ f(\alpha = 0.0,\ M)$$

$$\Delta C_{L_{O_{FLEX}}} = \Delta C^{(F4)}_{L_O} f(\bar{q},\ M)$$

$$\eta_N(C_L - C_{L_O})_{BASIC} = \eta_N\ (F6)\ f(\bar{q},\ M) \cdot \left[C_{L_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} - C_{L_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\ (A1)\ f(\alpha = 0.0,\ M)\right]$$

$$C_{L_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} = \begin{cases} C_{L_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\ (A1)\ f(\alpha,\ M) & [0.25 \leq M \leq 20.0] \\ C_{L_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\ (A87)\ f(\alpha,\ \bar{V}'_{\infty}) & [0.005 \leq \bar{V}'_{\infty} \leq 0.08] \\ C_{L_{\substack{\delta_{SB}=25\\ \delta_{F}=0}}}\ (A105)\ f(\alpha,\ h_{eq}) & [300{,}000\text{ft} \leq h_{eq} \leq 600{,}000\text{ft}] \end{cases}$$

$$\eta_{L_e}\left(\Delta C_{L_{ELEVON}} + \Delta C_{L_{AILERON}}\right) = \eta_{L_e}\ (F8)\ f(\bar{q},M) \cdot \left[\Delta C_{L_{ELEVON}} + \Delta C_{L_{AILERON}}\right]$$

$$\Delta C_{L_{ELEVON}} = K_L^{(A83)} f(\delta_e, M) \cdot \Delta C_{L_{e_I}} + \left[1 - K_L^{(A83)} f(\delta_e, M)\right] \cdot \Delta C_{L_{e_O}}$$

$$\Delta C_{L_{e_I}} = \begin{cases} \Delta C_{L_e}^{(A16)} f(\delta_{e_I}, \alpha, M) & [0.25 \leq M \leq 20] \\ \Delta C_{L_e}^{(A93)} f(\delta_{e_I}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{L_e}^{(A111)} f(\delta_{e_I}, \alpha, h_{eq}) & [300{,}000\text{ft} \leq h_{eq} \leq 600{,}000\text{ft}] \end{cases}$$

$$\Delta C_{L_{e_O}} = \begin{cases} \Delta C_{L_e}^{(A16)} f(\delta_{e_O}, \alpha, M) & [0.25 \leq M \leq 20 \\ \Delta C_{L_e}^{(A93)} f(\delta_{e_O}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{L_e}^{(A111)} f(\delta_{e_O}, \alpha, h_{eq}) & [300{,}000\text{ft} \leq h_{eq} \leq 600{,}000\text{ft}] \end{cases}$$

$$\Delta C_{L_{AILERON}} = \frac{1}{2}\left\{\left[K_L^{(A83)} f(\delta_{e_L}, M) \cdot \Delta C_{L_{e_{I_L}}} + \left(1 - K_L^{(A83)} f(\delta_{e_L}, M)\right) \cdot \Delta C_{L_{e_{O_L}}}\right]\right.$$
$$\left. + \left[K_L^{(A83)} f(\delta_{e_R}, M) \cdot \Delta C_{L_{e_{I_R}}} + \left(1 - K_L^{(A83)} f(\delta_{e_R}, M)\right) \cdot \Delta C_{L_{e_{O_R}}}\right]\right\} - \Delta C_{L_{ELEVON}}$$

$$\Delta C_{L_{e_{I_L}}} = \begin{cases} \Delta C_{L_e}^{(A16)} f(\delta_{e_{I_L}}, \alpha, M) & [0.25 \leq M \leq 20] \\ \Delta C_{L_e}^{(A93)} f(\delta_{e_{I_L}}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{L_e}^{(A111)} f(\delta_{e_{I_L}}, \alpha, h_{eq}) & [300{,}000\text{ft} \leq h_{eq} \leq 600{,}000\text{ft}] \end{cases}$$

$\Delta C_{L_{e_{O_L}}}$, $\Delta C_{L_{e_{I_R}}}$, $\Delta C_{L_{e_{O_R}}}$ — Use identical procedure defined for $\Delta C_{L_{e_{I_L}}}$ except replace δ_e argument with appropriate panel

$$\eta_{L_{BF}}\left(\Delta C_{L_{\substack{BODY \\ FLAP}}}\right) = \eta_{L_{BF}}^{(F10)} f(\bar{q}, M) \cdot \Delta C_{L_{BF}}$$

$$\Delta C_{L_{BF}} = \begin{cases} \Delta C_{L_{BF}}^{(A34)} f(\delta_{BF}, \alpha, M) & [0.25 \leq M \leq 20] \\ \Delta C_{L_{BF}}^{(A96)} f(\delta_{BF}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{L_{BF}}^{(A114)} f(\delta_{BF}, \alpha, h_{eq}) & [300{,}000\text{ft} \leq h_{eq} \leq 600{,}000\text{ft}] \end{cases}$$

$$\Delta C_{L_{RUDDER}} = 0.0$$

$$\eta_{t_{SB}}(\Delta C_{L_{SB}}) = \overset{1.0}{\eta_{t_{SB}}} \Delta C_{L_{SB}}^{(A25)} f(\delta_{SB}, \alpha, M)$$

$$\Delta C_{L_{\substack{LANDING \\ GEAR}}} = \Delta C_{L_{LG}}^{(A7)} f(\alpha, \theta_{MG})$$

$$\Delta C_{L_{\substack{GROUND \\ EFFECT}}} = \Delta C_{L_{GE}}^{(A13)} f(h/b, \alpha, \delta_e)$$

$$\Delta C_{L_{\substack{SILTS \\ POD}}} = \begin{cases} 0.0018229 - 0.0019876M + 0.0004314427M^2 & \text{for } M \leq 6.0 \\ 0.0 & \text{for } M > 6.0 \end{cases}$$

$$C_{L_{\dot{\alpha}}} = C_{L_{\hat{q}}} = 0.0$$

$$\theta_{MG} = \begin{cases} 0.0 & \text{Landing gear up} \\ 98.0 & \text{Landing gear fully extended} \end{cases}$$

$$\delta_e = \tfrac{1}{2}(\delta_{e_I} + \delta_{e_O}) = \tfrac{1}{2}(\delta_{e_L} + \delta_{e_R})$$

$$\delta_{e_I} = \tfrac{1}{2}(\delta_{e_{I_L}} + \delta_{e_{I_R}})$$

$$\delta_{e_O} = \tfrac{1}{2}(\delta_{e_{O_L}} + \delta_{e_{O_R}})$$

$$\delta_{e_L} = \tfrac{1}{2}(\delta_{e_{I_L}} + \delta_{e_{O_L}}) = \delta_e + \delta_a$$

$$\delta_{e_R} = \tfrac{1}{2}(\delta_{e_{I_R}} + \delta_{e_{O_R}}) = \delta_e - \delta_a$$

$$\delta_a = \tfrac{1}{2}(\delta_{e_L} - \delta_{e_R}) = \tfrac{1}{2}(\delta_{a_I} + \delta_{a_O})$$

$$\delta_{a_I} = \tfrac{1}{2}(\delta_{e_{I_L}} - \delta_{e_{I_R}})$$

$$\delta_{a_O} = \tfrac{1}{2}(\delta_{e_{O_L}} - \delta_{e_{O_R}})$$

ELEVON TORSIONAL STIFFNESS METHOD

$$\text{Set } \Delta C_{L_o} \overset{(F4)}{f}(\bar{q},M) = 0$$

$$\eta_N \overset{(F6)}{f}(\bar{q},M) = 1.0$$

$$\eta_{L_e} \overset{(F8)}{f}(\bar{q},M) = 1.0$$

Modify initial elevon deflection with flexible increment

$$\delta_{e_{I_L}} = \delta_{e_{I_L}} + \Delta\delta_{e_{I_L}}$$

$$\delta_{e_{O_L}} = \delta_{e_{O_L}} + \Delta\delta_{e_{O_L}}$$

$$\delta_{e_{I_R}} = \delta_{e_{I_R}} + \Delta\delta_{e_{I_R}}$$

$$\delta_{e_{O_R}} = \delta_{e_{O_R}} + \Delta\delta_{e_{O_R}}$$

where,

$$\Delta\delta_{e_{I_L}} = K_I \bar{q} S_e \bar{c}_e C^F_{h_{e_{I_L}}}$$

$$C^F_{h_{e_{I_L}}} = \frac{C_{h_{e_{I_L}}} \overset{(A45)}{f}(\delta_{e_{I_L}}, \alpha, M)}{1 - C_{h_{e_{I_L}\delta_e}} K_I \bar{q} S_e \bar{c}_e}$$

$$C_{h_{e_{I_L}\delta_e}} = \frac{1}{2\delta'_e}\left[C_{h_{e_I}} \overset{(A45)}{f}(\delta_e = \delta_{e_{I_L}} + \delta'_e,\alpha,M) - C_{h_{e_I}} \overset{(A45)}{f}(\delta_e = \delta_{e_{I_L}} - \delta'_e,\alpha,M)\right]$$

$$\Delta\delta_{e_{O_L}} = K_O \bar{q} S_e \bar{c}_e C^F_{h_{e_{O_I}}}$$

$$C_{h_{e_{O_t}}}^{F} = \frac{C_{h_{e_{O_t}}}^{(A46)} f(\delta_{e_{O_t}}, \alpha, M)}{1 - C_{h_{e_{O_t}\delta_e}} K_O \bar{q} S_e \bar{c}_e}$$

$$C_{h_{e_{O_t}\delta_e}} = \frac{1}{2\delta_e'}\left[C_{h_{e_O}}^{(A46)} f(\delta_e = \delta_{e_{O_t}} + \delta_e', \alpha, M) - C_{h_{e_O}}^{(A46)} f(\delta_e = \delta_{e_{O_t}} - \delta_e', \alpha, M)\right]$$

K_I = 1.547×10^{-6} degree /inch-pound

K_O = 3.323×10^{-6} degree /inch-pound

δ_e' = 1 degree (recommended)

$\Delta\delta_{e_{I_R}}$, $\Delta\delta_{e_{O_R}}$: Use identical procedure defined for $\Delta\delta_{e_{I_t}}$ and $\Delta\delta_{e_{O_t}}$ except replace hinge moment coefficients and δ_e with appropriate right-hand terms.

(n) = Rockwell SSG data tape file (or table) number

where,

(An) = Aerodynamic data file numbers

(Fn) = Flexible data file numbers

DRAG COEFFICIENT

The total aerodynamic drag force coefficient is obtained by the following equation:

$$C_{D_{\substack{TOTAL\\AERO}}} = C_{D_{BASIC}} + \left[\Delta C_{D_{ELEVATOR}} + \Delta C_{D_{AILERON}}\right]_{ELEVON} + \Delta C_{D_{\substack{BODY\\FLAP}}} + \Delta C_{D_{RUDDER}} + \Delta C_{D_{\substack{SPEED\\BRAKE}}}$$

$$+ \Delta C_{D_{FLEX}} + \Delta C_{D_{\substack{LANDING\\GEAR}}} + \Delta C_{D_{\substack{GROUND\\EFFECT}}} + \Delta C_{D_{\substack{SILTS\\POD}}}$$

where,

$$C_{D_{BASIC}} = C_{D_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}$$

$$C_{D_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} = \begin{cases} C_{D_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\ (A2)\ f(\alpha,M) & [0.25 \le M \le 20.0] \\ C_{D_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\ (A88)\ f(\alpha,\bar{V}'_\infty) & [0.005 \le \bar{V}'_\infty \le 0.08] \\ C_{D_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\ (A106)\ f(\alpha,h_{eq}) & [300{,}000 \text{ ft} \le h_{eq} \le 600{,}000 \text{ ft}] \end{cases}$$

$$\Delta C_{D_{ELEVON}} = \begin{cases} \Delta C_{D_e}\ (A17)\ f(\delta_e,\alpha,M) & [0.25 \le M \le 20.0] \\ \Delta C_{D_e}\ (A94)\ f(\delta_e,\alpha,\bar{V}'_\infty) & [0.005 \le \bar{V}'_\infty \le 0.08] \\ \Delta C_{D_e}\ (A112)\ f(\delta_e,\alpha,h_{eq}) & [300{,}000 \text{ ft} \le h_{eq} \le 600{,}000 \text{ ft}] \end{cases}$$

$$\Delta C_{D_{AILERON}} = \frac{1}{2}\left[\Delta C_{D_{e_L}} + \Delta C_{D_{e_R}}\right] - \Delta C_{D_{ELEVON}}$$

$$\Delta C_{D_{e_L}} = \begin{cases} \Delta C_{D_e}\ (A17)\ f(\delta_{e_L}, \alpha, M) & [0.25 \leq M \leq 20.0] \\ \Delta C_{D_e}\ (A94)\ f(\delta_{e_L}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{D_e}\ (A112)\ f(\delta_{e_L}, \alpha, h_{eq}) & [300{,}000 \text{ ft} \leq h_{eq} \leq 600{,}000 \text{ ft}] \end{cases}$$

$\Delta C_{D_{e_R}}$ = identical to procedure for $\Delta C_{D_{e_L}}$ except δ_{e_L} is replaced with δ_{e_R}.

$$\Delta C_{D_{BF}} = \begin{cases} \Delta C_{D_{BF}}\ (A35)\ f(\delta_{BF}, \alpha, M) & [0.25 \leq M \leq 20.0] \\ \Delta C_{D_{BF}}\ (A97)\ f(\delta_{BF}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{D_{BF}}\ (A115)\ f(\delta_{BF}, \alpha, h_{eq}) & [300{,}000 \leq h_{eq} \leq 600{,}000 \text{ ft}] \end{cases}$$

$$\Delta C_{D_{RUDDER}} = 0.0$$

$$\Delta C_{D_{\substack{SPEED \\ BRAKE}}} = \Delta C_{D_{SB}}\ (A26)\ f(\delta_{SB}, \alpha, M)$$

$$\Delta C_{D_{FLEX}} = C_{D_{\bar{q}_{ref}=300 psf}}\ (F4C)\ f(\delta_e, \alpha, M) \cdot \frac{\bar{q}}{300}$$

$$\Delta C_{D_{\substack{LANDING \\ GEAR}}} = \Delta C_{D_{LG}}\ (A8)\ f(\alpha, \theta_{MG})$$

$$\Delta C_{D_{\substack{GROUND \\ EFFECT}}} = \Delta C_{D_{GE}}\ (A14)\ f(h/b, \alpha, \delta_e)$$

$$\Delta C_{D_{\substack{SILTS \\ POD}}} = \begin{cases} -0.0004647 + 0.000790212M - 0.0001259M^2 & \text{for } M \leq 6.0 \\ 0.0 & \text{for } M > 6.0 \end{cases}$$

θ_{MG}
δ_e
δ_a } (see page D.1-16)

ELEVON TORSIONAL STIFFNESS METHOD

Set $\Delta C_{D_{FLEX}} = 0.0$

Modify initial elevon deflection with flexible increment (see page D.1-17)

PITCHING MOMENT COEFFICIENT

(n) = Rockwell SSG data tape file (or table) number

(An) = Aerodynamic data file numbers

(Fn) = Flexible data file numbers

Moment Reference Center: X_o 1076.7, Y_o 0.0, Z_o 375.0

The total aerodynamic pitching moment coefficient about a Moment Reference Center located at 65 percent of the body length is obtained by the following equation:

$$C_{m_{\substack{TOTAL\\AERO_{0.65L_B}}}} = C_{m_{BASIC}} + [\Delta C_{m_{ELEVATOR}} + \Delta C_{m_{AILERON}}]_{ELEVON} + \Delta C_{m_{\substack{BODY\\FLAP}}} + \Delta C_{m_{RUDDER}} + \Delta C_{m_{\substack{SPEED\\BRAKE}}}$$
$$+ C_{m_{\dot\alpha}} \frac{\dot\alpha \bar c}{2V} + [C_{m_{\hat q}} + \Delta C_{m_{\hat q_{\substack{SB\\BF}}}}] \frac{q\bar c}{2V} + \Delta C_{m_{FLEX}} + \Delta C_{m_{\substack{LANDING\\GEAR}}} + \Delta C_{m_{\substack{GROUND\\EFFECT}}} + \Delta C_{m_{\substack{SILTS\\POD}}}$$

where,

$$\Delta C_{m_{FLEX}} = \Delta C^F_{m_o} - (1 - \eta_N)(C_m - C_{m_o})^R_{BASIC} - \left(\frac{\Delta x_{AC}}{\bar c}\right)^F \eta_N (C_N - C_{N_o})^R_{BASIC}$$
$$- (1 - \eta_{M_e})\, \Delta C^R_{m_e} - (1 - \eta_{M_{BF}})\, \Delta C^R_{m_{BF}} - (1 - \eta_{M_{SB}})\, \Delta C^R_{m_{SB}}$$
$$- (1 - \eta_{M_q})\, C^R_{m_{\hat q}} \frac{q\bar c}{2V}$$

substituting the expression for $\Delta C_{m_{FLEX}}$ yields;

$$C_{m_{\substack{TOTAL\\FLEX}}} = C_{m_{O_{BASIC}}} + \Delta C_{m_{O_{FLEX}}} + \eta_N \left[(C_m - C_{m_o})_{BASIC} - \left(\frac{\Delta X_{AC}}{\bar c}\right)(C_N - C_{L_o})_{BASIC}\right]$$
$$+ \eta_{m_e}\left(\Delta C_{m_{ELEVON}} + \Delta C_{m_{AILERON}}\right) + \eta_{m_{BF}}\left(\Delta C_{m_{BF}}\right) + \Delta C_{m_{RUDDER}}$$
$$+ \eta_{m_{SB}}(\Delta C_{m_{SB}}) + \Delta C_{m_{\substack{LANDING\\GEAR}}} + \Delta C_{m_{\substack{GROUND\\EFFECT}}} + \Delta C_{m_{\substack{SILTS\\POD}}} + \eta_{m\hat q}(C_{m\hat q}) \frac{q\bar c}{2V} + C_{m\dot\alpha} \frac{\dot\alpha \bar c}{2V}$$

where,

$$C_{m_{O_{BASIC}}} = C_{m_{\substack{\delta_{SB}=25^\circ\\ \delta_{BF}=0^\circ}}}^{(A3)} f(\alpha = 0.0, M)$$

$$\Delta C_{m_{O_{FLEX}}} = \Delta C_{m_o}^{(F5)} f(\bar q, M)$$

$$\eta_N \left[(C_m - C_{m_o})_{BASIC} - \left(\frac{\Delta X_{AC}}{\bar c}\right)(C_N - C_{N_o})_{BASIC}\right] = \overset{(F6)}{\eta_N} f(\bar q, M)\left\{\left[C_{m_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} - C_{m_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}^{(A3)} f(\alpha=0.0, M)\right] - \frac{1}{100}\left[\frac{\Delta X_{AC}}{\bar c}\overset{(F7)}{f}(\bar q, M)\right]\left[C_{N_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} - C_{L_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}^{(A1)} f(\alpha=0.0, M)\right]\right\}$$

$$C_{m_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} = \begin{cases} C_{m_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A3)} f(\alpha, M) & [0.25 \leq M \leq 20.0] \\ C_{m_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A89)} f(\alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ C_{m_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A102)} f(\alpha, h_{eq}) & [300{,}000 \text{ ft} \leq h_{eq} \leq 600{,}000 \text{ ft}] \end{cases}$$

$$C_{N_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} = \begin{cases} C_{L_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A1)} f(\alpha, M) \cdot \cos\alpha + C_{D_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A2)} f(\alpha, M) \sin\alpha & [0.25 \leq M \leq 20.0] \\ C_{L_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A87)} f(\alpha, \bar{V}'_\infty) \cdot \cos\alpha + C_{D_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A88)} f(\alpha, \bar{V}'_\infty) \sin\alpha & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ C_{L_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A103)} f(\alpha, h_{eq}) \cdot \cos\alpha + C_{D_{\substack{\delta_{sb}=25 \\ \delta_{ep}=0}}} \text{(A104)} f(\alpha, h_{eq}) \sin\alpha & [300\text{K ft} \leq h_{eq} \leq 600\text{K ft}] \end{cases}$$

$$\eta_{m_e}\left(\Delta C_{m_{ELEVON}} + \Delta C_{m_{AILERON}}\right) = \text{(F9)} f(\bar{q}, M)\left(\Delta C_{m_{ELEVON}} + \Delta C_{m_{AILERON}}\right)$$

$$\Delta C_{m_{ELEVON}} = K_{m_{\delta_e}} \text{(A84)} f(\delta_e, M) \cdot \Delta C_{m_{e_I}} + \left[1 - K_{m_{\delta_e}} \text{(A84)} f(\delta_e, M)\right] \cdot \Delta C_{m_{e_O}}$$

$$\Delta C_{m_{e_I}} = \begin{cases} \Delta C_{m_e} \text{(A18)} f(\delta_{e_I}, \alpha, M) & [0.25 \leq M \leq 20.0] \\ \Delta C_{m_e} \text{(A95)} f(\delta_{e_I}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{m_e} \text{(A113)} f(\delta_{e_I}, \alpha, h_{eq}) & [300{,}000 \text{ ft} \leq h_{eq} \leq 600{,}000 \text{ ft}] \end{cases}$$

$$\Delta C_{m_{e_O}} = \begin{cases} \Delta C_{m_e} \text{(A18)} f(\delta_{e_O}, \alpha, M) & [0.25 \leq M \leq 20.0] \\ \Delta C_{m_e} \text{(A95)} f(\delta_{e_O}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{m_e} \text{(A113)} f(\delta_{e_O}, \alpha, h_{eq}) & [300{,}000 \text{ ft} \leq h_{eq} \leq 600{,}000 \text{ ft}] \end{cases}$$

$$\Delta C_{m_{AILERON}} = \frac{1}{2}\left\{\left[K_{m_{\delta_e}} \text{(A84)} f(\delta_{e_L}, M) \cdot \Delta C_{m_{e_{I_L}}} + \left(1 - K_{m_{\delta_e}} \text{(A84)} f(\delta_{e_L}, M)\right) \cdot \Delta C_{m_{e_{O_L}}}\right]\right.$$
$$\left. + \left[K_{m_{\delta_e}} \text{(A84)} f(\delta_{e_R}, M) \cdot \Delta C_{m_{e_{I_R}}} + \left(1 - K_{m_{\delta_e}} \text{(A84)} f(\delta_{e_R}, M)\right) \cdot \Delta C_{m_{e_{O_R}}}\right]\right\} - \Delta C_{m_{ELEVON}}$$

$$\Delta C_{m_{e_{IL}}} = \begin{cases} \Delta C_{m_e}^{(A18)} f(\delta_{e_{IL}}, \alpha, M) & [0.25 \leq M \leq 20.0] \\ \Delta C_{m_e}^{(A95)} f(\delta_{e_{IL}}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{m_e}^{(A113)} f(\delta_{e_{IL}}, \alpha, h_{eq}) & [300{,}000 \text{ ft} \leq h_{eq} \leq 600{,}000 \text{ ft}] \end{cases}$$

$\Delta C_{m_{O_L}}$, $\Delta C_{m_{I_R}}$, $\Delta C_{m_{O_R}}$ use identical procedure defined for $\Delta C_{m_{e_I}}$ except replace δ_e argument with appropriate panel

$$\eta_{m_{BF}}(\Delta C_{m_{BF}}) = \eta_{m_{BF}}^{(F11)} f(\bar{q}, M)(\Delta C_{m_{BF}})$$

$$\Delta C_{m_{BF}} = \begin{cases} \Delta C_{m_{BF}}^{(A36)} f(\delta_{BF}, \alpha, M) & [0.25 \leq M \leq 20.0] \\ \Delta C_{m_{BF}}^{(A98)} f(\delta_{BF}, \alpha, \bar{V}'_\infty) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \\ \Delta C_{m_{BF}}^{(A116)} f(\delta_{BF}, \alpha, h_{eq}) & [300{,}000 \text{ ft} \leq h_{eq} \leq 600{,}000 \text{ ft}] \end{cases}$$

$$\Delta C_{m_{RUDDER}} = 0.0$$

$$\eta_{SB}(\Delta C_{m_{SB}}) = \eta_{m_{SB}}^{1.0} \cdot \Delta C_{m_{SB}}^{(A27)} f(\delta_{SB}, \alpha, M)$$

$$\Delta C_{m_{\substack{LANDING \\ GEAR}}} = \Delta C_{m_{LG}}^{(A9)} f(\alpha, \theta_{MG})$$

$$\Delta C_{m_{\substack{GROUND \\ EFFECT}}} = \Delta C_{m_{GE}}^{(A15)} f(h/b, \alpha, \delta_e)$$

$$\Delta C_{m_{\substack{SILTS \\ POD}}} = \begin{cases} -0.000635152 + 0.000881151M - 0.000173119M^2 & (\text{for } M \leq 6.0) \\ 0.0 & (\text{for } M \leq 6.0) \end{cases}$$

$$\eta_{m_{\hat{q}}}(C_{m_{\hat{q}}})\frac{q\bar{c}}{2V} = \eta_{m_{\hat{q}}}^{(F35)} f(\bar{q}, M)(C_{m_{\hat{q}_{BASIC}}} + C_{m_{\hat{q}_{SB,BF}}})\frac{q\bar{c}}{2V}$$

$$C_{m_{\hat{q}}} = C_{m_{\hat{q}}} \overset{(A40)}{f}(\alpha, M)$$

$$\Delta C_{m_{\hat{q}_{SB,BF}}} = \left[K_{SB}\left(\frac{\delta_{SB} - 25}{75}\right) + (1 - K_{SB})\left(\frac{\delta_{BF}}{13.75}\right)\right] \Delta C_{m_{\hat{q}_{\substack{SB \\ BF}}}} \overset{(A82)}{f}(\alpha, M)$$

$$C_{m_{\dot{\alpha}}} = 0.0$$

$K_{SB} = 0.5$

θ_{MG}, δ_e, δ_a

$$\hat{q} = \frac{q\bar{c}}{2V}$$

q = pitch rate, radians/second
$\bar{c}$ = mean aerodynamic chord = 39.5675 ft.
V = speed, feet/second

(see page D.1-16)

ELEVON TORSIONAL STIFFNESS METHOD

Set $\Delta C_{m_o} \overset{(F5)}{f}(\bar{q}, M) = 0$

$\Gamma \overset{(F6)}{f}(\bar{q}, M) = 1.0$

$-\frac{\Delta X_{AC}}{\bar{c}} \overset{(F7)}{f}(\bar{q}, M) = 0$

$\Gamma_{n_e} \overset{(F9)}{f}(\bar{q}, M) = 1.0$

Modify initial elevon deflection with flexible increment

(see page D.1-17)

LATERAL-DIRECTIONAL AERODYNAMIC CHARACTERISTICS (BODY-AXIS DATA)

(n) = Rockwell SSG data tape file (or table) number

where,

(An) = Aerodynamic data file numbers

(Fn) = Flexible data file numbers

SIDE FORCE COEFFICIENT

The total aerodynamic side force coefficient is obtained by the following equation:

$$C_{Y_{TOTAL}} = C_{Y_{BASIC}} + \Delta C_{Y_{\beta_{ELEVON}}}\beta + C_{Y_{\delta_a}}\delta_a + \Delta C_{Y_{BODY\ FLAP}} + C_{Y_{\delta_r}}\delta_r + \Delta C_{Y_{\beta_{SPEED\ BRAKE}}}\beta$$

$$+ C_{Y_{\hat{p}}}\frac{pb}{2V} + C_{Y_{\hat{r}}}\frac{rb}{2V} + \Delta C_{Y_{FLEX}} + \Delta C_{Y_{\beta_{LANDING\ GEAR}}}\beta + \Delta C_{Y_{GROUND\ EFFECT}} + \Delta C_{Y_{SILTS\ POD}}$$

where,

$$\Delta C_{Y_{FLEX}} = -(1-\eta_{Y_{WB}})(C^R_{Y_{BASIC}} - \Delta C^R_{Y_{\beta_V}}\beta) - (1-\eta_{Y_V})(\Delta C^R_{Y_{\beta_V}} + \Delta C^R_{Y_{\beta_{SB}}})\beta$$

$$-(1-\eta_{Y_a})\,C^R_{Y_{\delta_a}}\delta_a - (1-\eta_{Y_r})\,C^R_{Y_{\delta_r}}\delta_r$$

substituting the expression for $\Delta C_{Y_{FLEX}}$ yields:

$$C_{Y_{TOTAL}} = \eta_{Y_{WB}}\,\textcircled{F12}\,f(\bar{q}, M)\cdot\left[C_{Y_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} - \Delta C^R_{Y_{\beta_V}}\,\textcircled{F1}\,f(\alpha, M)\cdot\beta\right] + \eta_{Y_e}\,(1.0)\cdot\Delta C_{Y_{\beta_e}}\,\textcircled{A19}\,f(\delta_e,\alpha,M)\cdot\beta$$

$$+ \Delta C_{Y_{\beta_{LG}}}\,\textcircled{A10}\,f(\alpha, \theta_{MG})\cdot\beta + \eta_{Y_a}\,\textcircled{F18}\,f(\bar{q}, M)\cdot C_{Y_{\delta_a}}\cdot\left[K_{Y_{\delta_a}}(0.6)\cdot\delta_{a_I} + (1-K_{Y_{\delta_a}})(0.6)\cdot\delta_{a_O}\right]$$

$$+ \eta_{Y_V}\,\textcircled{F15}\,f(\bar{q}, M)\cdot\left[\Delta C_{Y_{\beta_V}}\,\textcircled{F1}\,f(\alpha, M) + \Delta C_{Y_{\beta_{SB}}}\,\textcircled{A28}\,f(\delta_{SB}, \alpha, M)\right]\cdot\beta + \Delta C_{Y_{\beta_{GE}}}(0.0)\cdot\beta$$

$$+ \eta_{Y_R}\,\textcircled{F21}\,f(\bar{q}, M)\cdot C_{Y_{\delta_R}}\,\textcircled{A31}\,f(\delta_{SB}, \alpha, M)\cdot\delta_R + \Delta C_{Y_{BF}}\,\textcircled{A37}\,f(|\beta|, \alpha, M, \delta_{BF})\cdot(0.0)\cdot\text{sign}(\beta)$$

$$+ C_{Y_{\hat{p}}}\frac{pb}{2V} + C_{Y_{\hat{r}}}\frac{rb}{2V}$$

where,

$$C_{Y_{\substack{\delta_{sb}=25 \\ \delta_{bf}=0}}} = \begin{cases} C_{Y_{\substack{\delta_{sb}=25 \\ \delta_{bf}=0}}} \text{(A4)}\ f(|\beta|, \alpha, M)\ \text{SIGN}(\beta) & [0.25 \le M \le 20.0] \\ C_{Y_{\substack{\delta_{sb}=25 \\ \delta_{bf}=0}}} \text{(A90)}\ f(\alpha, \bar{V}'_\infty)\cdot\beta & [0.005 \le \bar{V}'_\infty \le 0.08] \\ C_{Y_{\beta_{\substack{\delta_{sb}=25 \\ \delta_{bf}=0}}}} \text{(A108)}\ f(\alpha, h_{eq})\cdot\beta & [300{,}000\ \text{ft} \le h_{eq} \le 600{,}000\ \text{ft}] \end{cases}$$

$$C_{Y_{\delta_a}} = \begin{cases} C_{Y_{\delta_a}} \text{(A22)}\ f(\delta_e, \alpha, M) & [0.25 \le M \le 20.0] \\ C_{Y_{\delta_a}} \text{(A99)}\ f(\delta_e, \alpha, \bar{V}'_\infty) & [0.005 \le \bar{V}'_\infty \le 0.08] \\ C_{Y_{\delta_a}} \text{(A117)}\ f(\delta_e, \hat{r}, h_{eq}) & [300{,}000\ \text{ft} \le h_{eq} \le 600{,}000\ \text{ft}] \end{cases}$$

$C_{Y_{\hat{p}}} = C_{Y_{\hat{r}}} = 0.0$

$$\text{SIGN}(\beta) = \begin{cases} +1.0 & (\beta \ge 0) \\ -1.0 & (\beta < 0) \end{cases}$$

$$\hat{p} = \frac{pb}{2V}, \qquad \hat{r} = \frac{rb}{2V},$$

p = roll rate, radians/second
r = yaw rate, radians/second
b = wing span = 78.0566 ft.
V = speed, feet/second

ELEVON TORSIONAL STIFFNESS METHOD

Set $\eta_{Y_{wB}}$ (F12) $f(\bar{q}, M) = 1.0$

$\eta_{Y_e} = 1.0$

η_{Y_a} (F18) $f(\bar{q}, M) = 1.0$

Modify initial elevon deflection with flexible increment
(see page D.1-17)

YAWING MOMENT COEFFICIENT

(n) = Rockwell/SSG data tape file (or table) number

where,

(An) = Aerodynamic data file numbers

(Fn) = Flexible data file numbers

Moment Reference Center: X_o 1076.7, Y_o 0.0, Z_o 375.0

The total aerodynamic yawing moment coefficient about a moment reference center at 65 percent of the body length is obtained by the following equation:

$$C_{n_{\substack{TOTAL\\AERO}_{0.65\,l_B}}} = C_{n_{BASIC}} + \Delta C_{n_{\beta_{ELEVON}}}\beta + C_{n_{\delta_a}}\delta_a + \Delta C_{n_{\substack{BODY\\FLAP}}} + \Delta C_{n_{\beta_{\substack{SPEED\\BRAKE}}}}\beta + C_{n_{\delta_r}}\delta_r$$

$$+ C_{n_{\hat{p}}}\frac{pb}{2V} + C_{n_{\hat{r}}}\frac{rb}{2V} + C_{n_{\dot{\beta}}}\frac{\dot{\beta}b}{2V} + \Delta C_{n_{FLEX}} + \Delta C_{n_{\substack{\beta_{LANDING}\\GEAR}}}\beta + \Delta C_{n_{\substack{GROUND\\EFFECT}}} + \Delta C_{n_{\substack{SILTS\\POD}}}$$

where,

$$\Delta C_{n_{FLEX}} = -(1-\eta_{n_{WB}})(C^R_{n_{BASIC}} - \Delta C^R_{n_{\beta_V}}\beta) - (1-\eta_{n_V})(\Delta C^R_{n_{\beta_V}} + \Delta C^R_{n_{\beta_{SB}}})\beta$$

$$-(1-\eta_{n_a})\,C^R_{n_{\delta_a}}\delta_a - (1-\eta_{n_R})\,C^R_{n_{\delta_r}}\delta_r - (1-\eta_{n_{\hat{p}}})\,C^R_{n_{\hat{p}}}\frac{pb}{2V}$$

$$-(1-\eta_{n_{\hat{r}}})\,C^R_{n_{\hat{r}}}\frac{rb}{2V} - (1-\eta_{n_e})\Delta C_{n_{\beta_{ELEVON}}}\beta$$

Substituting the expression for $\Delta C_{n_{FLEX}}$ yields:

$$C_{n_{TOTAL}} = \overset{F13}{\eta_{n_{WB}}}\overset{1.0}{} f(\bar{q},M)\cdot\left[C_{n_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} - \Delta C^{R}_{n_{\beta_V}}\overset{F2}{} f(\alpha,M)\cdot\beta\right] + \eta_{n_e}\overset{1.0}{} \cdot \Delta C_{n_{\beta_e}}\overset{A20}{} f(\delta_e,\alpha,M)\cdot\beta$$

$$+ \Delta C_{n_{\beta_{LG}}}\overset{A11}{} f(\alpha,\theta_{MG})\cdot\beta + \eta_{n_a}\overset{F19}{} f(\bar{q},M)\cdot C_{n_{\delta a}}\cdot\left[K_{n_{\delta a}}\overset{A85}{} f(\delta_e,M)\cdot\delta_{a_I} + \left(1 - K_{n_{\delta a}}\overset{A85}{} f(\delta_e,M)\right)\cdot\delta_{a_O}\right]$$

$$+ \eta_{n_V}\overset{F16}{} f(\bar{q},M)\cdot\left[\Delta C^{R}_{n_{\beta_V}}\overset{F2}{} f(\alpha,M) - \Delta C_{n_{\beta_{SB}}}\overset{A29}{} f(\delta_{SB},\alpha,M)\right]\cdot\beta + \eta_{n_R}\overset{F22}{} f(\bar{q},M)\cdot C_{n_{\delta_R}}\overset{A32}{} f(\delta_{SB},\alpha,M)\cdot\delta_R$$

$$+ C_{n_{\beta_F}}\overset{A38}{} \overset{0.0}{} f(|\beta|,\alpha,M,\delta_{BF})\cdot sgn\ \beta) + \Delta C_{n_{\beta_{GE}}}\overset{0.0}{}\cdot\beta + \eta_{n_{\hat{r}}}\overset{F38}{} f(\bar{q},M)\cdot C_{n_{\hat{r}}}\overset{A41}{} f(\alpha,M)\cdot\frac{rb}{2V_O}$$

$$+ \eta_{n_{\hat{p}}}\overset{F36}{} f(\bar{q},M)\cdot C_{n_{\hat{p}}}\overset{A43}{} f(\alpha,M)\cdot\frac{pb}{2V_O}$$

where,

$$C_{n_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} = \begin{cases} C_{n_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\overset{(.5}{} f(|\beta|,\alpha,M)\cdot sgn\ (\beta) & [0.25 \le M \le 20.0] \\ C_{n_{\beta_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}}\overset{A91}{} f(\alpha,\bar{V}'_\infty)\cdot\beta & [0.005 \le \bar{V}'_\infty \le 0.08] \\ C_{n_{\beta_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}}\overset{A105}{} f(\alpha,h_{eq})\cdot\beta & [300{,}000\ ft \le h_{eq} \le 600{,}000\ ft] \end{cases}$$

$$C_{n_{\delta a}} = \begin{cases} C_{n_{\delta a}}\overset{A23}{} f(\delta_e,\alpha,M) & [0.25 \le M \le 20.0] \\ C_{n_{\delta a}}\overset{A100}{} f(\delta_e,\alpha,\bar{V}'_\infty) & [0.005 \le \bar{V}'_\infty \le 0.08] \\ C_{n_{\delta a}}\overset{A118}{} f(\delta_e,\alpha,h_{eq}) & [300{,}000\ ft \le h_{eq} \le 600{,}000\ ft] \end{cases}$$

$$\text{sign}(\beta) = \begin{cases} +1.0 & (\beta \geq 0) \\ -1.0 & (\beta < 0) \end{cases}$$

$$\hat{p} = \frac{pb}{2V_o}, \qquad \hat{r} = \frac{rb}{2V_o},$$

p = roll rate, radians/second
r = yaw rate, radians/second
b = wing span = 78.0566 ft
V_o = speed, feet/second

ELEVON TORSIONAL STIFFNESS METHOD

Set $\eta_{n_{ws}}^{(F13)} f(\bar{q},M) = 1.0$

$\eta_{n_e} = 1.0$

$\eta_{n_\alpha}^{(F19)} f(\bar{q}\ M) = 1.0$

Modify initial elevon deflection with flexible increment (see page D.1-17)

ROLLING MOMENT COEFFICIENT

(n) = Rockwell SSG data tape file (or table) number

where,

(An) = Aerodynamic data tape file numbers

(Fn) = Flexible data tape file numbers

Moment Reference Center: X_o 1076.7, Y_o 0.0, Z_o 375.0

The total aerodynamic rolling moment coefficient about a Moment Reference Center located at 65 percent of the body length is obtained by the following equation:

$$C_{\ell_{\substack{\text{TOTAL}\\\text{AERO}}}} = C_{\ell_{\text{BASIC}}} + \Delta C_{\ell_{\beta_{\text{ELEVON}}}} \beta + C_{\ell_{\delta_a}} \delta_a + \Delta C_{\ell_{\substack{\text{BODY}\\\text{FLAP}}}} + C_{\ell_{\delta_r}} \delta_r + \Delta C_{\ell_{\beta_{\substack{\text{SPEED}\\\text{BRAKE}}}}} \beta$$

$$+ C_{\ell_{\hat{p}}} \frac{pb}{2V} + C_{\ell_{\hat{r}}} \frac{rb}{2V} + \Delta C_{\ell_{\text{FLEX}}} + \Delta C_{\ell_{\substack{\beta_{\text{LANDING}}\\\text{GEAR}}}} \beta + \Delta C_{\ell_{\substack{\text{GROUND}\\\text{EFFECT}}}} + \Delta C_{\ell_{\substack{\text{SILTS}\\\text{POD}}}}$$

where,

$$\Delta C_{\ell_{\text{FLEX}}} = -(1 - \eta_{\ell_{wb}})(C^R_{\ell_{\text{BASIC}}} - \Delta C^R_{\ell_{\beta_v}} \beta) - (1 - \eta_{\ell_v})(\Delta C^R_{\ell_{\beta_v}} + \Delta C^R_{\ell_{\beta_{sb}}}) \beta$$

$$- (1 - \eta_{\ell_a}) C^R_{\ell_{\delta_a}} \delta_a - (1 - \eta_{\ell_R}) C^R_{\ell_{\delta_r}} \delta_r - (1 - \eta_{\ell_p}) C^R_{\ell_{\hat{p}}} \frac{pb}{2V}$$

$$- (1 - \eta_{\ell_r}) C^R_{\ell_{\hat{r}}} \frac{rb}{2V}$$

Substituting the expression for $\Delta C_{\ell_{\text{FLEX}}}$ yields:

$$C_{\ell_{TOTAL}} = \eta_{\ell_{WB}}\,(F14)\,f(\bar{q}, M) \cdot \left[C_{\ell_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} - \Delta C^{R}_{\ell_{\beta_V}}\,(F3)\,f(\alpha, M) \cdot \beta\right] + \eta_{\ell_e}\,(1.0) \cdot \Delta C_{\ell_{\beta_e}}\,(A21)\,f(\delta_e, \alpha, M) \cdot \beta$$

$$+ \Delta C_{\ell_{\beta_{LG}}}\,(A12)\,f(\alpha, \theta_{MG}) \cdot 3 + \eta_{\ell_a}\,(F20)\,f(\bar{q}, M) \cdot \left[C_{\ell_{\delta_a}} + \Delta C_{\ell_{\delta_{a_{GE}}}}\,(A81)\,f(h/b, |\phi|)\right] \cdot \left[K_{\ell_{\delta_a}}\,(A86)\,f(\delta_e, M) \cdot \delta_{a_I}\right.$$

$$\left. + (1 - K_{\ell_{\delta_a}}\,(A86)\,f(\delta_e, M)) \cdot \delta_{a_O}\right] + \eta_{\ell_v}\,(F17)\,f(\bar{q}, M) \cdot \left[\Delta C^{R}_{\ell_{\beta_V}}\,(F3)\,f(\alpha, M) + \Delta C_{\ell_{\beta_{SB}}}\,(A30)\,f(\delta_{SB}, \alpha, M)\right] \cdot \beta$$

$$+ \Delta C_{\ell_{\beta_{GE}}}\,(A80)\,f(h/b) \cdot \beta + \eta_{\ell_R}\,(F23)\,f(\bar{q}, M) \cdot C_{\ell_{\delta_R}}\,(A33)\,f(\delta_{SB}, \alpha, M) \cdot \delta_R + \Delta C_{\ell_{BF}}\,(0.0)\,(A39)\,(|\beta|, \alpha, M, \delta_{BF})$$

$$\cdot \text{SIGN}(\beta) + \eta_{\ell_{\hat{r}}}\,(F39)\,f(\bar{q}, M) \cdot C_{\ell_{\hat{r}}}\,(A42)\,f(\bar{q}, M) \cdot \frac{rb}{2V_o} + \eta_{\ell_{\hat{p}}}\,(F37)\,f(\bar{q}, M) \cdot C_{\ell_{\hat{p}}}\,(A44)\,f(\alpha, M) \cdot \frac{pb}{2V_o}$$

where,

$$C_{\ell_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}} = \begin{cases} C_{\ell_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}\,(A6)\,f(|\beta|, \alpha, M) \cdot \text{SIGN}(\beta) & [0.25 \le M \le 20.0] \\ C_{\ell_{\beta_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}}\,(A92)\,f(\alpha, \bar{V}'_\infty) \cdot \beta & [0.005 \le \bar{V}'_\infty \le 0.08] \\ C_{\ell_{\beta_{\substack{\delta_{SB}=25\\ \delta_{BF}=0}}}}\,(A110)\,f(\alpha, h_{eq}) \cdot \beta & [300{,}000 \text{ ft} \le h_{eq} \le 600{,}000 \text{ ft}] \end{cases}$$

$$C_{\ell_{\delta_a}} = \begin{cases} C_{\ell_{\delta_a}}\,(A24)\,f(\delta_e, \alpha, M) & [0.25 \le M \le 20.0] \\ C_{\ell_{\delta_a}}\,(A101)\,f(\delta_e, \alpha, \bar{V}'_\infty) & [0.005 \le \bar{V}'_\infty \le 0.08] \\ C_{\ell_{\delta_a}}\,(A119)\,f(\delta_e, \alpha, h_{eq}) & [300{,}000 \text{ ft} \le h_{eq} \le 600{,}000 \text{ ft}] \end{cases}$$

$$\text{SIGN}(\beta) = \begin{cases} +1.0 & (\beta \ge 0) \\ -1.0 & (\beta < 0) \end{cases}$$

$$\beta = \frac{pb}{2V_o}, \quad \hat{r} = \frac{rb}{2V_o}, \quad \begin{cases} p = \text{roll rate, radians/second} \\ r = \text{yaw rate, radians/second} \\ b = \text{wing span} = 78.0566 \text{ ft.} \\ V_o = \text{speed, feet/second} \end{cases}$$

ELEVON TORSIONAL STIFFNESS METHOD

Set $\eta_{\ell_{ws}}^{(F14)} f(\bar{q}, M) = 1.0$

$\eta_{\ell_e} = 1.0$

$\eta_{\ell_a}^{(F20)} f(\bar{q}, M) = 1.0$

Modify initial elevon deflection with flexible increment

(see page D.1-17)

HINGE MOMENTS

ELEVON

$$C_{h_{e_{TOTAL}}} = C_{h_{e_I}} + C_{h_{e_O}}$$

$$C_{h_{e_{\substack{TOTAL \\ FLEX}}}} = C_{h_{e_I}} \cdot \eta_{C_{he_I}} + C_{h_{e_O}} \cdot \eta_{C_{he_O}}$$

where,

$$C_{h_{e_I}} = C_{h_{e_I}}^{(A45)}(\delta_e, \alpha, M)$$

$$C_{h_{e_O}} = C_{h_{e_O}}^{(A46)}(\delta_e, \alpha, M)$$

$$\eta_{C_{he_I}} = \eta_{C_{he_I}}^{(A41)}(\bar{q}, M)$$

$$\eta_{C_{he_O}} = \eta_{C_{he_O}}^{(A42)}(\bar{q}, M)$$

BODY FLAP

$$C_{h_{BF}} = C_{h_{\substack{BF \\ \delta_{SB}=25}}}$$

$$C_{h_{\substack{BF \\ FLEX}}} = \eta_{HM_{BF}} \cdot C_{h_{BF}}$$

where,

$$C_{h_{\substack{BF \\ \delta_{SB}=25}}} = C_{h_{\substack{BF \\ \delta_{SB}=25}}}^{(A50)}(\delta_{BF}, \alpha, M)$$

$$\eta_{HM_{BF}} = \eta_{HM_{BF}}^{(F31)}(\bar{q}, M)$$

RUDDER/SPEEDBRAKE

$$C_{h_{SB}} = C_{h_{R/SB_{RH}}} + C_{h_{R/SB_{LH}}}$$

$$C_{h_R} = C_{h_{R/SB_{RH}}} - C_{h_{R/SB_{LH}}}$$

where,

$$C_{h_{R/SB_{RH}}} = C_{h_{SB_{RH}}} + C_{h_{\delta_{R_{RH}}}} \cdot \delta_R + C_{h_{\beta_{RH}}} \cdot \beta$$

$$C_{h_{R/SB_{LH}}} = C_{h_{SB_{RH}}} - C_{h_{\delta_{R_{RH}}}} \cdot \delta_R - C_{h_{\beta_{RH}}} \cdot \beta$$

$$C_{h_{\substack{R/SB \\ FLEX_{RH}}}} = C_{h_{SB_{RH}}} + \eta_{HM_R} \cdot C_{h_{\delta_{R_{RH}}}} \cdot \delta_R + \eta_{HM_\beta} \cdot C_{h_{\beta_{RH}}} \cdot \beta$$

$$C_{h_{\substack{R/SB \\ FLEX_{LH}}}} = C_{h_{SB_{RH}}} - \eta_{HM_R} \cdot C_{h_{\delta_{R_{RH}}}} \cdot \delta_R - \eta_{HM_\beta} \cdot C_{h_{\beta_{RH}}} \cdot \beta$$

$$C_{h_{SB_{RH}}} = C_{h_{SB_{RH}}}\,(A47)\, f(\delta_{SB}, \alpha, M)$$

$$C_{h_{\delta_{R_{RH}}}} = C_{h_{\delta_{R_{RH}}}}\,(A48)\, f(\delta_{SB}, \alpha, M)$$

$$C_{h_{\beta_{RH}}} = C_{h_{\beta_{RH}}}\,(A49)\, f(\delta_{SB}, \alpha, M)$$

$$\eta_{HM_R} = \eta_{HM_R}\,(F34)\, f(\bar{q}, M)$$

$$\eta_{HM_\beta} = \eta_{HM_\beta}\,(F33)\, f(\bar{q}, M)$$

TOTAL AERODYNAMIC UNCERTAINTIES (TAU)

T = TYPE = $\begin{cases} 1.0 \text{ TOLERANCE} \\ 2.0 \text{ VARIATION} \end{cases}$

M = Mach Number

h/b = Height-to-Span Ratio

b = 78.057 ft.

LIFT COEFFICIENT

$$\pm \Delta C_{L_{TAU}} = \pm \left\{ \left[\Delta C_{L_{TV}} \right]^2 + \left[\Delta C_{L_{GE_{TV}}} (69) (h/b, \pm T) \right]^2 \right\}^{1/2}$$

where,

$$\Delta C_{L_{TV}} = \begin{cases} \Delta C_{L_{TV}} (51) (M, T) & [0.25 \leq M \leq 20.0] \\ \Delta C_{L_{TV}} (102) (\bar{V}'_\infty, T) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \end{cases}$$

★ $\pm \Delta C_{L_{\alpha_{TAU}}} (M, T) = \pm \Delta C_{L_{\alpha_{TV}}} (54) (M, T)$

★ $\pm \Delta C_{L_{\delta_{e_{TAU}}}} (M, h/b, T) = \pm \left\{ \left[\Delta C_{L_{\delta_{e_{GE_{TV}}}}} (75) (h/b, T) \right]^2 + \left[\Delta C_{L_{\delta_{e_{TV}}}} (120) (M, T) \right]^2 \right\}^{1/2}$

DRAG COEFFICIENT

$$\pm \Delta C_{D_{TAU}} = \pm \left\{ \left[\Delta C_{D_{TV}} \right]^2 + \left[\Delta C_{D_{GE_{TV}}} (70) (h/b, \pm T) \right]^2 \right\}^{1/2}$$

where,

$$\Delta C_{D_{TV}} = \begin{cases} \Delta C_{D_{TV}} (52) (M, T) & [0.25 \leq M \leq 20.0] \\ \Delta C_{D_{TV}} (103) (\bar{V}'_\infty, T) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \end{cases}$$

PITCHING MOMENT COEFFICIENT

$$\pm \Delta C_{m_{TAU}} = \pm \left\{ \left[\Delta C_{m_{TV}} \right]^2 + \left[\Delta C_{m_{GE_{TV}}} (71) (h/b, T) \right]^2 \right\}^{1/2}$$

where,

$$\Delta C_{m_{TV}} = \begin{cases} \Delta C_{m_{TV}} (53) (M, T) & [0.25 \leq M \leq 20.0] \\ \Delta C_{m_{TV}} (104) (\bar{V}'_\infty, \pm T) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \end{cases}$$

★ These terms are to be used only in linearized analyses and are NOT to be added to total values.

★ $\pm \Delta C_{m_{\alpha_{TAU}}}(M, T) = \pm \Delta C_{m_{\alpha_{TV}}}(55)(M, T)$

★ $\pm \Delta C_{m_{\delta_{e_{TAU}}}}(M, h/b, T) = \pm \left\{ [\Delta C_{m_{\delta_{e_{TV}}}}(56)(M, T)]^2 + [\Delta C_{m_{\delta_{e_{GE_{TV}}}}}(76)(h/b, T)]^2 \right\}^{1/2}$

★These terms are to be used only in linearized analyses and are NOT to be added to total values.

LATERAL-DIRECTIONAL CHARACTERISTICS

SIDE FORCE COEFFICIENT

$$\pm \Delta C_{Y_{\beta_{TAU}}} = \pm\left\{\left[\Delta C_{Y_{\beta_{TV}}}\right]^2 + \left[\Delta C_{Y_{\beta_{GE_{TV}}}}\text{(72)}(h/b,\ T)\right]^2\right\}^{1/2}$$

where,

$$\Delta C_{Y_{\beta_{TV}}} = \begin{cases} \Delta C_{Y_{\beta_{TV}}}\text{(57)}(M,\ T) & [0.25 \le M \le 20.0] \\ \Delta C_{Y_{\beta_{TV}}}\text{(136)}(\bar{V}'_{\infty},\ T) & [0.005 \le \bar{V}'_{\infty} \le 0.08] \end{cases}$$

$$\pm \Delta C_{Y_{\delta_{a_{TAU}}}} = \pm \Delta C_{Y_{\delta_{a_{TV}}}}$$

where,

$$\Delta C_{Y_{\delta_{a_{TV}}}} = \begin{cases} \Delta C_{Y_{\delta_{a_{TV}}}}\text{(60)}(M,\ T) & [0.25 \le M \le 20.0] \end{cases}$$

$$\pm \Delta C_{Y_{\delta_{R_{TAU}}}}(M,\ T) = \pm \Delta C_{Y_{\delta_{R_{TV}}}}\text{(63)}(M,\ T)$$

YAWING MOMENT COEFFICIENT

$$\pm \Delta C_{n_{\beta_{TAU}}} = \pm \left\{\left[\Delta C_{n_{\beta_{TV}}}\right]^2 + \left[\Delta C_{n_{\beta_{GE_{TV}}}}\text{(73)}(h/b,\ \pm T)\right]^2\right\}^{1/2}$$

where,

$$\Delta C_{n_{\beta_{TV}}} = \begin{cases} \Delta C_{n_{\beta_{TV}}}\text{(58)}(M,\ T) & [0.25 \le M \le 20.0] \\ \Delta C_{n_{\beta_{TV}}}\text{(137)}(\bar{V}'_{\infty},\ T) & [0.005 \le \bar{V}'_{\infty} \le 0.008] \end{cases}$$

$$\pm \Delta C_{n_{\delta_{a_{TAU}}}} = \pm\left\{\left[\Delta C_{n_{\delta_{a_{TV}}}}\right]^2 + \left[\Delta C_{n_{\delta_{a_{GE_{TV}}}}}\text{(77)}(h/b,\ T)\right]^2\right\}^{1/2}$$

where,

$$\Delta C_{n_{\delta_{a_{TV}}}} = \begin{cases} \Delta C_{n_{\delta_{a_{TV}}}}\text{(61)}(M,\ T) & [0.25 \le M \le 20.0] \end{cases}$$

$$\pm \Delta C_{n_{\delta_{R_{TAU}}}}(M,\ T) = \Delta C_{n_{\delta_{R_{TV}}}}\text{(64)}(M, \pm T)$$

$$\pm C_{n_{o_{TAU}}}(M,\ A) = \pm C_{n_o}\text{(123)}(M,\ A)$$

ROLLING MOMENT COEFFICIENT

$$\pm \Delta C_{\ell_{\beta_{TAU}}} = \pm \left\{ \left[\Delta C_{\ell_{\beta_{TV}}} \right]^2 + \left[\Delta C_{\ell_{\beta_{GE_{TV}}}} (74)(h/b, T) \right]^2 \right\}^{1/2}$$

where,

$$\Delta C_{\ell_{\beta_{TV}}} = \begin{cases} \Delta C_{\ell_{\beta_{TV}}} (59)(M, T) & [0.25 \leq M \leq 20.0] \\ \Delta C_{\ell_{\beta_{TV}}} (138)(\bar{V}'_\infty, T) & [0.005 \leq \bar{V}'_\infty \leq 0.08] \end{cases}$$

$$\pm \Delta C_{\ell_{\delta_{a_{TAU}}}} = \left\{ \left[\Delta C_{\ell_{\delta_{a_{TV}}}} \right]^2 + \left[\Delta C_{\ell_{\delta_{a_{GE_{TV}}}}} (78)(h/b, T) \right]^2 \right\}^{1/2}$$

where,

$$\Delta C_{\ell_{\delta_{a_{TV}}}} = \begin{cases} \Delta C_{\ell_{\delta_{a_{TV}}}} (62)(M, T) & [0.25 \leq M \leq 20.0] \end{cases}$$

$$\pm \Delta C_{\ell_{\delta_{R_{TAU}}}} (M, T) = \Delta C_{\ell_{\delta_{R_{TV}}}} (65)(M, \pm T)$$

$$\pm C_{\ell_{o_{TAU}}} (M, A) = \pm C_{\ell_o} (124)(M, A)$$

NOTE: (1) A = Asymmetry Type = $\begin{cases} 1.0 & \text{Combined Normally with other uncertainties} \\ 2.0 & \text{Combined with nominal } C_{n_\beta} \text{ \& } C_{\ell_\beta} \end{cases}$

$\Delta C_{n_{\beta_{TAU}}}$ & $\Delta C_{\ell_{\beta_{TAU}}}$ are set equal to zero.

(2) Values of $C_{n_{o_{TAU}}}$ & $C_{\ell_{o_{TAU}}}$ are ALWAYS of OPPOSITE sign

Total lateral-directional coefficient uncertainties when considering a single coefficient and assuming no correlation between the sideslip, aileron, and rudder derivative uncertainties of that coefficient:

$$\pm\Delta C_{Y_{TAU}} = \left[\left\{ \Delta C_{Y_{\beta_{TAU}}} \cdot \beta \right\}^2 + \left\{ \Delta C_{Y_{\delta a_{TAU}}} \cdot \delta_a \right\}^2 + \left\{ \Delta C_{Y_{\delta r_{TAU}}} \cdot \delta_r \right\}^2 \right]^{1/2}$$

$$\pm\Delta C_{n_{TAU}} = \left[\left\{ \Delta C_{n_{\beta_{TAU}}} \cdot \beta \right\}^2 + \left\{ \Delta C_{n_{\delta a_{TAU}}} \cdot \delta_a \right\}^2 + \left\{ \Delta C_{n_{\delta r_{TAU}}} \cdot \delta_r \right\}^2 \right]^{1/2} \pm C_{n_{o_{TAU}}}$$

$$\pm\Delta C_{\ell_{TAU}} = \left[\left\{ \Delta C_{\ell_{\beta_{TAU}}} \cdot \beta \right\}^2 + \left\{ \Delta C_{\ell_{\delta a_{TAU}}} \cdot \delta_a \right\}^2 + \left\{ \Delta C_{\ell_{\delta r_{TAU}}} \cdot \delta_r \right\}^2 \right]^{1/2} \mp C_{\ell_{o_{TAU}}}$$

CAUTION APPLICATION OF RUDDER DERIVATIVES MUST BE SUCH THAT CHANGES TO THE SIGN OF THE BASIC DERIVATIVE ARE AVOIDED.

i.e., $C_{Y_{\delta_r}} - \Delta C_{Y_{\delta_r}} \geq 0$

$C_{n_{\delta_r}} + \Delta C_{n_{\delta_r}} \leq 0$

$C_{\ell_{\delta_r}} - \Delta C_{\ell_{\delta_r}} \geq 0$

Note:

Values of $C_{n_{o_{TAU}}}$ & $C_{\ell_{o_{TAU}}}$ are ALWAYS of OPPOSITE sign

A=ASYMMETRY TYPE = { 1.0 COMBINED NORMALLY WITH OTHER UNCERTAINTIES
2.0 COMBINED WITH NOMINAL C_{n_β} & C_{ℓ_β} $\Delta C_{n_{\beta_{TAU}}}$ & $\Delta C_{\ell_{\beta_{TAU}}}$ ARE SET EQUAL TO ZERO

HINGE MOMENT COEFFICIENT

ELEVON

$$\pm \Delta C_{h_{e_{TAU}}}(M, T) = \pm \Delta C_{h_{e_{TV}}}^{(A66)}(M, T)$$

$$\pm \Delta C_{h_{e_{I_{TAU}}}}(M, T) = \pm \Delta C_{h_{e_{O_{TAU}}}}(M, T) = \pm \frac{\Delta C_{h_{e_{TAU}}}^{(A66)}(M, T)}{\sqrt{2}}$$

BODY FLAP

$$\pm \Delta C_{h_{BF_{TAU}}}(M, T) = \Delta C_{h_{BF_{TV}}}^{(A121)}(M, T)$$

SPEED BRAKE/RUDDER

$$\pm \Delta C_{h_{SB_{TAU}}}(M, T) = \pm \Delta C_{h_{SB_{TV}}}^{(A122)}(M, T)$$

$$\pm \Delta C_{h_{SB_{RH_{TAU}}}}(M, T) = \pm \Delta C_{h_{SB_{LH_{TAU}}}}(M, T) = \pm \frac{\Delta C_{h_{SB_{TV}}}^{(A122)}(M, T)}{\sqrt{2}}$$

$$\pm \Delta C_{h_{\beta_{TAU}}}(M, T) = \pm \Delta C_{h_{\beta_{TV}}}^{(A67)}(M, T)$$

$$\pm \Delta C_{h_{\delta_{R_{TAU}}}}(M, T) = \pm \Delta C_{h_{\delta_{R_{TV}}}}^{(A68)}(M, T)$$

$$\pm \Delta C_{h_{R_{TAU}}} = \left\{\left[\Delta C_{h_{\beta_{TAU}}} \cdot \beta\right]^2 + \left[\Delta C_{h_{\delta_{R_{TAU}}}} \cdot \delta_R\right]^2\right\}^{1/2}$$

$$\pm \Delta C_{h_{\beta_{RH_{TAU}}}}(M, T) = \pm \Delta C_{h_{\beta_{LH_{TAU}}}}(M, T) = \pm \frac{\Delta C_{h_{\beta_{TV}}}^{(A67)}(M, T)}{\sqrt{2}}$$

$$\pm \Delta C_{h_{\delta_{R_{RH_{TAU}}}}}(M, T) = \pm \Delta C_{h_{\delta_{R_{LH_{TAU}}}}}(M, T) = \pm \frac{\Delta C_{h_{\delta_{R_{TV}}}}^{(A68)}(M, T)}{\sqrt{2}}$$

$$\pm \Delta C_{h_{R_{RH_{TAU}}}} = \left\{\left[\Delta C_{h_{\beta_{RH_{TAU}}}} \cdot \beta\right]^2 + \left[\Delta C_{h_{\delta_{R_{RH_{TAU}}}}} \cdot \delta_R\right]^2\right\}^{1/2}$$

$$\pm \Delta C_{h_{R_{LH_{TAU}}}} = \left\{\left[\Delta C_{n_{\beta_{LH_{TAU}}}} \cdot \beta\right]^2 + \left[\Delta C_{h_{\delta_{R_{LH_{TAU}}}}} \cdot \delta_R\right]^2\right\}^{1/2}$$

NOTE: T = TYPE = { 1.0 TOLERANCE; 2.0 VARIATION } M = MACH NUMBER

$$\pm \Delta C_{h_{SB/R_{TAU}}} = \left[\left(\Delta C_{h_{SB_{TAU}}} \right)^2 + \left(\Delta C_{h_{R_{TAU}}} \right)^2 \right]^{1/2}$$

$$\pm \Delta C_{h_{SB/R_{RH_{TAU}}}} = \left[\left(\Delta C_{h_{SB_{RH_{TAU}}}} \right)^2 + \left(\Delta C_{h_{R_{RH_{TAU}}}} \right)^2 \right]^{1/2}$$

$$\pm \Delta C_{h_{SB/R_{LH_{TAU}}}} = \left[\left(\Delta C_{h_{SB_{LH_{TAU}}}} \right)^2 + \left(\Delta C_{h_{R_{LH_{TAU}}}} \right)^2 \right]^{1/2}$$

D.2 RCS INTERACTION/IMPINGEMENT.

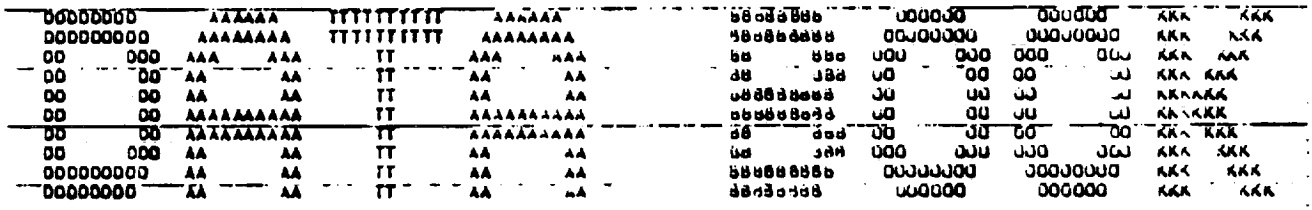
ROCKWELL INTERNATIONAL

SPACE DIVISION

DOWNEY CALIFORNIA

TABULATED OUTPUT FOR

OV102 RCS AERO INTERACTION (OCT.'78 ADDREV. -APR.'79 INCREMENT FORM)



OV102 RCS AERO INTERACTION (OCT.'78 ADDREV.2-APR.'79 INCREMENT FORM)

SUMMARY

DATASET CREATED WITH 175 RECORDS — EACH RECORD CONTAINS 100 WORDS

TOTAL NUMBER OF TABLES = 53 — DATA WRITTEN TO TAPE 12

TOTAL NUMBER OF POINTS = 5514 — LAST RECORD USED IS 153

JOB CARD USED TO CREATE OR CHANGE FILE		TIME OF DAY	DATE
STT111	#G,10,D4V4 DOC	9999999993999	17:11:04 04/05/79

FILE DESCRIPTION

OV102 RCS AERO INTERACTION (OCT.'78 ADDREV. -APR.'79 INCREMENT FORM)

OV102 RCS AERO INTERACTION (OCT.'76 ADDITIVE - JAN.'79 INCREMENT FORM)

TYPE	COEFF*	PROGRAM NAME	TABLUP ARGUMENTS X	Y	Z	W	FILE NUMBER	DATA BOOK REFERENCE**
	$N_{SURF_{TAB}}$	NSID	PINF (PSI)				1	4.1.1.1-103
	$\frac{\partial N}{\partial \delta_e}\|_0$	DNESID	PINF (PSI)	SIGN(DELE)			2	4.1.1.1-106
	$\frac{\partial N}{\partial \delta_{BF}}\|_0$	DNBFSID	PINF (PSI)	SIGN(DELBF)			3	4.1.1.1-107
	$A_{SURF_{TAB}}$	ASID	PINF (PSI)				4	4.1.1.2-104
	$\frac{\partial A}{\partial \delta_e}\|_0$	DAESID	PINF (PSI)				5	4.1.1.2-105
	$\frac{\partial A}{\partial \delta_{BF}}\|_0$	DABFSID	PINF (PSI)				6	4.1.1.2-106
	$N_{SURF_{TAB}}$	NSID	PINF (PSI)				7	4.1.1.3-120
	$\frac{\partial N}{\partial \delta_e}\|_0$	DNESID	PINF (PSI)	SIGN(DELE)			8	4.1.1.3-121
	$\frac{\partial N}{\partial \delta_{BF}}\|_0$	DNBFSID	PINF (PSI)	SIGN(DELBF)			9	4.1.1.3-122
	$Y_{SURF_{TAB}}$	YSID	PINF (PSI)				10	4.2.1.1-135
	$Y_{SURF_{TAB}}$	YSIU	PINF (PSI)				11	4.2.1.1-136
	$\mathcal{M}_{SURF_{TAB}}$	LNSID	PINF (PSI)				12	4.2.1.2-152
	$\mathcal{M}_{SURF_{TAB}}$	LNSIU	PINF (PSI)				13	4.2.1.2-153
	$\mathcal{L}_{SURF_{TAB}}$	LLSID	PINF (PSI)				14	4.2.1.3-164
	$\mathcal{L}_{SURF_{TAB}}$	LLSIU	PINF (PSI)				15	4.2.1.3-165
	$\frac{\partial \mathcal{L}}{\partial \delta_e}\|_0$	DLLESID	PINF (PSI)	SIGN(DELE)			16	4.2.1.3-166
	$\frac{\partial \mathcal{L}}{\partial \delta_{BF}}\|_0$	DLLBFSID	PINF (PSI)	SIGN(DELBF)			17	4.2.1.3-167
	$\Delta C_{N_{JI_0}}$	DCNJID	OJ/OINF	ALPHA (DEG)			18	4.1.1.1-108
	$\Delta C_{N_{JI_0}}$	DCNJIS	MJ/MINF	ALPHA (DEG)			19	4.1.1.1-109
	$\Delta C_{N_{JI_0}}$	DCNJIU	OJ/OINF	ALPHA (DEG)			20	4.1.1.1-110

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 RCS AERO INTERACTION (OCT.'78 ADDENDA JAN.'79 INCREMENT FORM)

TYPE	COEFF*	PROGRAM NAME	FLAGS/ARGUMENTS X	Y	Z	M	FILE NUMBER	DATA BOOK REFERENCE**
	$\Delta C_{N_{\delta_{e_{REF_0}}}}$	OCNEJID OJ/OINF	ALPHA (DEG)	DE REF (DEG)			21	4.1.1.1-[11]>[12]
	$\Delta C_{N_{\delta_{e_{REF_1}}}}$	OCNEJIS MJ/MINF	ALPHA (DEG)	DE REF (DEG)			22	4.1.1.1-[13]>[14]
	$\Delta C_{N_{\delta_{BF_{REF_0}}}}$	OCNBFJID OJ/OINF	ALPHA (DEG)	DBF REF(DEG)			23	4.1.1.1-[15]
	$\Delta C_{N_{DOWN\ FIRING\ CARRYOVER_{JI}}}$	OCNJICO ALPHA (DEG)					24	4.1.1.1-[16]
	$\Delta C_{A_{JI_0}}$	OCAJID OJ/OINF	ALPHA (DEG)				25	4.1.1.2-[07]
	$\Delta C_{A_{JI_1}}$	OCAJIS MJ/MINF	ALPHA (DEG)				26	4.1.1.2-[08]
	$\Delta C_{A_{JI_0}}$	OCAJIU OJ/OINF	ALPHA (DEG)				27	4.1.1.2-[09]
	$\Delta C_{A_{\delta_{e_{REF_0}}}}$	OCAEJID OJ/OINF	ALPHA (DEG)	DE REF (DEG)			28	4.1.1.1-[10]
	$\Delta C_{A_{\delta_{e_{REF_1}}}}$	OCAEJIS MJ/MINF	ALPHA (DEG)	DE REF (DEG)			29	4.1.1.2-[11]>[12]
	$\Delta C_{A_{\delta_{BF_{REF_0}}}}$	OCABFJID OJ/OINF	ALPHA (DEG)	DBF REF(DEG)			30	ZERO FILE
	$\Delta C_{A_{DOWN\ FIRING\ CARRYOVER_{JI}}}$	OCAJICO ALPHA (DEG)					31	4.1.1.2-[13]
	$\Delta C_{m_{JI_0}}$	OCMJID OJ/OINF	ALPHA (DEG)				32	4.1.1.3-[23]
	$\Delta C_{m_{JI_1}}$	OCMJIS MJ/MINF	ALPHA (DEG)				33	4.1.1.3-[24]
	$\Delta C_{m_{JI_0}}$	OCMJIU OJ/OINF	ALPHA (DEG)				34	4.1.1.3-[25]
	$\Delta C_{m_{\delta_{e_{REF}}}}$	OCMEJID OJ/OINF	ALPHA (DEG)	DE REF (DEG)			35	4.1.1.3-[26]>[27]
	$\Delta C_{m_{\delta_{e_{REF}}}}$	OCMEJIS MJ/MINF	ALPHA (DEG)	DE REF (DEG)			36	4.1.1.3-[28]>[29]
	$\Delta C_{m_{\delta_{BF_{REF}}}}$	OCMBFJID OJ/OINF	ALPHA (DEG)	DBF REF(DEG)			37	4.1.1.3-[30]
	$\Delta C_{m_{DOWN\ FIRING\ CARRYOVER_{JI}}}$	OCMJICO ALPHA (DEG)					38	4.1.1.3-[31]
	$\Delta C_{Y_{JI_0}}$	OCYJID OJ/OINF	ALPHA (DEG)				39	4.2.1.1-[37]
	$\Delta C_{Y_{JI_1}}$	OCYJIS MJ/MINF	ALPHA (DEG)				40	4.2.1.1-[38]

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

OV102 RCS AERO INTERACTION (OCIJ.*70 ADDENDUM 2-JAN.*79: INCREMENT FORM)

TYPE	COEFF*	PROGRAM NAME	TRANS ARGUMENTS X	Y	Z	A	FILE NUMBER	DATA BOOK REFERENCE**
	$\Delta C_{Y_{JI_0}}$	DCYJIU	OJ/OINF	ALPHA (DEG)			41	3.2.1.1- 134
	$\Delta C_{n_{JI_0}}$	DCLNJID	OJ/OINF	ALPHA (DEG)			42	3.2.1.2- 135
	$\Delta C_{n_{JI_0}}$	DCLNJIS	MJ/MINF	ALPHA (DEG)			43	3.2.1.2- 135
	$\Delta C_{n_{JI_0}}$	DCLNJIU	OJ/OINF	ALPHA (DEG)			44	3.2.1.2- 136
	$\Delta C_{l_{JI_0}}$	DCLLJID	OJ/OINF	ALPHA (DEG)			45	3.2.1.3- 166
	$\Delta C_{l_{JI_0}}$	DCLLJIS	MJ/MINF	ALPHA (DEG)			46	3.2.1.3- 169
	$\Delta C_{l_{JI_0}}$	DCLLJIU	OJ/OINF	ALPHA (DEG)			47	3.2.1.3- 170
	$\Delta C_{l_{\delta_{ase_0}}}$	DCLLEJID	OJ/OINF	ALPHA (DEG)	δE REF (DEG)		48	3.2.1.3- 171>174
	$\Delta C_{l_{\delta_{ase_0}}}$	DCLLEJIS	MJ/MINF	ALPHA (DEG)	δE REF (DEG)		49	3.2.1.3- 173>174
	$\eta_{(\ )_{JI_{0_T}}}$	DCIMPT	JET GROUP	COEFF. TYPE			50	TABLE 6.6 - 4
	$\Delta C_{(\ )_{JI_{UP_T}}}$	DCJIDP	COEFF. TYPE	ALPHA (DEG)			51	TABLE 6.6 - 1
	$\Delta C_{(\ )_{JISP_T}}$	DCJISP	COEFF. TYPE	ALPHA (DEG)	MJ/MINF		52	TABLE 6.6 - 1
	$\Delta C_{(\ )_{JIUP_T}}$	DCJIUP	COEFF. TYPE	ALPHA (DEG)			53	TABLE 6.6 - 1

* ALL DERIVATIVES ARE PER DEGREE UNLESS OTHERWISE NOTED

** AERO DATA BOOK FIGURES UNLESS OTHERWISE NOTED

RCS FLOW FIELD INTERACTIONS

NORMAL FORCE

$$N_{RCS} = N_{JT} + \left[N_{SURF} + \Delta N_e + \Delta N_{BF}\right]_{IMP} + \bar{q}\, S \left[\Delta C_N + \Delta C_{N_e} + \Delta C_{N_{BF}} + \Delta C_{N_{\substack{DOWN\ FIRING\ CARRYOVER\ 2\ SIDES}}}\right]_{JI}$$

$$N_{JET} = N_{JET_D} \cdot (n_{LH_D} + n_{RH_D}) + N_{JET_S} \cdot (n_{LH_S} + n_{RH_S}) + N_{JET_U} \cdot (n_{LH_U} + n_{RH_U})$$

$$N_{SURF_{IMP}} = \overset{(1)}{N_{SURF_{IMP_D}}}(P_\infty) \cdot \left[(n_{LH_D}) + (n_{RH_D})\right]$$

$$\Delta N_{e_{IMP}} = \left.\frac{\partial N}{\partial \delta_e}\right|_D^{(2)} \left(P_\infty, \mathrm{SIGN}(\delta_{e_L})\right) \cdot \delta_{e_L} \cdot (n_{LH_D}) + \left.\frac{\partial N}{\partial \delta_e}\right|_D^{(2)} \left(P_\infty, \mathrm{SIGN}(\delta_{e_R})\right) \cdot \delta_{e_R} \cdot (n_{RH_D})$$

$$\Delta N_{BF_{IMP}} = \left.\frac{\partial N}{\partial \delta_{BF}}\right|_D^{(3)} \left(P_\infty, \mathrm{SIGN}(\delta_{BF})\right) \cdot \delta_{BF} \cdot \left[(n_{LH_D}) + (n_{RH_D})\right]$$

$$\Delta C_{N_{JI}} = \overset{(18)}{\Delta C_{N_{JI_D}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D}, \alpha\right) + \overset{(18)}{\Delta C_{N_{JI_D}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}, \alpha\right)$$

$$+ K_{JI} \cdot \left[\overset{(19)}{\Delta C_{N_{JI_S}}}\left(\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{LH_S}, \alpha\right) + \overset{(19)}{\Delta C_{N_{JI_S}}}\left(\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{RH_S}, \alpha\right)\right]$$

$$+ \overset{(20)}{\Delta C_{N_{JI_U}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_U}, \alpha\right) + \overset{(20)}{\Delta C_{N_{JI_U}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_U}, \alpha\right)$$

NOTE: n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets
n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$\frac{\phi_J}{\phi_\infty} = \left(\frac{\dot{m}_J V_J}{\bar{q}_\infty A_{REF}}\right)\left(\frac{A_{REF}}{2\, S_{REF}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$$\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D} = 0.1543\left(\frac{n_{LH_D}}{\bar{q}_\infty}\right) \qquad \left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{\bar{q}_\infty}\right)$$

$$\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{\bar{q}_\infty}\right) \qquad \left.\frac{\phi_J}{\phi_\infty}\right|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{\bar{q}_\infty}\right)$$

$$\Delta C_{N_{e_{JI}}} = \Delta C_{N_{\delta e_{REF_D}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D}, \alpha, \delta_{e_{REF_L}}\right) \cdot \left(\frac{\delta_{e_L}}{\delta_{e_{REF_L}}}\right)^{0.75} \quad (21)$$

$$+ \Delta C_{N_{\delta e_{REF_D}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}, \alpha, \delta_{e_{REF_R}}\right) \cdot \left(\frac{\delta_{e_R}}{\delta_{e_{REF_R}}}\right)^{0.75} \quad (21)$$

$$+ K_{JI}\left[\Delta C_{N_{\delta e_{REF_S}}}\left(\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{LH_S}, \alpha, \delta_{e_{REF_L}}\right) \cdot \left(\frac{\delta_{e_L}}{\delta_{e_{REF_L}}}\right)^{0.75} \quad (22)\right.$$

$$\left. + \Delta C_{N_{\delta e_{REF_S}}}\left(\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{RH_S}, \alpha, \delta_{e_{REF_R}}\right) \cdot \left(\frac{\delta_{e_R}}{\delta_{e_{REF_R}}}\right)^{0.75} \quad (22)\right]$$

$$\Delta C_{N_{BF_{JI}}} = \left[\Delta C_{N_{\delta_{BF_{REF_D}}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D}, \alpha, \delta_{BF_{REF}}\right) + \Delta C_{N_{\delta_{BF_{REF_D}}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}, \alpha, \delta_{BF_{REF}}\right) (23)\right] \cdot \left(\frac{\delta_{BF}}{\delta_{BF_{REF}}}\right)^{0.75}$$

$$\Delta C_{N_{\substack{\text{DOWN FIRING CARRYOVER}_{JI} \\ \text{2 SIDES}}}} = \begin{cases} \dfrac{\partial C_{N_{JI_D}}}{\partial(\phi_J/\phi_\infty)}(\alpha) \cdot \dfrac{1}{2}\left(\left.\dfrac{\phi_J}{\phi_\infty}\right|_{LH_D} + \left.\dfrac{\phi_J}{\phi_\infty}\right|_{RH_D}\right) \text{ for } \left.\dfrac{\phi_J}{\phi_\infty}\right|_{LH_D} > 0 \quad (24) \\ \qquad\qquad \underline{\text{and}} \quad \left.\dfrac{\phi_J}{\phi_\infty}\right|_{RH_D} > 0 \\ 0 \quad \text{for } \left.\dfrac{\phi_J}{\phi_\infty}\right|_{LH_D} = 0 \quad \underline{\text{or}} \quad \left.\dfrac{\phi_J}{\phi_\infty}\right|_{RH_D} = 0 \end{cases}$$

NOTE: $\frac{\dot{m}_J}{\dot{m}_\infty} = \frac{1}{\gamma}\left(\frac{\phi_J}{\phi_\infty}\right)\left(\frac{V_\infty}{V_J}\right)(\sin\theta_J)^{1/2} = 3.296 \times 10^{-4}\left(\frac{V_\infty}{a_\infty}\right)$

$\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{LH_S} = 3.296 \times 10^{-4}\left(\frac{V_\infty}{a_\infty}\right)$ $\qquad$ $\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{RH_S} = 3.296 \times 10^{-4}\left(\frac{V_\infty}{a_\infty}\right)$

$0 < \frac{1}{2}\left[\left(\frac{\phi_J}{\phi_\infty}\right)_{LH_D} + \left(\frac{\phi_J}{\phi_\infty}\right)_{RH_D}\right] \leq 0.03$

$\delta_{e_{REF_{L,R}}} = \begin{cases} -30 \text{ for } \delta_{e_{L,R}} \leq 0° \\ -10 \text{ for } \delta_{e_{L,R}} > 0° \end{cases}$ $\qquad$ $\delta_{BF_{REF}} = \begin{cases} -14.25 \text{ for } \delta_{BF} \leq 0° \\ +16.30 \text{ for } \delta_{BF} > 0° \end{cases}$

AXIAL FORCE

$$A_{RCS} = A_{JT} + [A_{SURF} + \Delta A_e + \Delta A_{BF}]_{IMP} + \bar{q}\, S[\Delta C_A + \Delta C_{A_e} + \overset{0}{\Delta C_{A_{BF}}} + \Delta C_{A_{\substack{\text{DOWN FIRING} \\ \text{CARRYOVER} \\ \text{2 SIDES}}}}]_{JI}$$

$$A_{JT} = A_{JET_D} \cdot (n_{LH_D} + n_{RH_D}) + \overset{0}{A_{JET_S}} \cdot (n_{LH_S} + n_{RH_S}) + \overset{0}{A_{JET_U}} \cdot (n_{LH_U} + n_{RH_U})$$

$$A_{SURF_{IMP}} = \overset{(4)}{A_{SURF_{IMP_D}}}(P_\infty) \cdot [(n_{LH_D}) + (n_{RH_D})]$$

$$\Delta A_{e_{IMP}} = \left.\overset{(5)}{\frac{\partial A}{\partial \delta_e}}\right|_D (P_\infty) \cdot \delta_{e_L} \cdot (n_{LH_D}) + \left.\overset{(5)}{\frac{\delta_A}{\partial \delta_e}}\right|_D (P_\infty) \cdot \delta_{e_R} \cdot (n_{RH_D})$$

$$\Delta A_{BF_{IMP}} = \left.\overset{(6)}{\frac{\partial A}{\partial \delta_{BF}}}\right|_D (P_\infty) \cdot \delta_{BF} \cdot [(n_{LH_D}) + (n_{RH_D})]$$

$$\Delta C_{A_{JI}} = \overset{(25)}{\Delta C_{A_{JI_D}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D}, \alpha\right) + \overset{(25)}{\Delta C_{A_{JI_D}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}, \alpha\right) + K_{JI} \cdot \left[\overset{(26)}{\Delta C_{A_{JI_S}}}\left(\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{LH_S}, \alpha\right)\right.$$

$$\left. + \overset{(26)}{\Delta C_{A_{JI_S}}}\left(\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{RH_S}, \alpha\right)\right] + \overset{(27)}{\Delta C_{A_{JI_U}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_U}, \alpha\right) + \overset{(27)}{\Delta C_{A_{JI_U}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_U}, \alpha\right)$$

$$\Delta C_{A_{e_{JI}}} = \overset{(28)}{\Delta C_{A_{\delta_{e_{REF_D}}}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D}, \alpha, \delta_{e_{REF_L}}\right) \cdot \left(\frac{\delta_{e_L}}{\delta_{e_{REF_L}}}\right)^{0.75}$$

$$+ \overset{(28)}{\Delta C_{A_{\delta_{e_{REF_D}}}}}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}, \alpha, \delta_{e_{REF_R}}\right) \cdot \left(\frac{\delta_{e_R}}{\delta_{e_{REF_R}}}\right)^{0.75}$$

$$+ K_{JI} \cdot \left[\Delta C_{A_{\delta e_{REF_S}}} \left(\frac{\dot{m}_j}{\dot{m}_\infty}\Big|_{LH_S}, \alpha, \delta_{e_{REF_L}} \right) \cdot \left(\frac{\delta_{e_L}}{\delta_{e_{REF_L}}} \right)^{0.75} \right.$$

$$\left. + \Delta C_{A_{\delta e_{REF_S}}} \left(\frac{\dot{m}_J}{\dot{m}_\infty}\Big|_{RH_S}, \alpha, \delta_{e_{REF_R}} \right) \cdot \left(\frac{\delta_{e_R}}{\delta_{e_{REF_R}}} \right)^{0.75} \right]$$

$$\Delta C^{0}_{A_{BF_{JI}}} = \left[\Delta C^{0}_{A_{\delta_{BF_{REF_D}}}} \left(\frac{\phi_J}{\phi_\infty}\Big|_{LH_D}, \alpha, \delta_{BF_{REF}} \right) + \Delta C^{0}_{A_{\delta_{BF_{REF_D}}}} \left(\frac{\phi_J}{\phi_\infty}\Big|_{RH_D}, \alpha, \delta_{BF_{REF}} \right) \right] \left(\frac{\delta_{BF}}{\delta_{BF_{REF}}} \right)^{0.75}$$

$$\Delta C_{\substack{A_{DOWN} \\ FIRING \\ CARRYOVER \\ 2\ SIDES}_{JI}} = \begin{cases} \dfrac{\partial C_{A_{JI_D}}}{\partial(\phi_J/\phi_\infty)}(\alpha) \cdot \dfrac{1}{2}\left(\dfrac{\phi_J}{\phi_\infty}\Big|_{LH_D} + \dfrac{\phi_J}{\phi_\infty}\Big|_{RH_D} \right) & \text{for } \dfrac{\phi_J}{\phi_\infty}\Big|_{LH_D} > 0 \text{ and } \dfrac{\phi_J}{\phi_\infty}\Big|_{RH_D} > 0 \\ 0 & \text{for } \dfrac{\phi_J}{\phi_\infty}\Big|_{LH_D} = 0 \text{ or } \dfrac{\phi_J}{\phi_\infty}\Big|_{RH_D} = 0 \end{cases}$$

NOTE: n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$0 < \frac{1}{2}\left[\left(\frac{\phi_J}{\phi_\infty} \right)_{LH_D} + \left(\frac{\phi_J}{\phi_\infty} \right)_{RH_D} \right] \leq 0.03$$

$$\frac{\phi_J}{\phi_\infty} = \left(\frac{\dot{m}_j V_j}{q_\infty A_{REF}} \right)\left(\frac{A_{REF}}{2\, S_{REF}} \right) n = 0.1543 \left(\frac{n}{q_\infty} \right)$$

$$\delta_{e_{REF_{L,R}}} = \begin{cases} -30 & \text{for } \delta_{e_{L,R}} \leq 0° \\ +10 & \text{for } \delta_{e_{L,R}} > 0° \end{cases}$$

$$\frac{\phi_J}{\phi_\infty}\Big|_{LH_D} = 0.1543 \left(\frac{n_{LH_D}}{q_\infty} \right) \qquad \frac{\phi_J}{\phi_\infty}\Big|_{RH_D} = 0.1543 \left(\frac{n_{RH_D}}{q_\infty} \right)$$

$$\frac{\phi_J}{\phi_\infty}\Big|_{LH_U} = 0.1543 \left(\frac{n_{LH_U}}{q_\infty} \right) \qquad \frac{\phi_J}{\phi_\infty}\Big|_{RH_U} = 0.1543 \left(\frac{n_{RH_U}}{q_\infty} \right)$$

$$\delta_{BF_{REF}} = \begin{cases} -14.25 & \text{for } \delta_{BF} \leq 0° \\ +16.30 & \text{for } \delta_{BF} > 0° \end{cases}$$

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \frac{1}{n}\left(\frac{\phi_J}{\phi_\infty} \right)\left(\frac{V_\infty}{V_j} \right)(\sin\theta_j)^{1/2} = 8.296 \times 10^{-6}\left(\frac{V_\infty}{q_\infty} \right) \qquad K_{JI} = 1$$

$$\frac{\dot{m}_j}{\dot{m}_\infty}\Big|_{LH_S} = 8.296 \times 10^{-6}\left(\frac{V_\infty}{q_\infty} \right) \qquad \frac{\dot{m}_j}{\dot{m}_\infty}\Big|_{RH_S} = 8.296 \times 10^{-6}\left(\frac{V_\infty}{q_\infty} \right)$$

PITCHING MOMENT

$$M_{RCS} = M_{JT} + \left[M_{SURF} + \Delta M_e + \Delta M_{BF}\right]_{IMP} + \bar{q}\, S\bar{c}\left[\Delta C_m + \Delta C_{m_e} + \Delta C_{m_{BF}} + \Delta C_{m_{\substack{\text{DOWN FIRING CARRYOVER 2 SIDES}}}}\right]_{JI}$$

$$M_{JT} = M_{JET_D}(n_{LH_D} + n_{RH_D}) + M_{JET_S} \cdot (n_{LH_S} + n_{RH_S}) + M_{JET_U} \cdot (n_{LH_U} + n_{RH_U})$$

$$M_{SURF_{IMP}} = \overset{(7)}{M_{SURF_{IMP_D}}}(P_\infty) \cdot \left[(n_{LH_D}) + (n_{RH_D})\right]$$

$$\Delta M_{e_{IMP}} = \left.\frac{\partial M}{\partial \delta_e}\right|_D^{(8)} \left(P_\infty, \text{SIGN}\,(\delta_{e_L})\right) \cdot \delta_{e_L} \cdot (n_{LH_D})$$

$$+ \left.\frac{\partial M}{\partial \delta_e}\right|_D^{(8)} \left(P_\infty, \text{SIGN}\,(\delta_{e_R})\right) \cdot \delta_{e_R} \cdot (n_{RH_D})$$

$$\Delta M_{BF_{IMP}} = \left.\frac{\partial M}{\partial \delta_{BF}}\right|_D^{(9)} \left(P_\infty, \text{SIGN}\,(\delta_{BF})\right) \cdot \delta_{BF} \cdot \left[(n_{LH_D}) + (n_{RH_D})\right]$$

$$\Delta C_{m_{JI}} = \Delta C_{m_{JI_D}}^{(32)}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D}, \alpha\right) + \Delta C_{m_{JI_D}}^{(32)}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}, \alpha\right) + K_{JI} \cdot \left[\Delta C_{m_{JI_S}}^{(33)}\left(\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{LH_S}, \alpha\right)\right.$$

$$\left. + \Delta C_{m_{JI_S}}^{(33)}\left(\left.\frac{\dot{m}_J}{\dot{m}_\infty}\right|_{RH_S}, \alpha\right)\right] + \Delta C_{m_{JI_U}}^{(34)}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_U}, \alpha\right) + \Delta C_{m_{JI_U}}^{(34)}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_U}, \alpha\right)$$

NOTE: n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$\frac{\phi_i}{\phi_\infty} = \left(\frac{\dot{m}_i V_i}{\bar{q}_\infty A_{exp}}\right)\left(\frac{A_{exp}}{2\,S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right) \qquad \frac{\dot{m}_i}{\dot{m}_\infty} = \frac{1}{n}\left(\frac{\phi_i}{\phi_\infty}\right)\left(\frac{V_\infty}{V_j}\right)(\text{SIN}\,\theta_i)^{1/2} = 8.296\times10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$$

$$\left.\frac{\phi_i}{\phi_\infty}\right|_{LH_D} = 0.1543\left(\frac{n_{LH_D}}{\bar{q}_\infty}\right) \qquad \left.\frac{\phi_i}{\phi_\infty}\right|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{\bar{q}_\infty}\right) \qquad \left.\frac{\dot{m}_i}{\dot{m}_\infty}\right|_{LH_S} = 8.296\times10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right) \qquad \left.\frac{\dot{m}_i}{\dot{m}_\infty}\right|_{RH_S} = 8.296\times10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$$

$$\left.\frac{\phi_i}{\phi_\infty}\right|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{\bar{q}_\infty}\right) \qquad \left.\frac{\phi_i}{\phi_\infty}\right|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{\bar{q}_\infty}\right) \qquad K_{JI} = 1$$

$$\Delta C_{m_{e_{JI}}} = \Delta C_{m_{\delta_{e_{REF_D}}}}^{(35)}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D}, \alpha, \delta_{e_{REF_L}}\right)\cdot\left(\frac{\delta_{e_L}}{\delta_{e_{REF_L}}}\right)^{0.75} + \Delta C_{m_{\delta_{e_{REF}}}}^{(35)}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}, \alpha, \delta_{e_{REF_R}}\right)\cdot\left(\frac{\delta_{e_R}}{\delta_{e_{REF_R}}}\right)^{0.75}$$

$$+ K_{JI}\left[\Delta C_{m_{\delta_{e_{REF_S}}}}^{(36)}\left(\left.\frac{\dot m_J}{\dot m_\infty}\right|_{LH_S}, \alpha, \delta_{e_{REF_L}}\right)\cdot\left(\frac{\delta_{e_L}}{\delta_{e_{REF_L}}}\right)^{0.75} + \Delta C_{m_{\delta_{e_{REF_S}}}}^{(36)}\left(\left.\frac{\dot m_J}{\dot m_\infty}\right|_{RH_S}, \alpha, \delta_{e_{REF_R}}\right)\cdot\left(\frac{\delta_{e_R}}{\delta_{e_{REF_R}}}\right)^{0.75}\right]$$

$$\Delta C_{m_{BF_{JI}}} = \left[\Delta C_{m_{\delta_{BF_{REF_D}}}}^{(37)}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D}, \alpha, \delta_{BF_{REF}}\right) + \Delta C_{m_{\delta_{BF_{REF_D}}}}^{(37)}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}, \alpha, \delta_{BF_{REF}}\right)\right]\cdot\left(\frac{\delta_{BF}}{\delta_{BF_{REF}}}\right)^{0.75}$$

$$\Delta C_{m_{\substack{\text{DOWN FIRING}\\ \text{CARRYOVER}\\ \text{2 SIDES}}_{JI}}} = \begin{cases} \dfrac{\partial C_{m_{JI_D}}^{(38)}}{\partial\left(\frac{c_1}{\phi_\infty}\right)}(\alpha)\cdot\frac{1}{2}\left(\left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D} + \left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D}\right) & \text{for } \left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D} > 0 \ \underline{\text{and}}\ \left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D} > 0 \\ 0 & \text{for } \left.\frac{\phi_J}{\phi_\infty}\right|_{LH_D} = 0 \ \underline{\text{or}}\ \left.\frac{\phi_J}{\phi_\infty}\right|_{RH_D} = 0 \end{cases}$$

NOTE:

$\delta_{LG} = \begin{cases} 0.0 \text{ LANDING GEAR UP} \\ 1.0 \text{ LANDING GEAR DOWN} \end{cases}$ Tape does not include gear extension.

$$0 < \frac{1}{2}\left[\left(\frac{\phi_J}{\phi_\infty}\right)_{LH_D} + \left(\frac{\phi_J}{\phi_\infty}\right)_{RH_D}\right] \le 0.03$$

$\delta_e = \frac{1}{2}(\delta_{e_1} + \delta_{e_0}) = \frac{1}{2}(\delta_{e_L} + \delta_{e_R})$

$\delta_{e_1} = \frac{1}{2}(\delta_{e_{1_L}} + \delta_{e_{1_R}})$

$\delta_{e_0} = \frac{1}{2}(\delta_{e_{0_L}} + \delta_{e_{0_R}})$

$\delta_{e_L} = \delta_e + \delta_a = \frac{1}{2}(\delta_{e_{1_L}} + \delta_{e_{0_L}})$

$\delta_{e_R} = \delta_e - \delta_a = \frac{1}{2}(\delta_{e_{1_R}} - \delta_{e_{0_R}})$

$\delta_a = \frac{1}{2}(\delta_{e_L} - \delta_{e_R})$

$\bar q = \frac{q\bar c}{2V_0}$ with $\begin{cases} q = \text{pitch rate, rad/sec} \\ \bar c = \text{MAC} = 39.567 \text{ ft} \\ V_0 = \text{Speed, ft/sec} \end{cases}$

CONVERSION TO BODY AXIS SYSTEM

$C_N = -C_L\cdot\cos(\alpha) + C_D\cdot\sin(\alpha)$

$C_A = C_D\cdot\cos(\alpha) - C_L\cdot\sin(\alpha)$

MOMENT TRANSFER

$$C_m\left[X_{CG_{NEW}}^{(in)}, Z_{CG_{NEW}}^{(in)}\right] = C_m\left[X_{CG}^{1076.71}, Z_{CG}^{375.01}\right] + \left[\frac{X_{CG(in)} - 1076.7}{\bar c}\right]\cdot C_N - \left[\frac{Z_{CG(in)} - 375.0}{\bar c}\right]\cdot C_A$$

where, $\bar c$ = MAC = 474.8 in

SIDE FORCE

$$Y_{RCS} = Y_{JT} + \left[Y_{SURF} + \overset{0}{\cancel{\Delta Y_e}} + \overset{0}{\cancel{\Delta Y_{BF}}}\right]_{IMP} + \bar{q}\, S \left[\Delta C_Y + \overset{0}{\cancel{\Delta C_{Y_e}}} + \overset{0}{\cancel{\Delta C_{Y_{BF}}}} + \overset{0}{\cancel{\Delta C_{Y_{DOWN\ FIRING\ CARRYOVER\ 2\ SIDES}}}}\right]_{JI}$$

$$Y_{JT} = Y_{JET_D}(n_{LH_D} - n_{RH_D}) + Y_{JET_S}(n_{LH_S} - n_{RH_S}) + Y_{JET_U}(n_{LH_U} - n_{RH_U})$$

$$Y_{SURF_{IMP}} = Y_{SURF_{IMP_D}}(P_\infty)\left[(n_{LH_D}) - (n_{RH_D})\right] + Y_{SURF_{IMP_U}}(P_\infty)\cdot\left[(n_{LH_U}) - (n_{RH_U})\right]$$

$$\Delta C_{Y_{JI}} = \Delta C_{Y_{JI_D}}\left(\frac{\phi_J}{\phi_\infty}\bigg|_{LH_D}, \alpha\right) - \Delta C_{Y_{JI_D}}\left(\frac{\phi_J}{\phi_\infty}\bigg|_{RH_D}, \alpha\right)$$

$$+K_{JI}\cdot\left[\Delta C_{Y_{JI_S}}\left(\frac{\dot{m}_J}{\dot{m}_\infty}\bigg|_{LH_S}, \alpha\right) - \Delta C_{Y_{JI_S}}\left(\frac{\dot{m}_J}{\dot{m}_\infty}\bigg|_{RH_S}, \alpha\right)\right]$$

$$+\Delta C_{Y_{JI_U}}\left(\frac{\phi_J}{\phi_\infty}\bigg|_{LH_U}, \alpha\right) - \Delta C_{Y_{JI_U}}\left(\frac{\phi_J}{\phi_\infty}\bigg|_{RH_U}, \alpha\right)$$

NOTE: n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$\frac{\phi_i}{\phi_\infty} = \left(\frac{\dot{m}_i V_i}{\bar{q}_\infty A_{REF}}\right)\left(\frac{A_{REF}}{2\,S_{REF}}\right)\sin\theta_i = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$$\frac{\phi_i}{\phi_\infty}\bigg|_{LH_D} = 0.1543\left(\frac{n_{LH_D}}{\bar{q}_\infty}\right) \qquad \frac{\phi_i}{\phi_\infty}\bigg|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{\bar{q}_\infty}\right)$$

$$\frac{\phi_i}{\phi_\infty}\bigg|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{\bar{q}_\infty}\right) \qquad \frac{\phi_i}{\phi_\infty}\bigg|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{\bar{q}_\infty}\right)$$

$$\frac{\dot{m}_i}{\dot{m}_\infty} = \frac{1}{n}\left(\frac{\phi_i}{\phi_\infty}\right)\left(\frac{V_\infty}{V_{j_i}}\right)(\sin\theta_i)^{1/2} = 8.296\times10^{-6}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$$

$$\frac{\dot{m}_i}{\dot{m}_\infty}\bigg|_{LH_S} = 8.296\times10^{-6}\left(\frac{V_\infty}{\bar{q}_\infty}\right) \qquad \frac{\dot{m}_i}{\dot{m}_\infty}\bigg|_{RH_S} = 8.296\times10^{-6}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$$

$$\delta_{e_{REF_{1,2}}} = \begin{cases} -30 & \text{for } \delta_{e_{1,2}} \le 0° \\ -10 & \text{for } \delta_{e_{1,2}} > 0° \end{cases} \qquad \delta_{SF_{REF}} = \begin{cases} -14.25 & \text{for } \delta_{SF} \le 0° \\ -16.30 & \text{for } \delta_{SF} > 0° \end{cases}$$

$K_{JI} = 1$

YAWING MOMENT

$$\mathcal{N}_{RCS} = \mathcal{N}_{JT} + \left[\mathcal{N}_{SURF} + \Delta\mathcal{N}_{\theta}^{0} + \Delta\mathcal{N}_{BF}^{0}\right]_{IMP} + \bar{q}Sb\left[\Delta C_n + \Delta C_{n_{\theta}}^{0} + \Delta C_{n_{BF}}^{0} + \Delta C_{n_{DOWN\ FIRING\ CARRYOVER\ 2\ SIDES}}^{0}\right]_{JI}$$

$$\mathcal{N}_{JT} = \mathcal{N}_{JET_D} \cdot (n_{LH_D} - n_{RH_D}) + \mathcal{N}_{JET_S} \cdot (n_{LH_S} - n_{RH_S}) + \mathcal{N}_{JET_U} \cdot (n_{LH_U} - n_{RH_U})$$

$$\mathcal{N}_{SURF_{IMP}} = \mathcal{N}_{SURF_{IMP_D}}^{(12)}(P_{\infty}) \cdot \left[(n_{LH_D}) - (n_{RH_D})\right] + \mathcal{N}_{SURF_{IMP_U}}^{(13)}(P_{\infty}) \cdot \left[(n_{LH_U}) - (n_{RH_U})\right]$$

$$\Delta C_{n_{JI}} = \Delta C_{n_{JI_D}}^{(42)}\left(\frac{\phi_J}{\phi_{\infty}}\bigg|_{LH_D}, \alpha\right) - \Delta C_{n_{JI_D}}^{(42)}\left(\frac{\phi_J}{\phi_{\infty}}\bigg|_{RH_D}, \alpha\right)$$

$$+ K_{JI}\left[\Delta C_{n_{JI_S}}^{(43)}\left(\frac{\dot{m}_J}{\dot{m}_{\infty}}\bigg|_{LH_S}, \alpha\right) - \Delta C_{n_{JI_S}}^{(43)}\left(\frac{\dot{m}_J}{\dot{m}_{\infty}}\bigg|_{RH_S}, \alpha\right)\right]$$

$$+ \Delta C_{n_{JI_U}}^{(44)}\left(\frac{\phi_J}{\phi_{\infty}}\bigg|_{LH_U}, \alpha\right) - \Delta C_{n_{JI_U}}^{(44)}\left(\frac{\phi_J}{\phi_{\infty}}\bigg|_{RH_U}, \alpha\right)$$

NOTE: n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$\frac{\phi_J}{\phi_{\infty}} = \left(\frac{\dot{m}_J V_J}{\bar{q}_{\infty} A_{REF}}\right)\left(\frac{A_{REF}}{2\,S_{REF}}\right)n = 0.1543\left(\frac{n}{\bar{q}_{\infty}}\right)$$

$$\frac{\phi_J}{\phi_{\infty}}\bigg|_{LH_D} = 0.1543\left(\frac{n_{LH_D}}{\bar{q}_{\infty}}\right) \qquad \frac{\phi_J}{\phi_{\infty}}\bigg|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{\bar{q}_{\infty}}\right)$$

$$\frac{\phi_J}{\phi_{\infty}}\bigg|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{\bar{q}_{\infty}}\right) \qquad \frac{\phi_J}{\phi_{\infty}}\bigg|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{\bar{q}_{\infty}}\right)$$

$$\frac{\dot{m}_J}{\dot{m}_{\infty}} = \frac{1}{\gamma}\left(\frac{\phi_J}{\phi_{\infty}}\right)\left(\frac{V_{\infty}}{V_J}\right)(\sin\theta_J)^{1/2} = 8.296\times10^{-4}\left(\frac{V_{\infty}}{\bar{q}_{\infty}}\right)$$

$$\frac{\dot{m}_J}{\dot{m}_{\infty}}\bigg|_{LH_S} = 8.296\times10^{-4}\left(\frac{V_{\infty}}{\bar{q}_{\infty}}\right) \qquad \frac{\dot{m}_J}{\dot{m}_{\infty}}\bigg|_{RH_S} = 8.296\times10^{-4}\left(\frac{V_{\infty}}{\bar{q}_{\infty}}\right)$$

$$\delta_{e_{REF,R}} = \begin{cases} -30 & \text{for } \delta_{e_{L,R}} \le 0° \\ -10 & \text{for } \delta_{e_{L,R}} > 0° \end{cases} \qquad \delta_{sp_{REF}} = \begin{cases} -14.25 & \text{for } \delta_{sp} \le 0° \\ -16.30 & \text{for } \delta_{sp} > 0° \end{cases}$$

$K_{JI} = 1$

ROLLING MOMENT

$$\mathscr{L}_{RCS} = \mathscr{L}_{JT} + \left[\mathscr{L}_{SURF} + \Delta\mathscr{L}_{e} + \Delta\mathscr{L}_{BF}\right]_{IMP} + \bar{q}Sb\left[\Delta C_{\ell} + \Delta C_{\ell_e} + \overset{0}{\Delta C_{\ell_{BF}}} + \overset{0}{\Delta C_{\ell_{\substack{\text{DOWN FIRING}\\ \text{CARRYOVER}\\ \text{2 SIDES}}}}}\right]_{JI}$$

$$\mathscr{L}_{JT} = \mathscr{L}_{JET_D}\cdot(n_{LH_D} - n_{RH_D}) + \mathscr{L}_{JET_S}\cdot(n_{LH_S} - n_{RH_S}) + \mathscr{L}_{JET_U}\cdot(n_{LH_U} - n_{RH_U})$$

$$\mathscr{L}_{SURF_{IMP}} = \mathscr{L}^{(14)}_{SURF_{IMP_D}}(P_\infty)\cdot\left[(n_{LH_D}) - (n_{RH_D})\right] + \mathscr{L}^{(15)}_{SURF_{IMP_U}}(P_\infty)\cdot\left[(n_{LH_U}) - (n_{RH_U})\right]$$

$$\Delta\mathscr{L}_{e_{IMP}} = \left.\frac{\partial\mathscr{L}^{(16)}}{\partial\delta_e}\right|_0\left[P_\infty, \text{sign}(\delta_{e_L})\right]\cdot\delta_{e_L}\cdot(n_{LH_D}) - \left.\frac{\partial\mathscr{L}^{(16)}}{\partial\delta_e}\right|_0\left[P_\infty, \text{sign}(\delta_{e_R})\right]\cdot\delta_{e_R}\cdot(n_{RH_D})$$

$$\Delta\mathscr{L}_{BF_{IMP}} = \left.\frac{\partial\mathscr{L}^{(17)}}{\partial\delta_{BF}}\right|_0\left[P_\infty, \text{sign}(\delta_{BF})\right]\cdot\delta_{BF}\cdot\left[(n_{LH_D}) - (n_{RH_D})\right]$$

$$\Delta C_{\ell_{JI}} = \Delta C^{(45)}_{\ell_{JI_D}}\left(\left.\frac{\phi_j}{\phi_\infty}\right|_{LH_D}, \alpha\right) - \Delta C^{(45)}_{\ell_{JI_D}}\left(\left.\frac{\phi_j}{\phi_\infty}\right|_{RH_D}, \alpha\right)$$

$$+ K_{JI}\cdot\left[\Delta C^{(46)}_{\ell_{JI_S}}\left(\left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{LH_S}, \alpha\right) - \Delta C^{(46)}_{\ell_{JI_S}}\left(\left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{RH_S}, \alpha\right)\right]$$

$$+ \Delta C^{(47)}_{\ell_{JI_U}}\left(\left.\frac{\phi_j}{\phi_\infty}\right|_{LH_U}, \alpha\right) - \Delta C^{(47)}_{\ell_{JI_U}}\left(\left.\frac{\phi_j}{\phi_\infty}\right|_{RH_U}, \alpha\right)$$

NOTE: n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \frac{1}{n}\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{V_{j_\infty}}{V_j}\right)(\text{SIN}\,\theta_j)^{1/2} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right)$$

$$\left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{LH_S} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right) \qquad \left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{RH_S} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right)$$

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j V_j}{\bar{q}_\infty A_{eff}}\right)\left(\frac{A_{eff}}{2\,S_{exp}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$$\delta_{e_{EXP_{L,R}}} = \begin{cases} -30 & \text{for } \delta_{e_{L,R}} \le 0° \\ +10 & \text{for } \delta_{e_{L,R}} > 0° \end{cases} \qquad \delta_{BF_{EXP}} = \begin{cases} -14.25 & \text{for } \delta_{BF} \le 0° \\ -16.30 & \text{for } \delta_{BF} > 0° \end{cases}$$

$$\left.\frac{\phi_j}{\phi_\infty}\right|_{LH_D} = 0.1543\left(\frac{n_{LH_D}}{\bar{q}_\infty}\right) \qquad \left.\frac{\phi_j}{\phi_\infty}\right|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{\bar{q}_\infty}\right)$$

$$\left.\frac{\phi_j}{\phi_\infty}\right|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{\bar{q}_\infty}\right) \qquad \left.\frac{\phi_j}{\phi_\infty}\right|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{\bar{q}_\infty}\right) \qquad K_{JI} = 1$$

$$\Delta C_{\ell_{e_{JI}}} = \Delta C_{\ell_{\delta_{e_{ref_D}}}}^{(48)} \left(\frac{\phi_J}{\phi_\infty}\bigg|_{LH_D}, \alpha, \delta_{e_{ref_L}} \right) \cdot \left(\frac{\delta_{e_L}}{\delta_{e_{ref_L}}} \right)^{0.75}$$

$$- \Delta C_{\ell_{\delta_{e_{ref_D}}}}^{(48)} \left(\frac{\phi_J}{\phi_\infty}\bigg|_{RH_D}, \alpha, \delta_{e_{ref_R}} \right) \cdot \left(\frac{\delta_{e_R}}{\delta_{e_{ref_R}}} \right)^{0.75}$$

$$+ K_{JI} \left[\Delta C_{\ell_{\delta_{e_{ref_S}}}}^{(49)} \left(\frac{\dot{m}_J}{\dot{m}_\infty}\bigg|_{LH_S}, \alpha, \delta_{e_{ref_L}} \right) \cdot \left(\frac{\delta_{e_L}}{\delta_{e_{ref_L}}} \right)^{0.75} \right.$$

$$\left. - \Delta C_{\ell_{\delta_{e_{ref_S}}}}^{(49)} \left(\frac{\dot{m}_J}{\dot{m}_\infty}\bigg|_{RH_S}, \alpha, \delta_{e_{ref_R}} \right) \cdot \left(\frac{\delta_{e_R}}{\delta_{e_{ref_R}}} \right)^{0.75} \right]$$

NOTE: n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j V_j}{3_{-} A_{exp}}\right)\left(\frac{A_{exp}}{2\, S_{ref}}\right) n = 0.1543\left(\frac{n}{q_\infty}\right)$$

$$\frac{\phi_j}{\phi_\infty}\bigg|_{LH_D} = 0.1543\left(\frac{n_{LH_D}}{q_\infty}\right) \qquad \frac{\phi_j}{\phi_\infty}\bigg|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{q_\infty}\right)$$

$$\frac{\phi_j}{\phi_\infty}\bigg|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{q_\infty}\right) \qquad \frac{\phi_j}{\phi_\infty}\bigg|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{q_\infty}\right)$$

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \frac{1}{n}\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{V_\infty}{V_j}\right)(\sin\theta_j)^{1/2} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right)$$

$$\frac{\dot{m}_j}{\dot{m}_\infty}\bigg|_{LH_S} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right) \qquad \frac{\dot{m}_j}{\dot{m}_\infty}\bigg|_{RH_S} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right)$$

$$\delta_{e_{ref_{L,R}}} = \begin{cases} -30 & \text{for } \delta_{e_{L,R}} \le 0° \\ +10 & \text{for } \delta_{e_{L,R}} > 0° \end{cases} \qquad \delta_{e_{ref_S}} = \begin{cases} -14.25 & \text{for } \delta_{e_S} \le 0° \\ +16.30 & \text{for } \delta_{e_S} > 0° \end{cases}$$

$K_{JI} = 1$

NORMAL FORCE UNCERTAINTIES

$$\Delta N_U = \left\{ \left[\left(K_{U_L} + K_{U_R} \right) \left(\Delta C_{N_U} \right)^2 + \left(K_{S_L} + K_{S_R} \right) \left(\Delta C_{N_S} \right)^2 + \left(K_{D_L} + K_{D_R} \right) \left(\Delta C_{N_D} \right)^2 \right] (\bar{q} S)^2 + \left(N_{L_U} + N_{R_U} \right)^2 K_{N_U}^2 + \left(N_{L_S} + N_{R_S} \right)^2 K_{N_S}^2 + \left(N_{L_D} + N_{R_D} \right)^2 K_{N_D}^2 \right\}^{1/2}$$

where,

$$\left.\begin{matrix} K_{U_L} \\ K_{U_R} \\ K_{S_L} \\ K_{S_R} \\ K_{D_L} \\ K_{D_R} \end{matrix}\right\} = \begin{matrix} 0.0, & n_{[\,]} = 0 \\ 1.0, & n_{[\,]} > 0 \end{matrix}$$

$\left\{\begin{matrix} n_{L_D} = \text{Number of operating left-hand down firing jets} \\ n_{L_S} = \text{Number of operating left-hand side firing jets} \\ n_{L_U} = \text{Number of operating left-hand up firing jets} \end{matrix}\right.$

$\left\{\begin{matrix} n_{R_D} = \text{Number of operating right-hand down firing jets} \\ n_{R_S} = \text{Number of operating right-hand side firing jets} \\ n_{R_U} = \text{Number of operating right-hand up firing jets} \end{matrix}\right.$

$$\Delta C_{N_U} = \Delta C_{N_U}^{(RS3)} f(\text{Type}, \alpha)$$

$$\Delta C_{N_S} = \Delta C_{N_S}^{(RS2)} f(\text{Type}, \alpha, \dot{m}_j/\dot{m}_\infty)$$

$$\Delta C_{N_D} = \Delta C_{N_D}^{(RS1)} f(\text{Type}, \alpha)$$

$$\text{Type} = \begin{cases} 1.0 \text{ Normal Force} \\ 2.0 \text{ Axial Force} \\ 3.0 \text{ Pitching Moment} \\ 4.0 \text{ Side Force} \\ 5.0 \text{ Yawing Moment} \\ 6.0 \text{ Rolling Moment} \end{cases}$$

$$\left(N_{L_U} + N_{R_U} \right) = 0.0$$

$$\left(N_{L_S} + N_{R_S} \right) = 0.0$$

$$\left(N_{L_D} + N_{R_D} \right) = \left(N_{SURF} + \Delta N_e + \Delta N_{BF} \right)_{IMP}$$

$$K_{N_U} = 0.0$$
$$K_{N_S} = 0.0$$
$$K_{N_D} = K_{N_D}^{(RS0)} f(\text{Jet Group}, \text{Type})$$

$$\text{Jet Group} = \begin{cases} 1.0 \text{ Down Firing} \\ 2.0 \text{ Side Firing} \\ 3.0 \text{ Up Firing} \end{cases}$$

$\left.\begin{matrix} N_{SURF_{IMP}} \\ \Delta N_{e_{IMP}} \\ \Delta N_{BF_{IMP}} \end{matrix}\right\}$ See page D.2-5

NOTE:

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j V_j}{\bar{q}_\infty A_{eff}} \right) \left(\frac{A_{eff}}{2 S_{ref}} \right) n = 0.1543 \left(\frac{n}{\bar{q}_\infty} \right)$$

$$\left.\frac{\phi_j}{\phi_\infty}\right|_{LN_D} = 0.1543 \left(\frac{n_{LN_D}}{\bar{q}_\infty} \right) \qquad \left.\frac{\phi_j}{\phi_\infty}\right|_{RN_D} = 0.1543 \left(\frac{n_{RN_D}}{\bar{q}_\infty} \right)$$

$$\left.\frac{\phi_j}{\phi_\infty}\right|_{LN_U} = 0.1543 \left(\frac{n_{LN_U}}{\bar{q}_\infty} \right) \qquad \left.\frac{\phi_j}{\phi_\infty}\right|_{RN_U} = 0.1543 \left(\frac{n_{RN_U}}{\bar{q}_\infty} \right)$$

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \frac{1}{n} \frac{\phi}{\phi_\infty} \left(\frac{V_\infty}{V_j} \right) (\sin \theta_j)^{3/2} = 8.296 \times 10^{-4} \left(\frac{V_\infty}{\bar{q}_\infty} \right)$$

$$\left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{LN_S} = 8.296 \times 10^{-4} \left(\frac{V_\infty}{\bar{q}_\infty} \right) \qquad \left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{RN_S} = 8.296 \times 10^{-4} \left(\frac{V_\infty}{\bar{q}_\infty} \right)$$

AXIAL FORCE UNCERTAINTIES

$$\Delta A_U = \left\{ \left[\left(K_{U_L} + K_{U_R} \right) \left(\Delta C_{A_U} \right)^2 + \left(K_{S_L} + K_{S_R} \right) \left(\Delta C_{A_S} \right)^2 + \left(K_{D_L} + K_{D_R} \right) \left(\Delta C_{A_D} \right)^2 \right] (\bar{q}S)^2 + \left(A_{L_U} + A_{R_U} \right)^2 K_{A_U}^2 + \left(A_{L_S} + A_{R_S} \right)^2 K_{A_S}^2 + \left(A_{L_D} + A_{R_D} \right)^2 K_{A_D}^2 \right\}^{1/2}$$

where,

$$\left.\begin{matrix} K_{U_L} \\ K_{U_R} \\ K_{S_L} \\ K_{S_R} \\ K_{D_L} \\ K_{D_R} \end{matrix}\right\} = \begin{matrix} 0.0, & n_{[\,]} = 0 \\ 1.0, & n_{[\,]} > 0 \end{matrix}$$

n_{L_D} = Number of operating left-hand down firing jets
n_{L_S} = Number of operating left-hand side firing jets
n_{L_U} = Number of operating left-hand up firing jets

n_{R_D} = Number of operating right-hand down firing jets
n_{R_S} = Number of operating right-hand side firing jets
n_{R_U} = Number of operating right-hand up firing jets

$$\Delta C_{A_U} = \Delta C_{A_U}^{(RS3)} f(\text{Type}, \alpha)$$
$$\Delta C_{A_S} = \Delta C_{A_S}^{(RS2)} f(\text{Type}, \alpha, \dot{m}_j/\dot{m}_\infty)$$
$$\Delta C_{A_D} = \Delta C_{A_D}^{(RS1)} f(\text{Type}, \alpha)$$

$$\text{Type} = \begin{cases} 1.0 \text{ Normal Force} \\ 2.0 \text{ Axial Force} \\ 3.0 \text{ Pitching Moment} \\ 4.0 \text{ Side Force} \\ 5.0 \text{ Yawing Moment} \\ 6.0 \text{ Rolling Moment} \end{cases}$$

$$\left(A_{L_U} + A_{R_U} \right) = 0.0$$
$$\left(A_{L_S} + A_{R_S} \right) = 0.0$$
$$\left(A_{L_D} + A_{R_D} \right) = \left(A_{SURF} + \Delta A_e + \Delta A_{BF} \right)_{IMP}$$

$$K_{A_U} = 0.0$$
$$K_{A_S} = 0.0$$
$$K_{A_D} = K_{A_D}^{(RS0)} f(\text{Jet Group}, \text{Type})$$

$$\text{Jet Group} = \begin{cases} 1.0 \text{ Down Firing} \\ 2.0 \text{ Side Firing} \\ 3.0 \text{ Up Firing} \end{cases}$$

$$\left.\begin{matrix} A_{SURF_{IMP}} \\ \Delta A_{e_{IMP}} \\ \Delta A_{BF_{IMP}} \end{matrix}\right\}$$ See page D.2-7

NOTE:

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j V_j}{\bar{q}_\infty A_{REF}} \right) \left(\frac{A_{REF}}{2 S_{REF}} \right) n = 0.1543 \left(\frac{n}{\bar{q}_\infty} \right)$$

$$\left. \frac{\phi_j}{\phi_\infty} \right|_{LH_D} = 0.1543 \left(\frac{n_{LH_D}}{\bar{q}_\infty} \right) \qquad \left. \frac{\phi_j}{\phi_\infty} \right|_{RH_D} = 0.1543 \left(\frac{n_{RH_D}}{\bar{q}_\infty} \right)$$

$$\left. \frac{\phi_j}{\phi_\infty} \right|_{LH_U} = 0.1543 \left(\frac{n_{LH_U}}{\bar{q}_\infty} \right) \qquad \left. \frac{\phi_j}{\phi_\infty} \right|_{RH_U} = 0.1543 \left(\frac{n_{RH_U}}{\bar{q}_\infty} \right)$$

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \frac{1}{n} \left(\frac{\phi_j}{\phi_\infty} \right) \left(\frac{V_\infty}{V_j} \right) (\sin \theta_j)^{1/2} = 8.296 \times 10^{-6} \left(\frac{V_\infty}{\bar{q}_\infty} \right)$$

$$\left. \frac{\dot{m}_j}{\dot{m}_\infty} \right|_{LH_D} = 3.296 \times 10^{-6} \left(\frac{V_\infty}{\bar{q}_\infty} \right) \qquad \left. \frac{\dot{m}_j}{\dot{m}_\infty} \right|_{RH_D} = 8.296 \times 10^{-6} \left(\frac{V_\infty}{\bar{q}_\infty} \right)$$

PITCHING MOMENT UNCERTAINTIES

$$\Delta M_U = \left\{\left[\left(K_{U_L}+K_{U_R}\right)\left(\Delta C_{m_U}\right)^2 + \left(K_{S_L}+K_{S_R}\right)\left(\Delta C_{m_S}\right)^2 + \left(K_{D_L}+K_{D_R}\right)\left(\Delta C_{m_D}\right)^2\right]\left(\bar{q}S\bar{c}\right)^2 + \left(M_{L_U}+M_{R_U}\right)^2 K_{M_U}^2 + \left(M_{L_S}+M_{R_S}\right)^2 K_{M_S}^2 + \left(M_{L_D}+M_{R_D}\right)^2 K_{M_D}^2\right\}^{1/2}$$

where,

$$\left.\begin{matrix} K_{U_L} \\ K_{U_R} \\ K_{S_L} \\ K_{S_R} \\ K_{D_L} \\ K_{D_R} \end{matrix}\right\} = \begin{matrix} 0.0, & n_{[\,]} = 0 \\ 1.0, & n_{[\,]} > 0 \end{matrix}$$

n_{Down_L} = Number of operating left-hand down firing jets
n_{Side_L} = Number of operating left-hand side firing jets
n_{Up_L} = Number of operating left-hand up firing jets
n_{Down_R} = Number of operating right-hand down firing jets
n_{Side_R} = Number of operating right-hand side firing jets
n_{Up_R} = Number of operating right-hand up firing jets

$$\Delta C_{m_U} = \Delta C_{m_U}^{(R53)} f\left(\text{Type}, \alpha\right)$$
$$\Delta C_{m_S} = \Delta C_{m_S}^{(R52)} f\left(\text{Type}, \alpha, \dot{m}_j/\dot{m}_\infty\right)$$
$$\Delta C_{m_D} = \Delta C_{m_D}^{(R51)} f\left(\text{Type}, \alpha\right)$$

$$\text{Type} = \begin{cases} 1.0 \text{ Normal Force} \\ 2.0 \text{ Axial Force} \\ 3.0 \text{ Pitching Moment} \\ 4.0 \text{ Side Force} \\ 5.0 \text{ Yawing Moment} \\ 6.0 \text{ Rolling Moment} \end{cases}$$

$$\left(M_{L_U} + M_{R_U}\right) = 0.0$$

$$\left(M_{L_S} + M_{R_S}\right) = 0.0$$

$$\left(M_{L_D} + M_{R_D}\right) = \left(M_{SURF} + \Delta M_e + \Delta M_{BF}\right)_{IMP}$$

$$K_{M_U} = 0.0$$
$$K_{M_S} = 0.0$$
$$K_{M_D} = K_{M_D}^{(R50)} f\left(\text{Jet Group}, \text{Type}\right)$$

$$\text{Jet Group} = \begin{cases} 1.0 \text{ Down Firing} \\ 2.0 \text{ Side Firing} \\ 3.0 \text{ Up Firing} \end{cases}$$

$M_{SURF_{IMP}}$
$\Delta M_{e_{IMP}}$
$\Delta M_{BF_{IMP}}$

See page D.2-9

NOTE:

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j V_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2\,S_{REF}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$$\left.\frac{\phi_j}{\phi_\infty}\right|_{Down_R} = 0.1543\left(\frac{n_{Down_R}}{\bar{q}_\infty}\right) \qquad \left.\frac{\phi_j}{\phi_\infty}\right|_{Down_L} = 0.1543\left(\frac{n_{Down_L}}{\bar{q}_\infty}\right)$$

$$\left.\frac{\phi_j}{\phi_\infty}\right|_{Side_L} = 0.1543\left(\frac{n_{Side_L}}{\bar{q}_\infty}\right) \qquad \left.\frac{\phi_j}{\phi_\infty}\right|_{Side_R} = 0.1543\left(\frac{n_{Side_R}}{\bar{q}_\infty}\right)$$

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \frac{1}{n}\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{V_\infty}{V_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296\times10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$$

$$\left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{Down_L} = 3.296\times10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right) \qquad \left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{Down_R} = 8.296\times10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$$

SIDE FORCE UNCERTAINTY

$$\Delta Y_U = \left\{ \left[K_U (\Delta C_{Y_U})^2 + K_S (\Delta C_{Y_S})^2 + K_D (\Delta C_{Y_D})^2 \right] (\bar{q}S)^2 + (Y_{L_U} + Y_{R_U})^2 K_{Y_U}^2 + (Y_{L_S} + Y_{R_S})^2 K_{Y_S}^2 + (Y_{L_D} + Y_{R_D})^2 K_{Y_D}^2 \right\}^{1/2}$$

where,

K_U, K_S, K_D =

- 0.0 If no jets are firing OR if one or more jets are firing (LH and RH) and ALL OPERATING JET GROUPS ARE SYMMETRICAL.
- 1.0 If one or more jets are firing (LH and/or RH) and ANY OPERATING JET GROUPS ARE UNSYMMETRICAL.

$$\Delta C_{Y_U} = \Delta C_{Y_U}^{(R53)} f(\text{Type}, \alpha)$$

$$\Delta C_{Y_S} = \Delta C_{Y_S}^{(R52)} f(\text{Type}, \alpha, \dot{m}_j/\dot{m}_\infty)$$

$$\Delta C_{Y_D} = \Delta C_{Y_D}^{(R51)} f(\text{Type}, \alpha)$$

Type =
- 1.0 Normal Force
- 2.0 Axial Force
- 3.0 Pitching Moment
- 4.0 Side Force
- 5.0 Yawing Moment
- 6.0 Rolling Moment

$$(Y_{L_U} + Y_{R_U}) = \left[Y_{SURF_{IMP_U}}^{(R11)} f(P_\infty) \right] \left[n_{LH_U} - n_{RH_U} \right]$$

$$(Y_{L_S} + Y_{R_S}) = 0.0$$

$$(Y_{L_D} + Y_{R_D}) = \left[Y_{SURF_{IMP_D}}^{(R10)} f(P_\infty) \right] \left[n_{LH_D} - n_{RH_D} \right]$$

n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$K_{Y_U} = K_{Y_U}^{(R50)} f(\text{Jet Group}, \text{Type})$$

$$K_{Y_S} = 0.0$$

$$K_{Y_D} = K_{Y_D}^{(R50)} f(\text{Jet Group}, \text{Type})$$

Jet Group =
- 1.0 Down Firing
- 2.0 Side Firing
- 3.0 Up Firing

NOTE: $\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j V_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2\ell_{ref}}\right)\eta = 0.1543\left(\frac{\eta}{q_\infty}\right)$

$\left.\frac{\phi_j}{\phi_\infty}\right|_{LH_D} = 0.1543\left(\frac{n_{LH_D}}{q_\infty}\right)$ $\qquad \left.\frac{\phi_j}{\phi_\infty}\right|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{q_\infty}\right)$

$\left.\frac{\phi_j}{\phi_\infty}\right|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{q_\infty}\right)$ $\qquad \left.\frac{\phi_j}{\phi_\infty}\right|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{q_\infty}\right)$

$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{\phi}{\phi_\infty}\right)\left(\frac{V_\infty}{V_j}\right)(\sin\theta_j)^{1/2} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right)$

$\left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{LH_D} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right)$ $\qquad \left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{RH_D} = 8.296\times10^{-6}\left(\frac{V_\infty}{q_\infty}\right)$

YAWING MOMENT UNCERTAINTY

$$\Delta\mathcal{N}_U = \left\{\left[K_U(\Delta C_{n_U})^2 + K_S(\Delta C_{n_S})^2 + K_D(\Delta C_{n_D})^2\right](\bar{q}Sb)^2 + (\mathcal{N}_{L_U} + \mathcal{N}_{R_U})^2 K_{n_U}^2 + (\mathcal{N}_{L_S} + \mathcal{N}_{R_S})^2 K_{n_S}^2 + (\mathcal{N}_{L_D} + \mathcal{N}_{R_D})^2 K_{n_D}^2\right\}^{1/2}$$

where,

K_U, K_S, K_D = 0.0 If no jets are firing OR if one or more jets are firing (LH and RH) and ALL OPERATING JET GROUPS ARE SYMMETRICAL.

1.0 If one or more jets are firing (LH and/or RH) and ANY OPERATING JET GROUPS ARE UNSYMMETRICAL.

$\Delta C_{n_U} = \Delta C_{n_U}^{(R53)} f(\text{Type}, \alpha)$

$\Delta C_{n_S} = \Delta C_{n_S}^{(R52)} f(\text{Type}, \alpha, \dot{m}_j/\dot{m}_\infty)$

$\Delta C_{n_D} = \Delta C_{n_D}^{(R51)} f(\text{Type}, \alpha)$

Type = { 1.0 Normal Force; 2.0 Axial Force; 3.0 Pitching Moment; 4.0 Side Force; 5.0 Yawing Moment; 6.0 Rolling Moment }

$(\mathcal{N}_{L_U} + \mathcal{N}_{R_U}) = \left[\mathcal{N}_{SURF_{IMP_U}}^{(R13)} f(P_\infty)\right]\left[n_{LH_U} - n_{RH_U}\right]$

$(\mathcal{N}_{L_S} + \mathcal{N}_{R_S}) = 0.0$

$(\mathcal{N}_{L_D} + \mathcal{N}_{R_D}) = \left[\mathcal{N}_{SURF_{IMP_D}}^{(R12)} f(P_\infty)\right]\left[n_{LH_D} - n_{RH_D}\right]$

n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$K_{n_U} = K_{n_U}^{(R50)} f(\text{Jet Group}, \text{Type})$

$K_{n_S} = 0.0$

$K_{n_D} = K_{n_D}^{(R50)} f(\text{Jet Group}, \text{Type})$

Jet Group = { 1.0 Down Firing; 2.0 Side Firing; 3.0 Up Firing }

NOTE: $\frac{\phi_i}{\phi_\infty} = \left(\frac{\dot{m}_j V_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2\,S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$

$\left.\frac{\phi_i}{\phi_\infty}\right|_{LH_D} = 0.1543\left(\frac{n_{LH_D}}{\bar{q}_\infty}\right)$ $\left.\frac{\phi_i}{\phi_\infty}\right|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{\bar{q}_\infty}\right)$

$\left.\frac{\phi_i}{\phi_\infty}\right|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{\bar{q}_\infty}\right)$ $\left.\frac{\phi_i}{\phi_\infty}\right|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{\bar{q}_\infty}\right)$

$\frac{\dot{m}_j}{\dot{m}_\infty} = \frac{1}{\gamma}\left(\frac{D}{D_\infty}\right)^2\left(\frac{P_\infty}{P_j}\right)(\sin\theta_j)^{1/2} = 8.296\cdot10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$

$\left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{LH_D} = 8.296\cdot10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$ $\left.\frac{\dot{m}_j}{\dot{m}_\infty}\right|_{RH_D} = 8.296\cdot10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$

ROLLING MOMENT UNCERTAINTY

$$\Delta \mathscr{L}_U = \left\{ \left[K_U (\Delta C_{\ell_U})^2 + K_S (\Delta C_{\ell_S})^2 + K_D (\Delta C_{\ell_D})^2 \right] (\bar{q} S b)^2 + (\mathscr{L}_{L_U} + \mathscr{L}_{R_U})^2 K_{\ell_U}^2 + (\mathscr{L}_{L_S} + \mathscr{L}_{R_S})^2 K_{\ell_S}^2 + (\mathscr{L}_{L_D} + \mathscr{L}_{R_D})^2 K_{\ell_D}^2 \right\}^{1/2}$$

where,

K_U, K_S, K_D = 0.0 If no jets are firing OR if one or more jets are firing (LH and RH) and ALL OPERATING JET GROUPS ARE SYMMETRICAL.

1.0 If one or more jets are firing (LH and/or RH) and ANY OPERATING JET GROUPS ARE UNSYMMETRICAL.

$$\Delta C_{\ell_U} = \Delta C_{\ell_U}^{(R53)} f(\text{Type}, \alpha)$$

$$\Delta C_{\ell_S} = \Delta C_{\ell_S}^{(R52)} f(\text{Type}, \alpha, \dot{m}_j/\dot{m}_\infty)$$

$$\Delta C_{\ell_D} = \Delta C_{\ell_D}^{(R51)} f(\text{Type}, \alpha)$$

Type = { 1.0 Normal Force; 2.0 Axial Force; 3.0 Pitching Moment; 4.0 Side Force; 5.0 Yawing Moment; 6.0 Rolling Moment }

$$(\mathscr{L}_{L_U} + \mathscr{L}_{R_U}) = \left[\mathscr{L}_{SURF_{IMP_U}}^{(R15)} f(P_\infty) \right] \left[n_{LH_U} - n_{RH_U} \right]$$

$$(\mathscr{L}_{L_S} + \mathscr{L}_{R_S}) = 0.0$$

$$(\mathscr{L}_{L_D} + \mathscr{L}_{R_D}) = \left[\mathscr{L}_{SURF_{IMP_D}}^{(R14)} f(P_\infty) \right] \left[n_{LH_D} - n_{RH_D} \right] + \Delta \mathscr{L}_{e_{IMP}} + \Delta \mathscr{L}_{RF_{IMP}}$$

$\Delta \mathscr{L}_{e_{IMP}}$, $\Delta \mathscr{L}_{RF_{IMP}}$ See Page D.2-13

n_{LH_D} = Number of operating left-hand down firing jets
n_{LH_S} = Number of operating left-hand side firing jets
n_{LH_U} = Number of operating left-hand up firing jets

n_{RH_D} = Number of operating right-hand down firing jets
n_{RH_S} = Number of operating right-hand side firing jets
n_{RH_U} = Number of operating right-hand up firing jets

$$K_{\ell_U} = K_{\ell_U}^{(R50)} f(\text{Jet Group}, \text{Type})$$

Jet Group = { 1.0 Down Firing; 2.0 Side Firing; 3.0 Up Firing }

$$K_{\ell_S} = 0.0$$

$$K_{\ell_D} = K_{\ell_D}^{(R50)} f(\text{Jet Group}, \text{Type})$$

NOTE: $\frac{\phi_i}{\phi_\infty} = \left(\frac{\dot{m}_i V_i}{\bar{q}_\infty A_{eff}}\right)\left(\frac{A_{eff}}{2 S_{ref}}\right)^n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$

$$\frac{\phi}{\phi_\infty}\Big|_{LH_S} = 0.1543\left(\frac{n_{LH_S}}{\bar{q}_\infty}\right) \qquad \frac{\phi_i}{\phi_\infty}\Big|_{RH_D} = 0.1543\left(\frac{n_{RH_D}}{\bar{q}_\infty}\right)$$

$$\frac{\phi_i}{\phi_\infty}\Big|_{LH_U} = 0.1543\left(\frac{n_{LH_U}}{\bar{q}_\infty}\right) \qquad \frac{\phi_i}{\phi_\infty}\Big|_{RH_U} = 0.1543\left(\frac{n_{RH_U}}{\bar{q}_\infty}\right)$$

$$\frac{\dot{m}_i}{\dot{m}_\infty} = \frac{1}{\gamma}\left(\frac{\phi}{\phi_\infty}\right)\left(\frac{V_\infty}{V_j}\right)(\sin\theta_i)^{1/2} = 8.296 \times 10^{-4}\left(\frac{1}{\bar{q}_\infty}\right)$$

$$\frac{\dot{m}_i}{\dot{m}_\infty}\Big|_{LH_S} = 8.296 \times 10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right) \qquad \frac{\dot{m}_i}{\dot{m}_\infty}\Big|_{RH_S} = 8.296 \times 10^{-4}\left(\frac{V_\infty}{\bar{q}_\infty}\right)$$

APPENDIX

E. OV102 ASYMMETRIC AERODYNAMICS. Estimated OV102 asymmetric aerodynamic coefficients are provided for use in GRTLS or contingency abort entry studies where the Orbiter Vehicle has not remained in orbit sufficiently long enough for cold soak. The aerodynamic coefficients presented are based on the as-measured OV102 alignment measurements of Reference E-1 and do not include on-orbit non-symmetric heating effects. These data are intended for use in conjunction with the basic aerodynamics presented in Section 5.0 for entry studies when aerodynamic uncertainties are not included. Uncertainties on the asymmetric yawing and rolling moment coefficients are given in Section 6.7 and, when used, include the effects presented in this appendix.

$$\Delta C_L = C_N = -0.0003 \qquad C_Y = 0.0003$$

$$C_m = 0.0001 \qquad C_n = -0.00008$$

$$C_\ell = 0.0001$$

NOTE: These values are not currently on the Rockwell digitized data tape.

Reference:

E-1 SAS/AERO/78-185, "OV102 Wind and Vertical Tail Alignment Measurements," Rockwell International, Space Systems Group, Internal Letter, Downey, California (April 26, 1978).

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